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Culture-sensitive e-learning course in movement analysis and therapy

A self-study manual

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SATAKUNNAN AMMATTIKORKEA KOULU OY
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MISKOLCI EGYETEM
CLINICA VISTAHERMOSA GRUPO HLA SL
ISTANBUL AYDIN UNIVERSITESI VAKFI
AKADEMIA WYCHOWANIA FIZYCZNEGO IM. BRONISLAWA CZECHA W KRAKOWIE

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INTRODUCTION

The aim of the Mov-E training is to help you develop skills and knowledge not only regarding the area of Physiotherapy and Movement Analysis but also including the transcultural scope with the recognition of the cultural perspective in the communication relationship between health professionals and patients by stressing the importance of the Intercultural Communication in the global world.

Our training, designed by a partnership comprised by research and academic professionals, experts as well as clinicians in the topic, will increase your understanding and awareness of the impact of our differences and similarities on the way we communicate and become more effective handling these differences and similarities effectively in our own cultural context, as well as in other intercultural contexts.

Even though there exist many definitions for the term, Intercultural communication could be understood as a symbolic, interpretive, transactional, contextual process, in which people from different cultures create shared meanings. (Lustig & Koester, 2007:46). When talking about different cultures it does not only mean people from different ethnic groups and backgrounds, it also refers to those from the same ethnicity but with different cultural values, traditions, believes, life experiences, and ways of thinking, including people from different generations, vulnerable population, minorities or those with any type of physical, mental or social limitation. If the health professional and patient have a difference in their sociocultural background, this can hamper communication. Communication between people with different cultural backgrounds is called intercultural communication. Intercultural communication competence is commonly known as the knowledge, motivation, and skills to interact effectively and appropriately with members of different cultures (Gibson & Zhong, 2005). Different communication patterns can lead to miscommunication and can be a barrier in providing qualitative care. Previous studies have suggested that health professionals communicate less effectively with racial and ethnic minorities, older patients, and those with lower educational attainment levels (Kaplan et al., 1995; Brown, 1999). Therefore, the attitude of the caregiver plays an important role in intercultural communication. Intercultural communication includes respect for, and interest in, patient experience. Respect for the person, trust, and accessibility are important conditions for building a care relationship and improving communication (Roberts, 2008; Papadopoulos, et al., 2016).

We will explore various topics in intercultural communication aligned with clinical contents, situations that will connect the audience with real scenarios in real settings and will practice intercultural learning processes in the context of your experience in your own culture and abroad that you can apply when working in a wide variety of contexts. In this course the audience will learn that the ability to be empathetic and the experience of living in a different culture or co-living with people from other cultural backgrounds, can help them to overcome challenges in culturally sensitive communication prospectively. During the training the professional will learn how to communicate at the patient's level. Although professionals are highly educated from a clinical point of view, they must be able to adapt in communication to

the level of education and language usage of the patient. In addition, the audience will learn some useful take home messages such as: (1) the professional does not speak too quickly, and that they pay attention to the interaction with the conversation partner. If the professional notices that the patient is no longer listening, or the message will be lost. (2) The professional should ask for feedback from the patient at certain times, to check whether the patient is still up to date with the message and the conversation. (3) The professional must also have the skills to dose the message, according to the patient's ability. (4) Sometimes, verbal communication and written information can be combined to support the patient in capturing the message. (5) Finally, it is of great importance that the non-verbal communication of the professional is supportive of the verbal message that they give, and that the non-verbal signals are in line with the values and norms that the patient has. (6) Additionally, the ability to speak a different language can help the caregiver in overcoming the challenges in culturally sensitive communication (Gibson & Zhong, 2005). (7) Sometimes, words can also have a different meaning or connotation in other countries or cultures. The meaning of words can also change over time and across generations. Language is not only necessary to formulate and understand the patient's request for help, but language is also important when taking an anamnesis or for communicating a diagnosis. (8) Giving meaning is also important in intercultural communication. This is how to explain illness and health and therefore also how to communicate about it. Sometimes, the communication is also filtered, to make the message come across differently and more socially desirable, or because people feel that they have to meet certain social standards. In addition to culture, gender, class, generation, sexual preference, age, and personality also play a role in giving meaning, and these factors therefore also influence how people communicate. Intercultural mediation could be a solution for this challenge. Intercultural mediation is an intervention that takes into account cultural differences when translating (Gibson & Zhong, 2005). It is important that professionals take sufficient time to communicate, specifically with the patient and their family, and ask them about their wishes and preferences. By investing sufficient time, one can overcome certain barriers, such as differences in meaning or language differences (Roberts, 2008).

Skilful learning to communicate beyond cultural limitations, will allow future health professionals leaders to stand out in the global job market when facing the new challenges of global and multicultural teams in this new century. The gained understanding and appreciation of cultural differences and similarities will help students adjust to the new cultural practices that come into their life - whether via the media or through interpersonal interactions.

Our training has been designed based on the paradigm of the Mobility of Professionals across Europe, especially for health professionals moving across countries, Erasmus Students and those from other educational exchange programmes worldwide. In practice, the recognition of professional qualifications laid down in Directive 2005/36/EC enables the free movement of professionals such as health professionals within the EU.

After completing this course, you will:

- Develop a deeper understanding of the field of intercultural communication.
- Understand their relevance to your own experience in the host culture and when working across differences in a wide variety of contexts.
- Increase your own cultural self-awareness.
- Increase your ability to recognize and bridge cultural gaps when communicating across cultures.
- Develop an intercultural competence that turns culture-specific and culture-general knowledge into practical tools to effectively communicate across differences.
- Understand the impact of intercultural communication and global relationships into health outcomes.

In terms of Intercultural Communication, the learning objectives are:

- To facilitate and promote communication and understanding between human beings from different cultures and countries all around the world, despite language diversity.
- To participate in or contribute to building a better world in its cross-cultural complexity.

As Long-term objectives:

- To develop tolerance, empathy and adaptability in ambiguous communication situations.
- To develop intercultural competence.

As Short-term objectives:

- To learn the basics of intercultural communication
- To be aware of our own identity (culture and values)
- To be aware of the way we communicate (family, friends, colleagues, etc.).
- To reflect upon our own prejudices and their consequences.
- To reflect upon different ways of interacting with patients.

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1 DETECTING MOTOR MILESTONES THROUGH OBSERVATION AND USE OF GENDER-SENSITIVE TERMS WHEN COMMUNICATING WITH FAMILIES

Johanna Vähä-Jaakkola

1.1 Sensomotor development

Sensomotor Development means the development of senses and movement. Development is based on inherent qualities, experiences from the environment and learning through experience. It begins already during the pregnancy as the featus moves a lot in the uterus. An infant continues the development by touching oneself and being in contact with the surroundings. In motor development, each stage is based on the skill learned before. Therefore, we can say that the skills are learned in a certain order, but each child is unique. The most development occurs during the first 18 months of life. In order to be able to detect atypical development, we need to be aware of the neurotypical development. Understanding a typical motor development is very important physiotherapeutic knowledge. However, identification of motor development disorders we also need to give up on over-reliance on the developmental milestones that have a great variability and move on to qualitative observations, common variations in achieving locomotor abilities and neurological or other markers of abnormality (Sheridan M, 2010)

The sequence of motor development of infant motor development is predictable, but the rate is variable (Gallahue & Ozmon 2012). In this lesson, we focus on the full-term child with no previous medical conditions. The focus is on detecting possible developmental delays related to motor functions through observation. Traditionally motor developmental evaluation is based on neurodevelopmental model that assumes the pace and sequence of development to be automatic with the central nervous system maturity. However, there are several factors affecting motor development such as growth, environment, genetics and muscle tone. One of the most important references for further examinations on child's development is the caregivers worry about child's development. With premature, it is essential to use the correct age when evaluating the motor milestones. (Tecklin, J.S. 2015)

Motor skills progress occur in typical development according to following sequence; from cephalic to caudal, from proximal to distal, and from generalized to specific, goal-oriented reactions. These neurodevelopmental sequences often are described in terms of the traditional developmental milestones. If the child has achieved the previous motor developmental milestones on time, at 6 months, infants develop the ability to adapt their postural activity to

specific situations. Infant is able to roll around the extended longitudinal axis of the body. They are able to support their extended upper limbs and unfolded hands in pronation. Child is having readiness for a quadrupedal stance. (Kuchler O'Shea, Roberta, 2009)

The observation of motor development or detection of developmental delays includes also evaluation of muscle tone (infants' ability to work against the gravity) and reflexes. It is important to also consider infants vitality for evaluation as it might have a great impact on the infant's performance. How the child reacts to sensory input and being in interaction with the surroundings. The goal of the neurodevelopmental evaluation for milestones is to detect severe abnormalities in motor and cognitive development. Regardless of the cause of the referral to physiotherapist neurodevelopmental evaluation, the concern of the caregivers should always be taken into notice and infants' status carefully explained in detail to meet caregivers need of information. (Kuchler O'Shea, Roberta, 2009)

Since in this lesson we focus on 6months old neurodevelopmental age, it is important that you read and refresh your knowledge on normal motor psychomotor development in 0-18month of age. When reading, pay special attention to red flags in reaching the developmental milestones. Also remind yourself the meaning of muscle tone and its variations.

You can refresh your memory for example by loading apps related to motor milestones (CDC milestone tracker) or by visiting accessible e-learning material https://www.healthychildren.org/English/MotorDelay/Pages/default.aspx#/explorer to see videos and explanations on normal/developmental delay.

1.2 Reflexes

A full-term newborns readiness for life and the neurodevelopmental evaluation is done by detecting neonatal primitive reflexes. Primitive reflexes can be present also with infants having neurological conditions, but they are often either asymmetrical or don't disappear at expected age. Below you can see a (table 1) reflexes.

Table 1: Reflexes that should disappear by 6 months. (self-made table)

Reflex	Purpose	Appears	Should integrate by:
Moro	Primitive fight or flight reaction	At Birth	4-6months
Rooting	Automatic response to turn towards food	At Birth	3-4months
Palmer	Help to automatically grasp	At Birth	5-6 months
ATNR	Develop cross patterns movements	At birth	6months

1.3 Muscle tone

Muscle tone is detected in various positions. It is important to notice that premature infants muscle tone is often decreased in the beginning compared to full term infant. Variations in muscle tone can be seen either as decreased, increased or asymmetrical. Increased muscle tone is seen as a strong flexion of the upper limbs, lowed limbs and head can be extended. Decreased muscle tone is seen as the opposite and appears as floppy and slow reactions to changes in position. In asymmetrical muscle tone there is a variation between the sides of the infants' muscle tone (Table 2) A detected abnormal variation of muscle tone always needs follow up for possible early diagnosis of Cerebral Palsy.

Table 2: Newborns variations on muscle tone (self-made table)

Increased muscle tone	Decreased muscle tone	Asymmetrical muscle tone
• Muscles feel tensed when palpated • Decreased range of motion in the joints • Strong flexion in joints • Stiff response to Moro-reflex	• Muscles feel extremely soft when palpated • Position follows the underlying surface • Extremities are easily moved to different positions • Moro-reflex is very weak	• Asymmetrical position on supine • Asymmetrical muscle tone in the body • Asymmetrical Moro-reflex response

1.4 Observation

As a physiotherapist, you need to be aware how to evaluate your clients/patient's motor development. As mentioned before, it is important to understand the reflexes and muscle tone variations. Before the observation, prepare the environment as well as possible. Increase attractive toys and keep in mind that the surface can be changed from hard to soft and vice versa if needed. The main idea is that the child would be able to play freely, and the role of the physiotherapist is only to observe and play along with the child to see what capabilities they have. If you need more information, you can facilitate the baby through the environment and senses or manually. For basic motor development evaluation through observation, you need to analyse the baby in the following positions: supine, prone, sitting, side lying and standing.

What you would expect from a typically developed baby to achieve by six months in different starting positions is listed on the table 3 below. Findings that indicate further follow up and examinations are listed on the table 4. By six months, the baby has developed their functional abilities through the control of the movement. When baby loses the balance, they should be able to break down the movement through the development of the balance reactions. What you should also be able to see is that the movements of the head are isolated from the trunk.

This rotation is possible through the development of righting reactions combined with weightbearing. Baby is interested on the surroundings and moves head and eyes towards attention. Baby is alert and usually interested in all small objects close by. Child might also show the understanding of depth awareness by dropping obstacles on the floor. (Salpa, Pirjo 2007)

Table 3: Starting positions for observation of 6 months old (self made table)

Supine:	-Babys body Is very symmetrical, and baby is able to use both sides of the body symmetrically. -Baby is able to bring lower extremities on top of the abdomen and flexion is very strong. -Baby is able to have weight bearing on the feet and lift the pelvis. -Fine motor functions are easier to achieve on supine and can be isolated -When lifting from the arms, baby braces shoulders and pulls self to sitting
Prone	-Baby is able to roll from prone to supine and back (can be still only one side) -Functional position where child likes to play -Baby is able to push to extended arms and flattened palms.
Sitting	-Ability to sit needs the development of protective reactions -Ability to right the head and trunk against the gravity -Baby has the ability to sit assisted and turn head from side to side
Side lying	-Requires controlled coordination between anterior and posterior muscles to obtain the position.
Standing	-When held in supported standing, the baby is able to bounce up and down actively -Protective reactions are starting to appear

As mentioned, by six months the baby might start to have protective reactions. Protective reactions can be forward, sideward and backward that appear by baby putting arms against the surface when tilted off balance. (Salpa, Pirjo 2007)

Table 4: Findings that require further examinations in the age of 6-12 months (self-made table)

Social interaction	- Baby is passive or tame in interaction - Baby is only interested in the environment for a short while - Baby is not shy with strange people - Baby does not mimic or imitate movements or wave - Baby is not in interaction with the caregiver
Communication	- Babys cry is anomalous - Baby's vocals are monotonous - Baby does not babble - Baby does not recognize own name - Baby does not understand speech, mimic or try to say words
Oral motor skills	- Baby has difficulties in chewing or processing food in mouth
Fine motor skills	- Baby doesn't hold obstacle in both hands simultaneously - Baby is not able the transfer a toy from hand to hand - Baby is not able to grip with fingers - Pincer's grip is missing - Baby has stereotypical movements
Gross motor skills	- Primitive reflexes still present - Protective reflexes have not started to develop - no crawling - not learning to sit or learn how to achieve sitting position - not learning to walk - Baby continuously swaying or rocking

To make a summary what you want to see from a 6-month-old baby are listed below:

- Symmetry and midline orientation
- Controlled and volitional asymmetry
- Combination of different movement patterns
- Strong extension and flexion in the trunk
- Extended arms on prone
- Rotations in spine and separate movements of the head
- The use of vision to discover the surroundings

1.5 Red flags

When the baby is not achieving the developmental milestones or the baby's movements are anomaly and the control of the movements is lacking, we need to refer the family for doctors' evaluation. It is important that we don't only observe is the baby able to achieve the movement but pay attention to quality of the movement and baby's ability to use variety of movements. (Salpa, P. & Autti-Rämö, I. 2010)

Red flags mean that the child is not achieving the majority of the milestones, there is a sudden stop of constant progress over weeks, or deprivation of already gained skills. If a red flag is detected during the observation, the caregivers are carefully explained that the baby needs further examination and referred to doctor and check-up within few weeks. Parents are often really worried, and it is very important that the situation is explained in detail and that time will show if there is something to be concerned. With a child that has reached motor milestones on time so far, at six months following signs would indicate for a red flag: Child doesn't roll in either direction. Child is not able to bring hands to the midline and together on supine. Child is having difficulties in bringing hands to mouth. Child only uses either upper extremity while other is fisted when reaching for objects. (Department of Health and Human Services, Centers for disease control and prevention)

1.6 Case and case report

Kuura is a 6m and 1w old baby with a referral to physiotherapy by public health nurse. Kuura is the second child in the family with a 3-year older sibling. The mother of Kuura was little concerned on the motor development of Kuura, as baby seems to prefer the left side in rolling over. Other than that, the mother had no concerns about the baby's development. Kuura and mother come to physiotherapy for the first time (Video 1).

Kuura was born as a second child of the family on week 39+5 weighting 3760g and being 51cm long. Kuura has developed at normal pace so far and achieved all the motor milestones according to age. Kuura is still breast fed but is already practicing eating cooked carrots, potatoes and sweet potatoes. Kuura sleeps well and is expected to be active during the time of the scheduled physiotherapy. What we can also see from the papers is that the family wants to use gender neutral terms and therefore they have selected also gender-neutral name, Kuura for the child.

With a limited amount of data available, physiotherapist needs to be well prepared when planning the meeting. A soft mattress is selected, with a possibility to also observe the baby on a hard surface. The observation is made during spontaneous play if possible. It is important that we select beforehand the suitable toys to achieve the goals of observation and participate actively in the interaction. Engaging the caregivers to observation needs room. Things to pay attention are also parent-child interaction and handling the baby. We make a list of the milestones we expect to see, look for symmetry/asymmetry, muscle tone and interaction through play.

Good book to read on preparing for motor development observation is Mary D.Sheridan's book; From Birth to five years, children's developmental progress, 2021, Routledge. By reading the book, you are able to learn the steps of the motor evaluation (performance, quality of movement, symmetry, typical and atypical movement, decision making). You can also go through the age-related motor milestones that you can assume to detect through observation and examination of the child. At this point, it is also good to refresh your memory on gender sensitive terms (Video 2), that the family prefers.

At 6 months of age, we start to see weight shifts and we can expect that the child would be lying on their back and raising hands to be lifted. When hands are grasped, the child should be able to lift the head, brace shoulders and pull to sitting. When the child is pulled to supported sitting, the back is straight, and the child is able to turn head from side to side. Child is not yet expected to sit independently. Child could also be expected to roll over from supine to prone and from prone to supine, but it usually is achieved by 7months. On abdomen, the child should be able to have open palms and ability to support themselves on extended extremities. When the child is held in a standing position, they take weight on the legs and usually also like to bounce up and down. Child is beginning to show signs of protective reactions and at this phase such as downward parachute and sideward/forward protective reaction. Child is able to manipulate objects and change them between the hands. (Sheridan, M.D. 2008. From birth to five years).

What we could see from the video 1. Was that Kuura's motor development is in the variety of normal. Kuura prefers the other side in rolling over but is able to roll over through both sides with the use of external stimuli. On top of that, we were able to detect during the observation, the pulled sitting with support, head support, pivoting on both directions, extended upper extremities on prone, bringing hands to midline on supine, symmetry in the body and normal muscle tone. Based on the observation, we have no reason to doubt any developmental delay and we make a report to health nurse that the physiotherapist check for motor delays is clear.

However, as the parents had a concern and Kuura is not yet completing tasks totally symmetrically, we agree a second appointment within two weeks of time, and we expect to see the symmetry to both directions in rolling over and at least the increase in the quality of the movements gained. We explain the situation and protocol for the mother carefully and leave time and space for further questions before ending the appointment. (Purpose here is to mark the hotspots to video with the timing of each observed component)

Still, it is very important to remember that even the observation and examination is crucial part of screening motor development, it is essential to use also standardized measures to provide systematic method to administer and score an assessment. This allows the therapists to compare results between the assessments. For example, with preterm infants, motor assessments are done on regular basis due to high risk of motor delays. (Piper, M. C, Darrah J, 2022)

1.7 Gender sensitive communication

When we work as physiotherapists in the social, health or welfare sector, we always encounter people as individuals. By deepening our own understanding of gender diversity, we can develop your speech to be more sensitive and therefore more appreciative towards each of our patient or client. It is impossible to know everything and avoid all the mistakes, but it makes it easier to meet people when you have up-to-date information on the topic. Gender-sensitivity is not intended to invalidate gender, but to enable everyone to grow into as own persons, for example become a girl, a boy, a transgender or an intersex person.

Gender has many meanings in our cultures. Take for example the birth of a baby in a family. The first thing that catches your attention at the moment of birth is often gender. There are a lot of expectations related to that situation.

Thinking about gender pluralism has changed a lot over time, and defining gender as something that is not just determined to genitals but also something that is now seen as experiential, socially and culturally constructed. It is good to remember that each of us has the right to self-determination and to try to move away from normative dichotomous thinking about gender. It is also important to recognise and validate that gender is just one human characteristic among others. The most important thing is not what I already know or don't know about the subject, but that we want to develop in a gender-sensitive encounter. This makes our clients feel safer and more appreciated as they are.

One way to increase sensitivity in communication is to use language that is sensitive to gender diversity, avoiding gendered terms such as "girls come here and boys go there". Some people of other genders or non-binary people prefer to use neutral language. However, the only way to be sure about this is by asking the client themselves. It is important to try to avoid making assumptions of your own in encounter situations, even if they are well- intentioned. If our assumptions are wrong, it can be very difficult for the client to revisit the issue and correct our assumptions. It is therefore good to remind oneself regularly that gender identity is not visible.

It is important to remember that each of us also has the right not to identify our gender and this can be expressed to the client, for example, when discussing confidentiality in a client situation. You can also think about whether asking about gender is always necessary for the issue or whether it is irrelevant, in which case it can be left unasked. If gender must be asked, it is always a good idea to give a brief explanation of why the information is needed. If you are communicating in a different language, always ask what personal pronoun they wish to use.

The use of one's own name, even it is informal, in an interaction is very relevant to the experience of being encountered. For a gender-conflict sufferer, the use of one's own name can, for example, reduce suicidal thoughts. It is important to be heard and encountered in a validating interaction. Validating interaction means, for example, that you clearly express that you understand and believe what the other person is saying and experiencing, or that you accept what the other person is saying without judging and that you link what you are saying to what the other person has just said. So, in a gender-sensitive interaction, empathy, acceptance, presence, listening, asking open questions and neutral language are important.

(Gender Diversity and Intersex centre of expertise)

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2 ASSESSMENT OF COORDINATION SKILLS IN CHILDREN WITH ANXIETY AND DISTRUST

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2.1 Components of movement

Several essential components of normal human movement can be identified. The 4-element model describes all the primary elements essential for movement: motion, force, motor control and energy. Motion refers to the ability of a tissue or joint to be passively moved. Force refers to the ability of contractile (muscles) and non-contractile structures (tendons) to generate movement and provide dynamic stability around joints during static and dynamic tasks. Motor control refers to the ability to plan, execute and adapt targeted movements so that they are precise, coordinated and efficient. Motor control refers to smoothness, coordination and timing of movement. Energy refers to the ability to perform sustained or repeated movements. It depends on the integrated functioning of the cardiovascular, pulmonary and neuromuscular systems. All movement is influenced by the environmental context (e.g. terrain, supporting surface and external distractions) and personal factors (e.g. age, gender, co-morbidities, self-efficacy, self-confidence, fear of movement and motivation) specific to the individual (Zarzycki et al., 2022).

2.1.1 Motor control – main components of control

The ability to finely control the movement of our bodies is important for both motor and cognitive development and to achieve skills that we use and develop throughout our lives.

Motor control depends on the reception and processing of task-relevant sensory inputs from visual, vestibular and somatosensory systems, and then the selection, planning and execution of actions to achieve task goals. Transition from perception to action relies on the integrity of sensory-motor pathways and intact perceptual and cognitive networks in the brain, including the cerebellum and basal ganglia. In general, motor control involves feedforward mechanisms essential for planning and execution, as well as feedback mechanisms necessary for adapting goal-directed actions (McClure et al., 2021; Sibley et al., 2015).

2.1.2 Sensory systems

Normal visual development starts at birth and continues throughout childhood. It involves changes in visual acuity, convergence and accommodation until adequate binocular vision (the ability to coordinate the eyes in a motor sense and integrate images to perceive and interact with the dynamic three-dimensional world) and stereopsis (depth perception) are achieved. Binocular vision and the accurate perception of depth enables the child to perform upper and lower limb movements correctly. Visual impairment usually cause a change in motor development. Authors have reported that surgical correction of strabismus led to partial restoration of binocular vision and improved eye-hand coordination skills. Others mentioned that proper development of the visual system is highly important for the development of correct balance, with research showing that a group of children with visual impairment had greater postural instability than children with normal vision (Sánchez-González et al., 2022; Candy&Cormack, 2022).

The vestibular apparatus is a complex group of structures and neural pathways that perform a variety of functions (Casale, 2023). It is responsible for sensing the spatial position of the body, maintaining normal posture and balance (Gerebenné Várbíró, 2021). Functions include the perception of orientation and acceleration of the head in any direction, which involves compensation for eye movement and posture. These reflexes are called vestibulo-ocular and vestibulospinal reflexes (Casale, 2023). The centre of the balance system is located in the inner ear. This organ interacts with a variety of multisensory information, with a good number of interconnected central processing programs, as well as with the descending locomotor pathway systems. In response to movement, nerve impulses are activated here and, after evaluation in the central nervous system, travel to different parts of the body and to the spinal cord (Gerebenné Várbíró, 2021). The vestibular system consists of two main parts. The first, three semicircular canals filled with fluid and arranged at right angles to each other and the second, utricle and saccule, also filled with fluid. Special hair cells are located in these organs and are stimulated by the fluid set in motion by the movement of the body. The angular acceleration and rotation of the head in different planes is detected by the semicircular canals (Casale, 2023; Bielefeldt, 2020). The central extensions of the sensory cells located in the vestibular ganglia form the vestibular nerve, through which information is transmitted to the cerebellum. Displacement of the hair cells activates nerve impulses that provide the brain with information about the direction, angle and extent of movement. This allows corrective muscle movements to be made (Blythe, 2006). The vestibulo-ocular reflex allows the eyes to remain fixed on an object while the head is moving. The vestibulo-ocular reflex maintains balance and posture by coordinating the muscles of the spine with the movement of the head. The known central vestibular connections include the vestibulo-thalamo-cortical tract, the tract between the dorsal tegmental nucleus and the entorhinal cortex, and the tract between the nucleus reticularis pontis oralis and the hippocampus. These play a functional role in self-motion perception, spatial navigation, spatial memory and object recognition memory. Dysfunction of the vestibular system can cause cognitive deficits related to spatial memory, learning and navigation (Casale, 2023).

Somatosensory system includes the receptors in our skin, muscles, tendons and joints provide information about the spatial position of our body, the location of our body parts, their interconnection and their interaction. The basic somatosensory modalities are pain, heat, tactile sensation and proprioception. There are many interactions between them and the speed of their transmission varies, depending on the myelination of the nerve fibre (Gerebenné Várbíró, 2021).

Proprioception is the conscious and involuntary perception of the position of the joints (Blythe, 2006). Proprioception, or the sense of movement, provides us with awareness of the spatial positioning of our body parts - at rest and during movement - maintain proper posture, and is involved in motor control, learning new movements, and has a protective function. Proprioceptors are found throughout the body, these are mainly located in joints, ligaments, and between the connections of muscles and tendons (Tóth, 2017). Information from them is processed primarily by the balance system, but they also influence body movements, and the adjustments needed to perform fine movements and are involved in joint protection (Sziliné Hangay & Gerencsér, 2005). Signs of proprioceptive weakness include poor posture, constant restless movements, strong urges to lean, clumsiness, and little concept about the spatial location of body parts (Blythe, 2006).

2.1.3 Action systems

Next to the sensory systems action systems play a crucial part in motor control. This system includes basal ganglia, cerebellum, central pattern generators and motor cortex. The choice of action and decision making represents a highly complex level. The basal ganglia play a main role and depend on input coming from the cortex, thalamus and dopamine system. The basal ganglia control command centres in the brainstem. These activate different command pathways to specific central pattern generator networks in the spinal cord or brainstem responsible for executing a particular motor program. The cerebellum plays a central role in motor learning and fine-tuning of different movements (Grillner&El Manira, 2020). The cerebellum is fundamentally involved in motor functions, but evidence is accumulating that it also contributes to non-motor, cognitive functions. It is now widely recognized that the cerebellum contributes to both motor behaviour and cognition. Anatomically and functionally, the cerebellum has extensive connections with brain areas that play key roles in non-motor functions, and these connections form consistent, closed loops. It has been suggested that these loops may form the basis for unified processing patterns across different functional domains. In other words, since the cerebellum is critically important for coordination and timing in the motor domain, it may fulfil similar functions in the cognitive domain as well (Peterburs&Desmond, 2016).

All in all, the cerebellum is a vital component of the human brain. It plays a role in regulating motor movements and balance, coordinating walking, maintaining posture, regulating muscle tone and voluntary muscle activity, but it cannot initiate muscle contraction. The cerebellum receives afferent information about voluntary muscle movements from the cerebral cortex, muscles, tendons and joints, and about balance from the vestibular nuclei. The cerebellar hemispheres control the same side of the body, and in case of damage, the symptoms appear

ipsilaterally. Its damage results in the loss of the ability to control fine movements, maintain posture, and learn motor skills (Jimsheleishvili&Dididze, 2023).

2.1.4 Laterality

Lateral dominance, including hand dominance means that the child uses one hand more often (e.g. a ball is always thrown with the same hand or pencil must be held in the dominant hand while writing). The dominant hand is slightly more skilled than the other one (Tóth, 2017).

Some research suggests that older adults show a stronger lateral preference than young adults. This supports the theory that handedness develops or becomes more stable with age (Marcori et al., 2019). If someone is dominantly right lateralized, then the left hemisphere of the brain is more competent than the right hemisphere in terms of fine motor skills and/or strength (Bondi et al., 2020). It has been shown that a less lateralised brain, which corresponds to a less lateralised behavioural preference, is associated with certain deficits in cognitive development (Crow, 1998). A higher prevalence of left-handedness or mixed handedness has been reported in a number of developmental disorders in the motor domain (e.g. developmental coordination disorder) compared to the general population (Darvik et al., 2018). Nevertheless, it cannot be clearly stated that these forms of handedness are risk factors for developmental disorders. The term "crossed laterality" is used to describe people whose hand, eye, foot or ear dominance is not equally right- or left-sided. It encourages the creation of a range of interventions to restore or consolidate lateral dominance (Ferrero et al., 2017).

2.1.5 Limb coordination

One of the key components of motor control is inter-limb coordination. It is achieved by synchronizing the spatial and temporal aspects of limb movements. It refers to movements that require synchronised and rhythmic use of both sides of the body (sequential, simultaneous or rhythmic). We can distinguish two categories: bimanual coordination (e.g. throwing a big ball with two hands, finger tapping with index fingers of both hands, finger tapping with one hand and tracing a circle with the other hand) or hand-foot coordination (e.g. tapping with hands and feet, clapping while walking) (Rose &Winstein, 2013; Arya&Pandian, 2014; Bobbio et al., 2009).

This movement involves the dexterous coordination of the two arms in a two-handed operation – the so-called bimanual action. Bimanual movements require coordination within the limbs (intra-limb coordination), as well as integration and sequencing of actions between limbs (i.e., inter-limb coordination). Bimanual control begins around age 4 and significant changes occur between the ages of 4 and 10 years (Bobbio et al., 2009). Many activities of daily life depend on successful bimanual coordination. The complexity of bimanual coordination tasks ranges from those as simple as clapping, which an infant performs almost reflexively, to those that require a lifetime of practice, such as playing a piano. However, the direction of movement is not an insignificant consideration. When the left and right hands move in a symmetrical or mirror-like pattern along the midline, they are easier to perform than when they have to move

in the same direction, i.e. parallel, in an asymmetrical pattern (Bobbio et al., 2009; Sisti et al., 2022).

Inter-limb coordination involves the simultaneous coordination of the upper and lower extremities. Actions can be performed with the upper and lower limbs on the same side of the body (ipsilateral movements), or with the limbs on both sides (contralateral movements). The rhythmic coordination of non-homologous limbs like hands and feet is more difficult to implement than movements using two hands due to mechanical differences between the limbs Improvements can be detected between the age of 4 to 10 years (Bobbio et al., 2009).

2.2 Motor development

2.2.1 Developmental milestones

Motor development is the step-by-step process of modifying movement patterns, based on an individual's genetic potential and previous and new movement experiences, occurring through the interaction between the organism and the environment. Motor development encompasses the individual development of complex movement forms and motor skills (such as crawling, climbing, walking, running, jumping, throwing, catching, hitting, and kicking), as well as the development of conditional abilities (strength, speed, endurance, joint flexibility), and coordination and balance skills. Different perspectives can be encountered regarding the stages of motor development (Farmosi, 2011).

The stage of reflex-like movements encompasses the period from birth to the end of the first year of life. The newborn is born with so-called primitive reflexes and elementary movement patterns. The primary function of these is to aid in feeding and defense, supporting the survival of the newborn. The secondary function of some of them is to serve as the basis for later voluntary movements. In the initial stages of motor development, only the lower-level, so-called subcortical centers are responsible for regulating movements, which are increasingly inhibited as the cortical nervous system centers mature (Vass, 2020).

The next stage - stage of elementary voluntary movements - is between 1 to 24 months. Elementary voluntary movements are considered the foundation of human locomotion, posture changes, and manipulative motor skills. There are movements related to stability (posture changes), manipulation, and locomotion. During this developmental period, the first voluntarily coordinated movements occur. Goal-directed grasping, upright posture, and independent locomotion develop. The characteristic developmental direction of this period is cephalocaudal, meaning that coordinated movement starts from the head and progresses toward the feet. So, coordinated elementary voluntary movements appear first in relation to the mouth, eyes, and head, followed by the development of coordinated movements of the arms, trunk, and legs (Vass, 2020; Rachwani, 2015). Contralateral symmetrical movements are characteristic (e.g. if an infant moves the left arm, the right arm will move simultaneously). Increased muscle tone also persists, which is most noticeable in the inefficient execution of movements. This primarily indicates the predominance of excitatory processes in the nervous system, which gradually

balance out with the engagement of inhibitory mechanisms in the nervous system. This stage is characterized by the gradual development of manipulative movements and the coordination of fine motor skills. Successful manipulation of objects fundamentally consists of three phases: reaching, grasping, and releasing (Farmosi, 2011). The development of the characteristic human posture and walking is the greatest achievement of this period (Farmosi&Gaál Sándorné, 2007).

In the stage called „Basic forms of movement stage (2–7 years of age)", motor development is characterized by the perfection of already acquired elementary voluntary movement patterns, the expansion of basic motor skills, and the emergence of the first movement combinations. Basic movement patterns can be grouped into postural (position-changing), locomotor (location-changing), and manipulative movement forms. Development follows three main directions, which are manifested in performance improvement, execution quality, and the combination of known movements (Porkolábné Balogh, 1995).

In the „Initial stage (between 2–3 years)" the child begins to consciously and purposefully apply basic movement patterns to explore and discover their environment. The involvement of individual body parts in a given motion or sequence of movements is often inadequate, or in some cases, certain body parts do not participate in the movement at all. More muscle groups are involved simultaneously during movements than necessary for the successful execution of the movement, and the already acquired movement patterns can only be applied under limited environmental conditions. If the execution of a particular movement pattern becomes uncertain, the child will choose another movement pattern in which they feel more confident (e.g. instead of walking unsteady on an unstable surface they switch to crawling). A low level of awareness regarding their own body, spatial orientation, and energy expenditure can be observed in their movements.

During „Elementary stage (3–5 years old)", due to the constant practice, there is a significant improvement in the sequencing of the limbs involved in the movements, the applicability of the movement patterns, and the coordination of movements. The limbs involved in the execution of a given movement are used in the correct order, the involvement of muscle groups that are not necessary for the execution of the movement decreases, and the range of environmental applicability expands. In terms of movement coordination, there is a significant improvement in the spatial and temporal synchronization of the limbs. Overall, there is an elevated level of awareness regarding their own body, spatial orientation, and energy expenditure during movements.

At „Proficient stage (5–7 years of age)", the implementation of basic forms of movement reaches the highest level. This means that during the execution of movements, the engaging and disengaging of each limb in a given movement, and ultimately the sequencing, is largely observed. Also, the economy of movement, that is, movement in terms of turning off the functioning of unnecessary muscle groups, the highest degree is reached. In case of movements there is a high level of awareness of one's own body, spatial orientation and energy investment.

The stage of specific movements (over 7 years of age) can be divided into three substages. Approximately between the seventh and tenth years of life - the transitional; between the age of eleven and thirteen - the application; from the age of thirteen - the life long utilization period.

The individual stages differ from each other both qualitatively and quantitatively. The characteristic and importance of the transition period lies in the continuous and smooth transition from basic to sport-specific movements. The application phase includes movements that are already specific to sports, which continue in the stage of movements that can be used later in life (Vass, 2020).

According to a different categorization the stages of motor development from preschool to early school age are the following.

- From 3.5 years to 7-7.5 years: This period is characterized by the rapid perfection of fundamental movement forms, the emergence of the first movement combinations, and the development of the ability structure. The increasing precision of movements enables their integration.
- From 7-7.5 years to 9-10 years: This stage is marked by the rapid development of the ability to learn movements. During this period, numerous new movements are acquired.
- Girls: from 9-10 years to 11-12 years, Boys: from 9-10 years to 12.5-13.5 years: In childhood, this stage is the most intense phase of movement learning, with gender-specific differences and individual movement characteristics becoming more pronounced (Farmosi, 2021).

(Summary Table 1 for ages 4-7 – Appendix 1)

2.2.2 Motor learning

During motor learning, by mastering the actions, we gain new movement skills, and we raise our previously acquired skills to a higher level. The process is created through practice based on individual experience. Part of it is the development, refinement, consolidation, application and retention of movement skills. The key elements are the feedback and correction instructions obtained by repeating the given movement skill.

Motor learning is therefore a process during which a change occurs in the motor performance of the given person. Many models have already been developed in relation to motor learning. Most theories are based on four different ideas about learning:

- a dynamic process that leads to the acquisition of the ability to perform specific actions;

- for its realization, the opportunity to practice and gather experience must be provided, making mistakes is a necessary part of the learning process;
- motor learning itself cannot be directly observed, it can be inferred by observing changes in motor behaviour;
- through motor memory, what has been learned can be applied or adapted in a changed task situation or within environmental constraints.

There are some important factors which affect motor learning process: verbal instructions (maintaining capacity for attention); characteristics and variability of practice, training (distributed practice, with prolonged rest periods rather than continuous repetition of tasks without rest periods); the individual's active participation and motivation (progress depends on these); the option of making mistakes; postural control (control over the body's position in space); memory (key component in learning process); and feedback (provide information about how the action is being carried out) (Cano-de-la-Cuerda et al., 2015).

According to one theory motor learning includes the following stages.

- *The development of rough coordination of movement:* first the task is understood, this is based on cognitive abilities, but the acceptance of the task and the development of interest also mobilize the emotions. After understanding, a relatively accurate picture of the movement is formed, which is mainly based on visual information. After the understanding and the idea, the first attempt to execute the movement takes place, which is then typically "jerky", sometimes unsuccessful. Apart from vision, the other senses are only moderately involved in the regulation process. Although information is received from the proprioceptors, it is not yet perceived by the nervous system. Previous movement experiences can help in the efficient processing of sensory information. On the other hand, movement elements stored in movement memory similar to the movement to be learned can hinder the improvement of coordination.
- *The stage of fine coordination of movement:* the coordination of movements improves along with continuous practice and correction of mistakes. Using kinesthetics information improves coordination. Movements are characterized by continuity, economy and rhythm.
- *Consolidation of the fine coordination of movement:* means application in changing conditions. The individual takes in the information necessary for successful execution, processes it and adapts the movement performance to the external circumstances (Polgár&Szatmári, 2011; Király&Szakály, 2011).

According to Fitts and Posner, there are three stages in motor learning.

- *Cognitive stage:* Learning a new skill or relearning an existing one. Frequent practice is required with supervision. Mistakes are neccessary and it is important to know how to correct them in this process. Movements are inefficient and slow, there is a need for cognitive activity.

- *Associative stage:* Being able to perform the task in a specific environment. Errors occur during the activity and correction is easier. Individual will begin to understand how the components of a skill are interrelated. Movements are smoother and more efficient, less cognitive activity is enough.

- *Autonomous stage:* Being able to move in different settings and maintain control during the task. The movements are precise and efficient, with little or no cognitive activity required. Learning is completed when there is the ability to retain a skill and apply it in various settings via automatisation. It is crucial, due to practical situations in real life are mostly random (Magill& Anderson, 2010; Fitts&Posner, 1967).

Gentile's two-stage model commences with comprehending the task's objective, formulating the requisite movement strategies for its execution, and discerning the environmental cues pertinent to the organization of movement. In the second stage, known as fixation or diversification, the individual seeks to refine their movement patterns. This involves enhancing the ability to adapt movements to varying tasks and environments, as well as achieving consistent and efficient task performance (Cano-de-la-Cuerda et al., 2015; Gentile, 1972).

2.3 Motor skills

The term "motor" is derived from Latin, meaning a device that generates kinetic energy or initiates movement. Motor skills are combinations of physical or bodily attributes that are prerequisites for performing a movement-oriented action aimed at a specific goal (Meszler&Tékus, 2015). Motor skills are essential for moving the body and body parts based on the activity of skeletal muscles as effectors (Tóth, 2017). Skills are determined by factors such as body structure, the functioning of organs and organ systems, and functional changes resulting from various influences. Adaptation is achieved through the unified functioning of structure and function.

Motor skills can be divided into fine and gross motor skills. Certain resources also mention hand-eye skills as a third type in addition to the previous ones, as part of coordination (detailed below). Gross motor skills are vital for human beings, these help individuals move, and this involves using the large muscles of the body. These motor skills require proper functioning of muscles, bones, nervous system and motor coordination. Fine motor skills include the use of smaller muscles, mostly of the hands. By these skills we perform various tasks or manipulate objects that we need in everyday situations. The precise movement of the hand required, for example, to write with a pen or to play a musical instrument (Tóth, 2017). Fine motor skill is

often interpreted as the skill to perform small manual operations which require hand-eye coordination as well (Luo et al., 2007). Two main aspects of this skill are manual dexterity and finger dexterity. Dexterity is often equated with object manipulation skills, that is why it is often measured with object manipulation tasks (e.g. coin tossing, beading, etc.) (Fischer et al., 2020; Petermann, 2015). Therefore, performance is often scored by the speed of completing a given task. Finger agility is described as the ability to move the fingers intentionally and individually. It is considered an essential skill measured, for example, in a tapping task (Roesch et al., 2021; Fischer et al., 2022). These skills strongly predict school achievement, the acquisition of fine motor skills is essential for children to learn handwriting (Grissmer et al., 2010; Seo, 2018). In addition, children with fine motor developmental problems have difficulty learning fine motor skills, they probably experience problems in school with writing or cutting tasks, or in everyday situations like tying shoelaces or zipping (Blank et al., 2019).

According to another classification of motor skills, there are three main groups: conditional abilities, coordination abilities, and joint mobility. Conditional abilities represent the energetic prerequisites for executing movements and can be characterized by physical measures. To successfully perform a movement, the ideal strength, speed, and endurance must be established. Conditional abilities the current performance capacity of the body and the ongoing adaptive phenomena within it. Influencing factors include the capacity of the nervous system, muscle tissue, cardiovascular system, respiratory system, and metabolic systems. Joint mobility is the condition of movements that reflects the freedom and limitations of the range of motion derived from the anatomical structures of the human motor system and regulated by various nervous system mechanisms. Coordination refers to the precision, effectiveness, and efficiency of movements. This motor skill is primarily depending on the functioning level of the nervous system. Movement coordination is a complex sensorimotor phenomenon that demonstrates the regulatory background of actions (Meszler & Tékus, 2015). The effectiveness of motor activity is determined by appropriate spatial and temporal orientation, the ability to connect component elements, differentiated movement perception, proper balance, complex reaction capability, adaptability, and rhythm sense (Polgár&Szatmári, 2011).

The acquisition of motor skills is not only essential for the functioning of everyday life, but also affects the cognitive and social development of children (Cools et al., 2009).

2.3.1 Conditional abilities

The three fundamental elements of conditional abilities are strength, speed, and endurance. Due to the interactions and relationships among these abilities, we can refer to abilities such as speed-strength, speed-endurance, and endurance-strength. Certain literature also classifies joint mobility in this group (Farmosi, 2011).

Conditional abilities provide the energetic conditions for executing movements, which can be characterized by physical measures. These parameters define the speed, duration, and the extent of exertion during movement. They are easy to measure and are the most accurately

measurable abilities. They ideally characterize an individual's current performance capacity and the adaptive phenomena within the body (Meszler et al., 2015).

Strength*:* A conditional ability that is created by muscle tension, shortening, or lengthening, enabling us to overcome various levels of resistance (Király & Szakály, 2011).

Speed*:* A conditional ability that allows high-speed execution of movements under given conditions. Speed is largely inherited, so its trainability is limited (Dorka et al., 2013). Literature divides speed into four elements: reaction speed, movement speed, frequency speed, and speed-strength required for acceleration.

Endurance: According to Nádory (1991), endurance is the body's resistance to fatigue during prolonged exertion. More broadly, endurance encompasses the physiological processes that enable the body to maintain biological balance over a long period under significant physical stress. Its most intense development phase occurs between 7-10 years of age, for both boys and girls. There are three types of endurance: long-term, medium-term, and short-term endurance. Additionally, due to the interactions with other conditional abilities, we can also talk about endurance-strength and speed-endurance.

Long-term Endurance: Characterized by exertion lasting over 15-30 minutes, where the intensity and pace do not significantly decrease, and the work is mainly aerobic.

Medium-term Endurance: Characterized by exertion lasting 2-9 minutes, where the intensity does not significantly change, and energy is supplied aerobically after 2 minutes.

Short-term Endurance: Characterized by exertion lasting 45 seconds to 2 minutes (Dorka et al., 2013).

2.3.2 Coordination abilities

Coordination abilities allow us to mobilise our conditional skills in a given task situation in a way that is appropriate to the task. Motor coordination enables a given movement to be executed accurately, smoothly, rhythmically, harmoniously, and aesthetically and enables us to adapt to an ever-changing environment, to adapt our behaviour and to perform our actions as a whole. Based on the analyses carried out so far, coordination abilities presuppose constant nervous regulation and control. Early childhood coordination refers to a child's motor skills, including walking, running, and jumping, and their smooth execution with harmonious movement. The characteristics of coordinated movement are appropriate speed, distance, direction, timing and muscle tension. Age-appropriate balance and coordination allows the child to experience success in sport by helping the body move to perform physical skills (e.g. ball games).

The classification of coordination abilities is diverse. In the early stages of motor development research, coordination abilities were referred to as a single ability - dexterity. With the expansion of research and literature, there was a need for more precise definitions, leading researchers to break down dexterity into distinct abilities (Farmosi, 2011). The main sub-

abilities include balancing ability, spatial orientation ability, rhythm ability, and speed coordination ability.

Balance skills

The balance system develops by the 16th week of intrauterine life, allowing the fetus to sense directions and orient itself within the mother's womb (Blythe, 2014). Balance is based on the cooperation of the cerebellum, antigravity muscles, and the eyes (Blythe, 2006). There are three types of balance perception that can be distinguished.

Static Balance: This type is responsible for sensing the position and acceleration of the head in space. To maintain this and perform daily activities, it primarily relies on information from the proprioceptive system and the skin. Static balance involves the stable fixation or maintenance of a body part or posture despite the potential for continuous loss of balance (Dubecz, 2009).

Dynamic Balance: This type senses angular velocity and changes in speed, requiring more complex sensory information for its execution (Shaffer & Harrison, 2007). Dynamic balance involves establishing and maintaining a balanced position during movements of various directions and speeds that would otherwise disrupt balance (Dubecz, 2009).

Object Balance: This type involves balancing while carrying objects (Pappné Gelencsér, 2023).

Balancing is an extremely complex process realized through the vestibular, somatosensory, and visual systems (Dulházi, 2018).

Additional coordination abilities

Spatial Orientation Ability: It involves coordinating the movement of one's own body, body parts, others, or foreign objects in space, particularly evident in play with others or complex spatial movements (Meszler et al., 2015). It is the perception of our position, the perception of the distance, speed, and direction of movement of various stationary and moving objects (persons, objects) relative to each other and to us, and the determination of expected changes (Polgár&Szatmári, 2011). As spatial orientation relies on perception, integration and interpretation of visual, vestibular and proprioceptive sensory information, vision, hearing, tactile and kinesthetics analysers are involved in it, their complex appearance creates this ability (Hamar, 2008).

Speed Coordination: Essentially the regulated, precise execution of movement and action programs under time constraints. This ability has a strong genetic component, making its sensitive period, which occurs during early school years (grades 1-3), critical for development (Dorka et al., 2013).

Rhythm ability: The understanding of the temporal and dynamic order of movement processes, the perception of the inherent or predetermined rhythm in the movements, and its display in

the execution of the movement. It can be found in the performance of all physical exercises and in the movement material of sports (Polgár&Szatmári, 2011; Hamar, 2008).

Reaction ability: A specific ability, with the help of which the individual can respond to stimuli and information from the environment with appropriate speed and appropriate actions. Its simpler and more complicated forms are also present in the field of life and sports activities, from stimuli that trigger an immediate response to a reaction that requires a decision and requires perception.

Movement perception (kinaesthesia): The type of coordination skills that manifests itself in kinesthetics differentiation through the perception of information indicating the degree of muscle tension and relaxation. This ability helps the individual to carry out the movements accurately and economically, as well as the pleasant feeling of the movement experience created during the lightness by eliminating unnecessary efforts (Hamar, 2008).

Eye-hand coordination

Eye-hand coordination depends on the integrated control of ocular and sensorimotor systems to achieve a single goal, such as touching a visual target. It is a complex process that requires precise activation of the eye and hand motor systems. Optimal function relies on complex feedforward and feedback-mediated connections between the visual-perceptual, ocular, and appendicular motor systems, and exploits finely tuned synergies between these systems in both the temporal and spatial domains. Timed and dexterous movements, such as reaching and grasping small objects, depend on the acquisition of high-quality visual information about the environment and the simultaneous control of the eyes and hands (Rizzo et al., 2019; Rizzo et al. 2020). Eye-hand or sometimes referred as hand-eye coordination or hand-eye skills include the control of the hands in a task such as catching or throwing a ball.

2.3.3 Consequences of poor skills

Children with low motor skills are less likely to take part in physical activities at home, school or in the community, and are often excluded from activities by their peers. They tend to show lower fitness levels than typically developing children. Research has reported reduced health-related fitness (explosive strength, power and endurance) and cardiorespiratory fitness in connection with lower motor skills. This suggests that low motor skills negatively affect health-related fitness components. Denysschen et al. (2021) found that children with low motor skills showed poorer outcomes in aerobic capacity, muscle strength and endurance compared to children with typical developmental milestones.

Gross motor skills (GMS) are the basis for many sports and physical activities. Moreover, higher levels of these motor skills are associated with lower body mass index, better cardiorespiratory fitness, increased cognitive development, social development and language skills. Lower self-esteem and higher anxiety are more common in children with poor gross motor skills (Veldman et al., 2016). The proper development of gross movements is a

prerequisite for the development of fine motor patterns, the basis for the development of fine movements (Farmosi, 1999).

Engaging in physical activity enhances the structural plasticity of both grey and white matter in children and adolescents. It facilitates the modulation of brain activation patterns in response to specific tasks, improves the structure of the brain and functional networks. Consequently, physical activity fosters positive changes in cognitive abilities, including attention, memory and thinking, as well as executive functions (Shi&Feng, 2022).

It is important to ensure the development of movement up to the age of 5 years, when the necessary organ functions (nervous system, muscular system, heart, lungs, blood circulation) are further developed, enabling children to acquire the important basic human skills (walking, running, jumping, throwing, crawling, climbing, etc.). Depending on the external influences, the control functions that are important in the organization of movement execution also develop, thus enabling the acquisition of more and more complex movements. The sense of balance, hand-eye coordination, spatial perception, sense of direction and rhythm, sense of pace, etc., are developed, which are also related to the development of thinking.

The consequences of developmental delay: learning problems (dyslexia, dysgraphia, dyscalculia, hypermotility); hyperactivity; disorders of cognitive functions (perception, attention disorders, memory and thinking); muscle tone, gross and fine motor disorders; behavioural disorders (aggressiveness, anxiety, integration disorders) (Király&Szakály, 2011).

2.4 Examination of motor skills

Since the development of motor skills is not a fixed linear process, it is recommended to monitor children's motor development from time to time, rather than assessing them once. Every child has their own individual learning pace and motor skills develop by leaps and bounds. By monitoring from time to time, the progress of their development can be detected. Motor development problems can be recognized at an early stage. By starting targeted diagnostic methods and therapy in time, the effects of their motor development problems can be reduced (Gerber&Erdie-Lalena, 2010; Brons et al., 2021).

2.4.1 Tests presented in the course

The tests used can be adapted to younger and older children based on the skills and developmental milestones expected at a given age, and, where appropriate, allow for retesting after a developmental program. These are easy-to-use tests with minimal equipment that allow the examiner to map child's motor skills and compare them with age-appropriate levels. The recordings show tests to assess fine and gross motor skills. However, it is important to mention that the following data should be recorded before the tests are carried out (Dannemiller et al., 2020).

History of the child:

- General intake data: date of birth, date of examination, gender, reason for referral, parent/caregiver concerns, general health, list of other service providers.
- Medical history: birth history (prematurity, birth weight), onset of symptoms that relate to motor concerns, medications, other medical conditions including vision or hearing concerns, coexisting conditions such as attention deficit hyperactivity disorder (ADHD), etc., events such as accidents or surgical procedures, medical interventions.
- Developmental history: developmental milestones in gross/fine motor, language, and social/adaptive skills, other areas of intellectual or developmental concern, behavioral or emotional differences.
- Family history: medical or developmental conditions that exist in the family, such as clumsiness, developmental coordination disorder (DCD), attention deficit disorder (ADD) or ADHD, specific learning disabilities, and intellectual disability (ID).
- Educational history: interventions received in early intervention or developmental preschool program, reports of difficulties with physical activities or academics, special education services in school, intellectual testing and determinations.
- Participation history: home activities of daily living (ADL) and chores, activities with family and friends, physical activity preferences that are motivating at home, school, and community, fitness level.
- Additional history may include, with parent/caregiver consent: reports secured from other professionals such as occupational therapists, speech therapists, psychologists, physicians, teachers, or other significant adults.
- Musculoskeletal screen: height and weight.
- Neuromuscular screen: fall history, toe walking.
- Cognitive/behavioural screen: ability to follow instructions and communicate needs, behavioural regulation and attention, ability to interact with adults and peers.
- Vision screen: history of acute changes in visual function, history of treated or untreated visual impairments or diagnoses.

Before completing the tests, the examiner needs to make sure that the examined child understands the tasks and has had chance to try them.

Assessment of fine motor skills

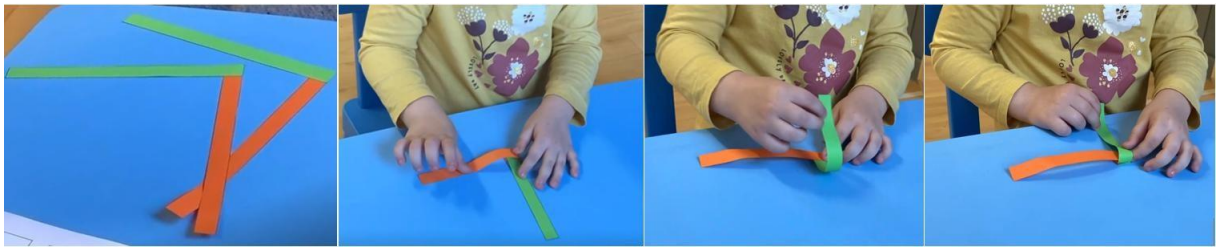
1. **Copying a square, a triangle and a diamond**

Equipment required: paper with geometric shapes, pencil. The child should copy three shapes using a pencil on a paper. Precision, quality of task implementation and pencil grasping is observed. The result can be compared to what is expected at a given age (Picture 1) (Radanović et al., 2021).

Picture 1 Copy test and observation of pencil grip

2. **Folding paper strips**

Equipment required: 2 paper strips (width 1.5 cm, length 20 cm) glued together at the end at right angles to each other, stopwatch. The child sits at the table, the glued strips of paper are in front of the child on the table. The examiner demonstrates the task by folding the paper strips over each other again and again as tight as possible, and verbally explains what he/she is doing. Then the child should fold the strips of paper over each other again and again until he/she reaches the end of the strips (Picture 2). Maximum time: 3 min – age 5; 2 min – age 6-8. Time is measured. Quality of performance is assessed. Possible scoring: the score is the number of correctly completed folds (i.e. the folded part covers the underlying part). The folds of both paper strips are counted, incomplete folds are not counted (URL 1).



Picture 2 Folding paper strips test

3. **Cutting paper with scissors**

Equipment required: colouring picture, scissors, stopwatch. The child sits at the paper with the colouring picture and the scissors in front of him/her. In this picture, a string is attached to the balloon. The child should start cutting at the end of the string and cut the string until he/her reaches the balloon. Not allowed to cut outside the black area of the string (Picture 3). Maximum time: 3,5 min – age 5; 3 min – age 6-7; 2 min – age 8. Time is measured. Quality of performance is assessed. Possible scoring: the score is the number of times the child crossed the lines (irrespective of the size of the error; also, a dot outside the lines is considered an error) (URL 1).

Picture 3 Cutting paper with scissor test – cutting inside the line not touching the balloon

Assessment of hand-eye skills and bilateral motor coordination

1. **Catching ball with two hands - Throwing the ball at a target**

Catching ball with two hands from 2 meters distance in 5 trials. Throwing the ball in a bin 2 meters distance in 5 trials. Quality of performance is assessed – whether the child can catch the ball in a smooth manner by timing the catch with two hands and throw it at a target successfully. The result can be compared to what is expected at a given age.

2. **Finger-foot same side synchronized**

Tapping finger/hand and foot on same side synchronized manner for 30 seconds (Picture 4). Best of 3 trials. Quality of performance is assessed – whether the child can synchronize the movements.

Picture 4 Tapping same side synchronized

3. **Finger-foot opposite side synchronized**

Tapping alternately finger/hand and foot of one side with the other side for 30 seconds. Best of 3 trials. Quality of performance is assessed – whether the child can maintain the rhythm of alternate limbs (Bobbio et al., 2009).

Assessment of gross motor skills

Pediatric Balance Scale: Pediatric Balance Scale is a version of the Berg Balance Scale adapted for children, designed to assess, and measure balance and stability in school age children - school age children (5-15) for children with mild to moderate motor impairments; typically developing children plateau around age 7-8. Administration and scoring take less than 15 minutes. Verbal instructions for each item are given. The child may receive one practice trial per item. If the child is unable to understand the directions, a second trial may be given. Verbal and visual instructions are given to clarify (Franjoine et al., 2010; Vekerdy-Nagy, 2019).

Equipment required: adjustable height bench, chair with back support and arm rest, stopwatch or watch with a second hand, masking tape, – 1 inch wide (1 inch = 2,54 centimetres), a step

stool 6 inches (15,24 cm) in height, chalkboard eraser, ruler or yardstick, a small level. Optional equipment that may be helpful includes: 2 child size footprints, blindfold, brightly coloured object at least 2 inches (5,08 cm) in size, flash cards, 2 inches (5,08 cm) of adhesive-backed hook, two 1-foot (30,48 cm) strips of loop.

14 item test - each item is scored 0 – 4 (max. 56 points)

Test 1 – Sitting to standing

Equipment: a bench of appropriate height to allow the child's feet to rest supported on the floor with the hips and knees maintained in 90 degrees of flexion. Instructions: child is asked to "Hold arms up and stand up." The child is allowed to select the position of his/her arms. Best of three trials.

4 points -able to stand without using hands and stabilize independently

3 points - able to stand independently using hands

2 points - able to stand using hands after several tries

1 point - needs minimal assist to stand or to stabilize

0 point - needs moderate or maxima assist to stand

(Test 1 and 2 may be tested simultaneously if, in the determination of the examiner, it will facilitate the best performance of the child.)

Test 2 – Standing to sitting

Equipment: a bench of appropriate height to allow the child's feet to rest supported on the floor with the hips and knees maintained in 90 degrees of flexion. Instructions: child is asked to sit down slowly, without use of hands. The child is allowed to select the position of his/her arms. Best of three trials.

4 points - sits safely with minimal use of hands

3 points - controls descent by using hands

2 points - uses back of legs against chair to control descent

1 point - sits independently, but has uncontrolled descent

0 point - needs assistance to sit

Test 3 – Transfers

Equipment: two chairs, or one chair and one bench. One seating surface must have armrest. One chair/bench should be of standard adult size and the other should be of an appropriate height to allow the child to conformably sit with feet supported on the floor and ninety degrees of hip and knee flexion. Instructions: arrange chair(s) for a stand pivot transfer, touching at a forty-five-degree angle. Ask the child to transfer one way toward a seat with armrests and one way toward a seat without armrests.

4 points - able to transfer safely with minor use of hands

3 points - able to transfer safely; definite need of hands

2 points - able to transfer with verbal cueing and/or supervision (spotting)

1 point - needs one person to assist

0 point - needs two people to assist or supervise (close guard) to be safe

Test 4 – Standing unsupported

Equipment: a stopwatch or watch with a second hand, a twelve-inch-long masking tape line or two footprints placed shoulder width apart. Instructions: the child is asked to stand for 30 seconds without holding on or moving his/her feet. A taped line or footprints may be placed on the floor to help the child maintain a stationary foot position. The child may be engaged in non-stressful conversation to maintain attention span for thirty seconds. Weight shifting and equilibrium responses in feet are acceptable; movement of the foot in space (off the support surface) indicates end of the timed trial.

4 points - able to stand safely for 30 seconds

3 points - able to stand 30 seconds with supervision (spotting)

2 points - able to stand 15 seconds unsupported

1 point - needs several tries to stand 10 seconds unsupported

0 point - unable to stand 10 seconds unassisted

_____Time in seconds

Special instructions: if a subject is able to stand 30 seconds unsupported, score full points for sitting unsupported. Proceed to item #6

Test 5 – Sitting with back unsupported and feet supported on the floor

Equipment: a stopwatch or watch with a second hand, a bench of appropriate height to allow the feet to rest supported on the floor with the hips and knees maintained in ninety degrees of flexion. Instructions: please sit with arms folded on your chest for 30 seconds. Child may be engaged in non-stressful conversation to maintain attention span for thirty seconds. Time should be stopped if protective reactions are observed in trunk or upper extremities.

4 points - able to sit safely and securely 30 seconds

3 points - able to sit 30 seconds under supervision (spotting) or may require definite use of upper extremities to maintain sitting position

2 points - able to sit 15 seconds

1 point - able to sit 10 seconds

0 point -unable to sit 10 seconds without support

_____Time in seconds

Test 6 – Standing unsupported with eyes closed

Equipment: a stopwatch or watch with a second hand, a twelve-inch-long masking tape line or two footprints placed shoulder width apart, blindfold. Instructions: the child is asked to stand still with feet shoulder width apart and close his/her eyes for ten seconds. Direction: „When I say close your eyes, I want you to stand still, close your eyes, and keep them closed until I say open." If necessary, a blindfold may be used. Weight shifting and equilibrium responses in the feet are acceptable; movement of the foot in space (off the support surface) indicates end of timed trial. A taped line or footprints may be placed on the floor to help the child maintain a stationary foot position. Best of 3 trials.

4 points - able to stand 10 seconds safely

3 points - able to stand 10 seconds with supervision (spotting)

2 points -able to stand 3 seconds

1 point - unable to keep eyes closed 3 seconds but stays steady

0 point-needs help to keep from falling

_____Time in seconds

Test 7 – Standing unsupported with feet together

Equipment: a stopwatch or watch with a second hand, a twelve-inch-long masking tape line or two footprints placed together. Instructions: the child is asked to place his/her feet together and stand still without holding on. The child may be engaged in non-stressful conversation to maintain attention span for thirty seconds. Weight shifting and equilibrium responses in the feet are acceptable; movement of the foot in space (off the support surface) indicates end of timed trial. A taped line or footprints may be placed on the floor to help the child maintain a stationary foot position. Best of 3 trials.

4 points - able to place feet together independently and stand 30 seconds safely

3 points - able to place feet together independently and stand 30 seconds with supervision (spotting)

2 points - able to place feet together independently but unable to hold for 30 seconds

1 point - needs help to attain position but able to stand 30 seconds with feet together

0 point - needs help to attain position and/or unable to hold for 30 seconds

_____Time in seconds

Test 8 – Standing unsupported one foot in front

Equipment: a stopwatch or watch with a second hand, a twelve-inch-long masking tape line or two footprints placed heel to toe. Instructions: the child is asked to stand with one foot in front of the other, heel to toe. If the child cannot place feet in a tandem position (directly in front), they should be asked to step forward far enough to allow the heel of one foot to be placed ahead of the toes of the stationary foot. A taped line and/or footprints may be placed on the floor to help the child maintain a stationary foot position. In addition to a visual demonstration, a single physical prompt (assistance with placement) may be given. The child may be engaged in non-stressful conversation to maintain his/her attention span for 30 seconds. Weight shifting and/or equilibrium reactions in the feet are acceptable. Timed trials should be stopped if either foot moves in space (leaves the support surface) and/or upper extremities support is utilized. Best of 3 trials. (Picture 5)

4 points - able to place feet tandem independently and hold 30 seconds

3 points - able to place foot ahead of other independently and hold 30 seconds

Note: The length of the step must exceed the length of the stationary foot and the width of the stance should approximate the subject's normal stride width.

2 points - able to take small step independently and hold 30 seconds, or required assistance to place foot in front, but can stand for 30 seconds

1 point - needs help to step, but can hold 15 seconds

0 point - loses balance while stepping or standing

_____Time in seconds

Test 9 – Standing on one leg

Equipment: a stopwatch or watch with a second hand, a twelve-inch-long masking tape line or two footprints placed heel to toe. Instructions: the child is asked to stand on one leg for as long as he/she is able to without holding on. If necessary, the child can be instructed to maintain his/her arms (hands) on his/her hips (waist). A taped line or footprints may be placed on the floor to help the child maintain a stationary foot position. Weight shifting and/or equilibrium reactions in the feet are acceptable. Timed trials should be stopped if the weight-bearing foot moves in space (leaves the support surface), the up limb touches the opposite leg or the support surface and/or upper extremities are utilized for support. 3 trials average score. (Picture 6)

4 points - able to lift leg independently and hold 10 seconds

3 points - able to lift leg independently and hold 5 to 9 seconds

2 points - able to lift leg independently and hold 3 to 4 seconds

1 point - tries to lift leg; unable to hold 3 seconds but remains standing

0 point - unable to try or needs assist to prevent fall

Picture 5-6 Standing unsupported one foot in front and standing on one leg – static balance tests

Test 10 – Turn 360 degrees

Equipment: a stopwatch or watch with a second hand. Instructions: the child is asked to turn completely around in a full circle, STOP, and then turn a full circle in the other direction.

4 points - able to turn 360 degrees safely in 4 seconds or less each way (total of less than eight seconds)

3 points - able to turn 360 degrees safely in one direction only in 4 seconds or less completes turn in other direction requires more than four seconds

2 points - able to turn 360 degrees safely but slowly

1 point - needs close supervision (spotting) or constant verbal cueing

0 point - needs assistance while turning

_____Time in seconds

Test 11 – Turning to look behind left and right shoulders while standing still

Equipment: a brightly coloured object of at least two inches in size, or flash cards, a twelve-inch-long masking tape line or two footprints placed shoulder width apart. Instructions: the child is asked to stand with his/her feet still, fixed in one place. „Follow this object as I move it. Keep watching it as I move it, but don't move your feet." (Picture 7)

4 points - looks behind/over each shoulder; weight shifts include trunk rotation

3 points - looks behind/over one shoulder with trunk rotation; weight shift in the opposite direction is to the level of the shoulder; no trunk rotation

2 points - turns head to look to level of shoulder; no trunk rotation

1 point - needs supervision (spotting) when turning; the chin moves greater than half the distance to the shoulder

0 point - needs assist to keep from losing balance or falling; movement of the chin is less than half the distance to the shoulder

Picture 7 Turning to look behind left and right shoulders while standing still – static balance test

Test 12 – Pick up object from the floor from a standing position

Equipment: a chalkboard eraser, a taped line or footprints. Instructions: the child is asked to pick up a chalkboard eraser placed approximately the length of his/her foot in front of his/her dominant foot. In children, where dominance is not clear, ask the child which hand they want to use and place the object in front of that foot.

4 points - able to pick up an eraser safely and easily

3 points - able to pick up eraser but needs supervision (spotting)

2 points - unable to pick up eraser but reaches 1 to 2 inches from eraser and keeps balance independently

1 point - unable to pick up eraser; needs supervision (spotting) while attempting

0 point - unable to try, needs assist to keep from losing balance or falling

Test 13 – Placing alternate foot on step stool while standing unsupported

Equipment: a stopwatch or watch with a second hand, a step/stool of four inches in height

Instructions: the child is asked to place each foot alternately on the step stool and to continue until each foot has touched the step/stool four times. (Picture 8)

4 points - stands independently and safely and completes 8 steps in 20 seconds

3 points - able to stand independently and complete 8 steps >20 seconds

2 points - able to complete 4 steps without assistance, but requires close supervision (spotting)

1 point - able to complete 2 steps; needs minimal assistance

0 point - needs assistance to maintain balance or keep from falling, unable to try

_____Time in seconds

Picture 8 Placing alternate foot on step stool while standing unsupported

Test 14 – Reaching forward with outstretched arm while standing

General instruction and set up: a yardstick affixed to a wall via Velcro strips will be used as the measuring tool. A taped line and/or footprints are used to maintain a stationary foot position. The child will be asked to reach as far forward without falling, and without stepping over the line. The MCP joint of the child's fisted hand will be used as the anatomical reference point for measurement. Assistance may be given to initially position the child's arm at 90 degrees. Support may not be provided during the reaching process. If 90 degrees of shoulder flexion cannot be obtained, then this item should be omitted. Equipment: a yardstick or ruler, a taped line or footprints, a level. Instructions: The child is asked to lift his/her arm up like this. „Stretch out your fingers, make a fist, and reach forward as far as you can without moving your feet." 3 trials average results. (Picture 9)

4 points - can reach forward confidently >10 inches (25,4 cm)

3 points - can reach forward >5 inches, safely (12,7 cm)

2 points - can reach forward >2 inches, safely (5,08 cm)

1 point - reaches forward but needs supervision (spotting)

0 point - loses balance while trying, requires external support

_____total test score

Picture 9 Reaching forward with outstretched arm while standing

Dynamic balance tests

1. **One-leg hop test**

Hopping on one leg as many times as the child could without stopping between hops and then to repeat the exercise on the other leg. The best measurement out of three is documented for each leg. The result can be compared to what is expected at a given age (Yanovich&Bar-Shalom, 2022).

2. **Tandem Gait (Heel-to-Toe)**

Walking in a straight line with the front foot placed such that its heel touches the toe of the standing foot (without shoes). 3 meters of tape is used for the line. Counted as mistake: stepping off the line, losing balance, not stepping close to the toes with the heel. Best of 3 trials. Quality of performance is assessed. The result can be compared to what is expected at a given age (Howell et al., 2019). (Picture 10)

Picture 10 Tandem Gait (Heel-to-Toe) - heel touches the toe of the standing foot

3. **Tandem Walk**

Walking along a 2-m length balance beam (8 cm width), starting with the dominant foot. Participant can wear comfortable shoes. Walking speed is self-selected, but time is measured. 1. Step on to the balance beam; 2. walk along the balance beam; 3. step off, turn around, step back onto the balance beam; 4. return back to the original position - recorded in seconds. Task failure: stepping off the beam during the trial. Best of 3 trials. Quality of performance is assessed (Hill et al., 2019).

There are many ways of approaching the assessment of the skills under investigation. It is important that the tests are preceded by a detailed interview with the parent/caregiver about the child's history in order to assess the current situation. Asking parents/caregivers or using a questionnaire about the child's daily activities is an important additional piece of information for planning therapy. The tests are short and can be administered quickly but, as mentioned before, there should be an opportunity to try out the test situations beforehand. It is worth allowing a break/free play time between test groups, or even between two sessions, to ensure relevant results. In the tests presented, the quality of the implementation was the main focus.

Developmental Coordination Disorder Questionnaire 2007 (DCDQ'07) can be used as a parental questionnaire. The DCDQ '07 measures three distinct factors: (1) 'Control during movement', which includes items related to the motor control of the child while performing a motor task (e.g., 'Your child hits an approaching ball or birdie with a bat or racquet accurately'); (2) items concerning 'fine motor and writing' (e.g., 'Your child's printing or writing or drawing in class is fast enough to keep up with the rest of the children in the class's); and (3) 'general coordination', which includes items about sports, clumsiness, fatigue and learning new motor tasks (e.g., 'Your child is quick and competent in tidying up, putting on shoes, tying shoes, dressing, etc.'). The three-factor scores alone do not provide any indication of the presence or absence of DCD, but the questionnaire provides support for the identification of difficulties in motor skills exhibited by the child (Rivard et al., 2014).

When completing the DCDQ'07 coordination questionnaire, after recording the general data, the parent/guardian's task is to compare their child's coordination with the abilities of other children of the same age. For the 15 statements, they are asked to circle the number that best describes their child. The 5 choices are: (1) „Not at all like your child", (2) „A bit like your child", (3) „Moderately like your child", (4) Quite a bit like your child, (5) „Extremely like your child".

After the assessment of the statements is completed, the score sheet follows, on which the total score can be calculated based on the points assigned to the categories of „Control during movement", „Fine motor/handwriting" and „General coordination". This can then be evaluated by the examiner according to age bands (5 years - 7 years 11 months; 8 years - 9 years 11 months; 10 years - 15 years). In the age range between 5 years and 7 years 11 months, between 15-46 points, DCD exists or is suspected, and between 47-75 points, DCD probably does not exist. (All other information can be found at the link: https://www.dcdq.ca/uploads/pdf/DCDQAdmin-Scoring-02-20-2012.pdf (URL 2))

2.4.2 Other test options and assessment tools

Many tests and test packages (assessment tools) are available for testing and evaluating children's motor skills. In the following, options will be presented, most of which are not available for free, but may be suitable for multi-aspect evaluation of abilities. In addition, questionnaires are available that approach the child's everyday functional activity and movement performance from the perspective of parents, teachers and/or therapists, thus collecting information on factors that limit activity (Dannemiller et al., 2020).

The *Original Movement Assessment Battery for Children (MABC)* was developed for children aged 4–12 years. The new and validated version has been standardized to identify impairments in motor performance of children and adolescents aged 3–16 years. The tasks and the normative samples are also designed for three age groups (3–6, 7–10, and 11–16 years). The tasks are about manual dexterity, ball skills, and balance. The assessment tool includes a 60-question checklist as well. It requires a parent or teacher to judge qualitatively how movement skills are performed by the child in natural contexts. According to the results, the professional decides whether the child should be assessed using the complete MABC-2 or not. The checklist also has a version where the items are reduced to 30 (Staples et al., 2012; Brown&Lalor, 2009).

The *Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2)* is a test using goal-directed activities to measure motor skills, fine and gross motor skills (motor skill efficiency) in individuals ages from 4 to 21 years. The BOT-2 highlights motor performance in the functional areas of stability, mobility, strength, coordination, and object manipulation. This test has a broad application in physical therapy. It can be used to monitor motor efficiency and can help in decision-making in order to adapt different programs for children. The short form of the test includes fourteen subtests for the assessment of fine motor precision and integration, bilateral coordination, balance, running speed, agility, upper body coordination, and strength (Deitz et al., 2007; URL 3).

The *Peabody Developmental Motor Scales, Third Edition (PDMS-3)* is an early childhood motor assessment and development program focusing on gross and fine motor skills. This tool measures interrelated motor abilities that develop early in life. It was designed to assess skills in children from birth to 5 years of age. Tests include the assessment of body control, body transport, object control, hand manipulation, eye-hand coordination, and physical fitness as a supplemental subtest (URL 4).

The *Test of Gross Motor Development (TGMD)* is a developmental framework for the examination of the performance of twelve fundamental movement skills which are necessary for successful presence in physical education and play in playgrounds. These include locomotor skills such as running, galloping, hopping, sliding, leaping, jumping and object control skills like striking and kicking a stationary ball, dribbling, catching, throwing and rolling. Therefore coordinated movements and the ability to play with and/or manipulate balls is assessed. This measuring system is created for children aged 3 to 10 years 11 months (Staples et al., 2012).

The *Körperkoordinations Test für Kinder (KTK test; Coordination Test for Children)* measures the dynamic coordination and motor control of the body. It can be used for normal developing children as well as for children with brain damage, behavioural issues and learning difficulties. The test focuses on the presence of motor deficits, and includes the analysis of balance, laterality, rhythm, speed, and agility. Four tasks are assessed: balance (in forward and backward paths); coordination of the lower limbs and their dynamic power (hopping on one leg over an obstacle); speed of execution with alternating jumps (jumping laterally); laterality and space–time structure (shifting platforms). The test is designed for analysis of motor coordination of children between ages of 5 to 14 years (Scordella et al., 2015; Biino et al., 2022).

Ages & Stages Questionnaires®, Third Edition (ASQ®-3) is a screening tool created for use by early educators and health care professionals. It assesses fine and gross motor skills, communication, problem solving, and personal-social aspects of development. It is designed to follow up the developmental progress in children between the ages of one month to 5 ½ years. This tool relies on parents as experts, as it is based on the parents' own observations of their child (Kendall et al., 2019; URL 5).

The *DCDDaily-Q* is a parental questionnaire, created for the investigation of specific Activities of Daily Living (ADL) difficulties in children with Developmental Coordination Disorder (DCD). The questionnaire assesses “self-care and self-maintenance,” “productivity and school” and “leisure and play”. The DCDDaily-Q is an addition to the DCDDaily which is a measuring tool with which professionals are enabled to assess children’s capacity in ADL in an objective way. The DCDDaily-Q has been designed for children age 5 to 8 years at risk for DCD (URL 6).

The use of *sensor-enhanced toys* has many advantages in the signal of children's fine motor development problems. A sensor-augmented toy can measure the smoothness of movements made with the toy or the accuracy how the game was played therefore these toys are suitable for indicating fine motor development problems in children (Brons et al., 2021).

2.4.3 Additional tests to assess muscle strength and endurance

In order to fully rule out the possibility of the developmental coordination disorder (DCD), it is also necessary to perform muscle strength and endurance tests in children.

Developmental coordination disorder (DCD) is a common neurodevelopmental disorder associated with difficulty learning gross or fine motor skills. As a result, academic results or functional impairment of everyday activities may be seen. The diagnosis is made only if the motor difficulties cannot be linked to a medical condition or disease, such as cerebral palsy (CP) or visual impairment, but the individual has low scores on standardized motor tests and motor problems for early development are in your medical history (Blank et al., 2019). Some test options related to measuring endurance and muscle strength can be found below.

The *six-minute walk test (6MWT)* is a simple assessment tool to quantify functional exercise capacity. The technical requirements of the test are low. Children and adolescents from 3 to 18 years can also be tested by this self-paced assessment tool. The task is to walk as fast as possible without running on a flat surface in 6 minutes. The distance walked is measured and recorded (ATS, 2002; Dannemiller et al., 2020).

During *Reduced Cooper test*, the child runs or walks around a measured, marked rectangle for 6 minutes. The distance covered in meters during the given time is recorded (Fjørtoft et al., 2011).

The *Muscle Power Sprint Test (MPST)* is a field test for evaluating anaerobic performance in children and adolescents (6-12 years) capable of walking, running, or self-propelling a wheelchair. It is commonly used with typically developing children and adolescents, as well as children with Developmental Coordination Disorder (DCD). The test involves an anaerobic field test consisting of six timed 15-meter sprints, with 10 seconds of recovery between each sprint (Verschuren et al., 2007; Dannemiller et al., 2020).

Standing broad jump (SBJ) is a valid field-based test used to evaluate the explosive strength of the lower limbs and physical fitness. Participants perform the test on a hard surface, jumping as far as possible from a standing position with feet parallel, using a free-arm swing, and must land with both feet together. The test is conducted three times with five-minute rest intervals, and the best score, measured in centimetres from the starting line to the nearest heel, is recorded (Thomas et al., 2020).

The *Functional Strength Measurement (FSM)* can be used for ages 4-10. This is a test for functional strength which includes eight items including muscle power (overarm and underarm throwing, standing long jump, chest pass) and muscle endurance (lateral step-up, sit to stand, lifting a box and stair climbing). It is not only a reliable assessment tool for typically developing children but can also be used for children with mild motor problems (Aertssen et al., 2016; Dannemiller et al., 2020).

Hand-held dynamometry (HHD) is frequently used for muscle strength testing, offering a reliable and objective method that is not gravity-dependent in its interpretation. The device can be used by children and adolescents aged 4-17 years (van den Beld et al., 2006; Dannemiller et al., 2020).

The *Sensory Organization Test (SOT)* is an objective test to identify dysfunctions in the visual, vestibular, and somatosensory systems by requiring reliance on one sensory input, such as

the vestibular system, to maintain postural control. During testing other inputs like vision and somatosensation are isolated. This test measures overall balance and the use of specific sensory inputs through posturography (Sinno et al., 2022; Dannemiller et al., 2020).

2.4.4 Other aspects to consider – Persistence of primitive reflexes

In order to get a full picture of the child's condition, it is necessary to carry out other tests or analyse the results of these tests. Primitive reflexes play a developmental role preparing the newborn for movement against gravity and leading to voluntary movement in the first months of life.

Primitive reflexes are involuntary motor responses originating in the brainstem. These are present for relatively short period of time after birth, but facilitate survival. These reflexes - which are actually central nervous system motor responses - are inhibited by 4 to 6 months of age as the brain matures. These mass movements are replaced by voluntary motor activities but may return in case of neurological disease. The Asymmetrical Tonic Neck Reflex (ATNR), Symmetrical Tonic Neck Reflex (STNR) and Tonic Labyrinthine Reflex (TLR) influence the functioning of the vestibular system, moreover these affect its interaction with other position and motion sensors (Modrell & Tadi, 2023; Sohn et al., 2011; Mestre & Lang, 2010; Blythe, 2014; Berg, 2014).

Children and also adults who have residual primitive reflexes (not inhibited in the right time) and/or under-developed postural reactions can have symptoms such as behavioural disorders, specific learning difficulties, under-achievement and anxiety states. These can also appear within the family and at school, in higher education. Balance - as mentioned before - requires the cooperation between proprioception, vestibular functioning, mechanoreceptors and vision, and a function of cerebellum. The vestibular system informs the brain where the head (the point of reference) is in the context of the external environment. The proprioceptive system informs the brain where the head is in relation to the rest of the body and to its supporting base. The brain understands where the body is in relation to its structural support. With this information the brain can place of the head and body in relationship to itself and the external environment. Abnormal primitive reflexes can show the lack of integration in the functioning of these systems, which are crucial in the sensation of position and stability in space. Problems can occur in control of balance in the field of postural control, coordination, control of eye movements (problems in visual perception); perception issues (in the sensation of direction and disorientation), vegetative symptoms (e.g. dizziness) and psychological signs such as anxiety and fear may be present (Blythe, 2014). Table 2 shows the most important primitive reflexes which can affect balance and coordination skills.

Table 5: Description of the effects of the primitive reflexes that most affect balance and coordination (self-edited based on Blythe, 2014; Blythe, 2015)

Reflex	Role after birth	Consequences of residual reflexes
Asymmetrical Tonic Neck Reflex (ATNR) • **inhibited between four and six months (postnatal)**	• part in spontaneous movements • developing ipsilateral movements • pre-conscious factor in training hand–eye coordination	Can interfere with the development of motor abilities: • rolling over, commando-style crawling, control of upright balance when the head is turned to one side, the ability to cross the midline of the body when the head is turned to the affected side, lateral eye movements and hand–eye coordination • activities which involve crossing the midline - writing position • mixed laterality
Symmetrical Tonic Neck Reflex (STNR) • **present for a few days at birth, re-emerges between five and eight months (for a few weeks)**	• helping to defy gravity • learning to push up on to hands and knees in preparation for crawling • pulling to standing at the side of an item of furniture	Can interfere: • with the next developmental stages of crawling, sitting and standing posture • hand–eye coordination In school: • problems in sitting posture when writing
Tonic Labyrinthine Reflex (TLR) • **forward: inhibited circa at four months of age (postnatal)** • **backward: inhibited between six weeks and three years**	• reaction to gravity - recedes as head control, muscle tone and postural control develop • affects muscle tone in the whole body	• problems with posture, muscle tone, balance, coordination and control of the eye movements needed for reading, writing, copying and mathematics, can affect spatial skills
Moro reflex • **inhibited between two and four months (postnatal)**	• sympathetic nervous system activation	• over-react and hyper-sensitive to specific stimuli • over-reactive startle response and increased propensity to anxiety

	• poor balance and coordination • problems with visual perception

Properly tested primitive reflexes can contribute to improved early psychomotor development in children in need, thus preventing many of the difficulties that children may encounter in their social and school lives.

More information about primitive reflexes, their examination and integration program are available in the literature of The Institute for Neuro-physiological Psychology (INPP) (Blythe, 2014; Blythe, 2015).

2.4.5 Red flags – warning signs of developmental delays

In the following, symptoms and signs of suspicion are mentioned that are cause for concern and may attract the attention of parents or professionals regarding the development of preschool children. These signs may predict delays in motor development and may indicate the performance of specific tests, further monitoring or the involvement of several specialists.

At age 4, warning signs include delays in gross motor skills such as being unable to balance on one foot even for a short time, inability to jump in place even with both feet, inability to run, pedal a tricycle, catch, throw, or kick a ball. The child may only descend stairs by crawling or with assistance. In terms of fine motor skills, the child cannot draw lines, circles, or people, does not like to draw, holds a pencil with a fist grip instead of between fingers. The child has difficulty turning pages and does not prefer playing with small objects.

At age 5, signs include poor balance, clumsiness in walking, running, climbing, and descending stairs, only able to descend with support or assistance, unable to stand on one foot even briefly or to jump repeatedly. The child does not jump or hop. He/she has significantly different ball skills compared to peers. The child is very clumsy, and is afraid of heights, unable to climb down from playground equipment. Fine motor skills are also delayed, with the child unable to draw simple Pictures like stick people, squares, or crosses, and generally dislikes drawing, still holding the pencil with a fist grip. The child does not eat or dress independently, does not play with small objects, and lacks dexterity.

At age 6, warning signs include the inability to stand on one foot even briefly with eyes open, unable to descend stairs or slopes without holding on or assistance, not jumping or hopping. The child is clumsy and does not enjoy sports or active games (e.g., hide and seek, dodgeball, tag). He/she has poor ball handling skills, cannot hit a target from 1 meter, cannot throw an object farther than 1 meter, and cannot catch a large ball. Fine motor skills are lacking, with difficulties in drawing, an inadequate pencil grip, and a continued lack of interest in small toys, with poor hand dexterity. The child has not developed lateralization.

At age 7, in addition to the previous factors, the child cannot climb anything, is overall clumsy with poor coordination and "jerky" movements, and is unable to learn dynamic activities like cycling. Fine motor skills are underdeveloped, with poor drawing abilities, disinterest in drawing, an immature pencil grip, and significantly déledé Picture drawing for their age. The child has not developed lateralization, and finger dexterity is poor, showing insufficient development.

At any stage: the child does not reach the indicated developmental milestones, loses skills significantly, response to sound or visual stimuli is incomplete or absent, there is a difference between the right and left sides of the body in muscle strength, movement or muscle tone (loose and floppy - low muscle tone; stiff and tense - high muscle tone) (Scharf et al., 2016; URL 7; URL 8).

2.5 Movement and skill development program

When motor development is delayed, therapy can be most effective if it is personalized, with sessions planned to the individual's pace of development, conducted daily, and continuously adjusted for proper execution of exercises.

Movement development exercises can be beneficial not only for children with varying abilities but also for typically developing children, promoting additional developmental progress. For children lagging behind, timely intervention can reduce or sometimes eliminate the severity of problems (Király&Szakály, 2011).

Movement development is the process of the formation and development of different forms of movement, movement skills, the conditional skills and coordination skills necessary for their execution. The purpose of the development program is to decrease difficulties arising from the immaturity of the nervous system, improve fine and gross motor skills, develop movement coordination and balance, strengthen basic skills, stimulate learning processes, promote emotional life and increase self-confidence. Therapy also plays a role in improving spatial orientation, cross-movements, body schema, and stabilizing lateral dominance. Ideally, these elements are included in preschool and school physical education (Király & Szakály, 2011).

The two pillars of movement development are the targeted compilation of movement tasks and their daily practice. The body takes in the information, as a result of which the different brain areas are activated and integrated, and we give an adaptive response to the environmental stimuli. Controlling the movement of body parts and staying in balance is a constantly developing skill for children. It is extremely important to develop proper movement coordination, movement safety and balance, as all later learning abilities are based on these skills (Gerebenné et al., 2021). Skill in movement – as mentioned before - means that you perform the given movement challenge or task expediently, efficiently, and smoothly. Dexterity can usually be interpreted in natural movements (Boronyai et al., 2015). Movement therapy often works with tools that help to strengthen the awareness of body parts, and the discrimination skill of the body surface can be developed by involving different materials and increasing sensory stimulation. Such supplies can be, for example, textiles, shawls, scarves,

blankets, ropes, balls made of different materials and of different sizes, elastic bands, pillows, etc., which are used for various movement purposes (Papp, 2020). During proprioceptive training, the basic task is to develop static and dynamic balance, building up the therapy from simpler exercises to more complex tasks, increasing the complexity of the exercises by increasing the speed of execution of the tasks, and additionally increasing the complexity of the exercise sequence by removing visual control and increasing the frequency of dynamic tasks (Sziliné & Gerencsér, 2005). Among the very successful methods in the development of children are obstacle courses, since this procedure directly affects and improves perception. After the movement experiences, the child is able to gain experiences about both his own body and his environment. The obstacle course can take place indoors or outdoors, and it is possible to create courses with various layouts built from different gymnastic equipment. During the tasks, the children perform planned and organized movement exercises, and they can gain many tactile experiences of their body, which helps to recognize cause-and-effect relationships, the development of imagination and anticipation, and affects the development of thinking and speaking. The development of the body schema is essential in the movement development of preschool children. It means the adaptation of the movement of the muscles to gravity and the balance of the body. The development of the vestibular system determines the quality of movement learning (Gerebenné et al., 2021).

The kindergarten period is also a great challenge for children. During this time, they have to learn how to tie their shoelaces, how to put on and take off their clothes, how to use cutlery and eat independently. There are good games that can develop children's fine motor skills, such as building with blocks/cubes or playing with puzzles (Tóth, 2017).

The following methods, some of which are specific to Hungary, are aimed at supporting motor development and enhancing the nervous system through movement. Their goal is the complex development, the strengthening of neural pathways, and the support of the child's functional presence in everyday life.

1. *Vojta Method:* It is a diagnostic and therapeutic system based on the fact that movement patterns are genetically coded in the central nervous system. It is a therapeutic approach based on neurophysiological principles of motor and postural control. The therapy uses tactile and proprioceptive sensory stimulation to activate innate movement complexes in humans, called "innate patterns" (Reflex locomotion - reflex crawling and reflex rotation). It aims to develop strength, coordination, muscle tone and function (Sánchez-González et al., 2024; Király&Szakály, 2011; Blythe, 2014).

2. *Ayres Therapy - Ayres Sensory Integration (ASI):* Originally developed to address learning disabilities, this method is effective for various childhood developmental issues by providing varied sensory stimuli. Sensory integration theory emphasizes the active, dynamic sensorimotor processes that support movement and interaction in social and physical environments and act as catalysts for development. It involves activities that offer tactile, proprioceptive, and vestibular stimulation (Lane et al., 2019; Király&Szakály, 2011; Blythe, 2014).

3. *Institute for Neuro-Physiological Psychology - INPP Therapy (Goddard Method):* It provides a unique system for assessing and treating signs of neuromotor immaturity in both children and adults. The INPP program integrates the remaining reflexes in a number of different ways depending on the condition of the person being treated. The exercises are based on the movements performed by normally developing babies in their first year of life (Blythe, 2014).

4. *Neuromotor Task Training (NTT):* Neuromotor task training is an activity-oriented approach specifically developed for children with DCD to facilitate participation in everyday situations. NTT is based on the principles of motor control and motor learning, but also takes into account motor teaching and motivational principles. Each activity or task has a specific purpose that involves physical movement (e.g. skipping rope, throwing, tying shoelaces, writing, etc.) and can usually be learned and refined with practice. The ultimate goal of the treatment is not only to improve the performance of functional tasks during the treatment, but also to transfer the learned skills to everyday life performance (Schoemaker et al., 2003; Smits-Engelsman& Verbecque, 2022).

5. *A combination of virtual reality and physical activity - Action Video Game (AVG):* AVG can provide a rich practice environment, resulting in prolonged, intensive practice, which can help solve many motor control problems in a fun way. Tasks in virtual environments can enhance motor skill learning by integrating multiple sensory processes such as proprioceptive, visual, auditory, and vestibular information into cognitive processes. Visualizing the body's movements on a screen can aid performance in balance tasks. Children receive immediate, safe feedback through the screen (Smits-Engelsman& Verbecque, 2022).

6. *Dévény Method (Dévény Special Manual Technique, DSGM):* the essence of the manual technique is the treatment started at an early age, which restores normal movement and movement development. The principle of the method is to ensure a direct effect on the nervous system and to restore the pathological condition of muscles and tendons. The goal of the gymnastics method, which uses individual gymnastics and musical group sessions, is to develop conscious, precise, expedient and harmonious movement (URL 9; URL 10; Király&Szakály, 2011).

7. *Basic Therapy*: it is a complex therapy that develops the nervous system, which is based on the development of movement. Its goal is to "restart" the sequence of human developmental movements, thereby developing movement skills. The development can start at the age of 5 (from age 5 to 16 years), as this method requires a sense of responsibility and commitment. It was developed in Hungary based on the Delacato method (Marton Dévényi et al., 2002; URL 11).

8. *BHRG Model - Budapest Hydrotherapy Rehabilitation Gymnastics:* This model includes HRG (Hydrotherapy Rehabilitation Gymnastics) for water-based development and TSMT (Planned Sensorimotor Training) for land-based exercises. The first is a complex movement development program carried out in water, which has a beneficial effect on

physical and psychological functions. TSMT is a movement development procedure aimed at sensory integration, which is used in children aged 0.5-12 years who have delayed movement development, who are characterized by muscle tone problems, poor movement coordination, impaired speech skills, behavioral disorders, and poor fine motor skills. Its purpose is to improve the maturation processes of the nervous system, to achieve the motor, psychological, cognitive and social performance level expected at a given age. (URL 12; Király&Szakály, 2011).

2.6 Communication

In this part of the lesson, you will learn how to communicate with an anxious and distrustful 5-year-old child and his mother, and what cultural and communication rules should be applied in such a case.

Healthcare professionals face a variety of communication problems when communicating with patients of different ages. Communicating with an elderly person, a teenager or a young child, even an infant, has completely different characteristics and difficulties. The purpose of this lesson is to show what can make it difficult and what can help when communicating with children - especially an anxious and distrustful 5-year-old and his mother.

Communication between the physiotherapist and the patient is one of the most important elements of the healthcare process*. In addition to providing correct information, effective physiotherapist-patient communication means providing encouragement and support, thereby increasing the patient's confidence, motivation and self-efficacy* - whether the patient is an adult or a child. Patients' positive (self-)assessment of their health status can influence their future development.

When it comes to communicating with children, promoting appropriate communication is an essential element of creating a healthcare culture that cares for and focuses on patients and their needs. Information should be provided in a clear and age-appropriate manner, enabling children and their families to be competent partners in the consultation process.

Communication with the child should be

- **open and complete**, in accordance with the needs and developmental characteristics of children
- **based on dignity and respect** (the physiotherapist listens to the patient and takes into account his or her cultural background, beliefs and preferences when developing the health plan)
- **participatory** - both the child and parents/carers are encouraged to take part in the assessment and decision-making process

- **collaborative** - physiotherapists, patients and their families work together for high quality performance and efficiency (Kolucki & Lemish, 2011)

The specific topics that we look at for communication development are:

- understanding the psychological and cognitive development of a child of a certain age
- what are the difficulties in communicating with children? (e.g. understanding emotions affecting the care of children, involving the child in treatment, etc.)
- child-parent-physiotherapist triad (video 4)
- what can help communication with the child? (e.g. preliminary preparation of the child, creation of a child-friendly environment, contact, method of taking anamnesis, use of age-appropriate communication techniques that can be used during the examination) (videos 1 and 2)
- specifics of informing the child, involving the child in his own treatment
- the importance and method of praise (video 3)

Characteristics of psychological and cognitive development in preschool children

Children have different characteristics depending on their age. There are many different approaches to describing these characteristics. In order to be able to communicate with a child of a certain age in the most appropriate way, we need to know what his average developmental characteristics are: how he thinks, what his cognitive functions are, how he relates to the social environment, what is important in terms of his personality development. In the following description, there are things that come to the fore in the characterisation of a pre-school child that are definitely worth remembering and keeping in mind as a physiotherapist during an examination or treatment. After the general description, we will look at the individual elements in detail:

During the pre-school years, the child continues to develop, becoming more independent and open to the world. Emotions play an important role in the life of a preschool child, influencing all his or her behaviour and actions. In everyday life, this process can be characterised as "choosing with the heart". Among the cognitive processes, imagination and fantasy play a prominent role, with the help of which he tries to explain things that are unknown to him. His strong love of fairy tales is also related to his emotions and imagination.

The preschooler is most likely to pay attention to and remember what is emotionally engaging and intriguing. He will mainly remember things with a very positive or very negative emotional charge. His characteristic is involuntary attention and memory. Motivation plays an important role in the activities of preschool children.

His main form of activity is play, in which he likes to imitate adults, in his play he tries to participate independently in their lives and activities, he tries to have the experiences that appeal to him in the behaviour of adults.

1. Development of the movement and the nervous system

The preschooler's need for movement and action is great, and the adult must satisfy this need by giving the child the opportunity to practise different forms of movement, according to his age and in the greatest possible safety. The child's movement is constantly enriched and becomes more and more varied thanks to the many activities and games.

As a result of **the intensive development of the pre-school child's nervous system**, he learns quickly, but in order to retain the knowledge, he needs a lot of repetition and practice. The plasticity of the nervous system (malleability, formability, flexibility) is great. The formation of conditional nerve connections is fast, short and effective. Among the processes of the nervous system, stimulation predominates over inhibition, which explains the high need for movement in children of this age. In the middle of the life stage, in parallel with the continuous maturation of the nervous system, stimulation and inhibition balance each other out and children become more and more calm and serene.

2. Perception and cognition

Among the perceptual processes of pre-school children, **visual perception** plays the most important role. At the beginning of the period, *emotional syncretism* (emphasis on an emotional basis) is characteristic of the perception of shape and form. At the end of the period, this changes into *intellectual syncretism*, i.e. while at the beginning he observes that detail, often an insignificant feature of the observed object, which for some reason has captured him emotionally, his later observation becomes more conscious, more purposeful, more planned, he no longer emphasises what is interesting to him, but what he considers logical and important.

The development of **spatial perception** depends on the development of the body schema. The body schema is the knowledge of the *spatial relations* between the organism and its environment, as well as between the organism and its parts, the information derived from these is called organization into perceptual schemes.

As a result of a long learning process, he becomes visually and kinaesthetically aware of how he fills the space with his own body and experiences its limits. The quality of reading and writing plays a decisive role in learning to read and write at school.

A preschool child's **sense of time** is initially underdeveloped. They are already aware of the concept of "now", but the expressions "yesterday", "tomorrow", "later", etc. are not yet clear to them. This begins to crystallise towards the end of the age group - around the age of 6.

3. Attention and memory

Preschool children – at about 3-4 years old - are characterised by involuntary attention in small groups. He/she is *able to pay attention to what has captured him emotionally*, what has aroused his interest sufficiently, so it is important for the adult to provide motivation and an emotional base. A preschooler's attention tends *to fluctuate* (wander) and be distracted. Therefore, it is not enough to motivate him once during an activity, but to keep his attention with more and more "favours". *By the end of this stage (5-6 years), his /her attention becomes more sustained.*

In preschool age, the child's attention often *wanders (gets stuck)* on one or another thing or event that has occupied him emotionally, so it is more difficult for him to switch to something else to observe, so his division of attention is weak at first. Outward signs of focused attention: dilated pupils, rigid posture, open lips. *Involuntary attention* turns into *conscious attention* when the child recognises the interest of the observed object and intellectualises it.

Similar to attention, memory is also characterised by spontaneity, involuntary, i.e. his memory images are recorded involuntarily, he mainly records things and stories that capture him emotionally. From the age of five, the involuntary memory is replaced by a **deliberate memory,** he concentrates consciously and deliberately and tries to remember things. The same qualitative change means that, in addition to his mechanical memory, his logical memory plays an increasingly important role, i.e. he interprets the things to be remembered, which makes his memory more efficient. The preschooler's memory is not reliable, its development is embedded in the process of learning active language. In preschool, memory can be much more effective if it is linked to action. If you can manipulate and play with an object, you can remember it better than if you just hear its name. Memory activity is more effective in a game situation than in a direct task situation.

4. Imagination

Imaginative activity is a unique way of processing reality. The brain rearranges the previously collected experiences stored in memory in a special way. Although a child's imagination is not more developed than an adult's - they have less experience, knowledge and memories, so they have fewer elements to build on - their imagination often seems richer because the child is able to make up for their incomplete knowledge, bring their unrealisable wishes to life and mobilise their imagination much more bravely and courageously than an adult. Although they have less experience and memory, they use their limited knowledge much more courageously than adults who cling to reality. The preschool years are characterised by **fantasy lies** used to satisfy desires or to make up for incomplete knowledge. This is not done deliberately or consciously, because the child believes the lie, which is divorced from reality.

5. Development of thinking

For preschoolers, the thinking process begins with the emergence of a need, aspiration and desire to solve a practical task or get out of a problem situation. A problem situation arises when the child wants to achieve a goal but does not know or only partially knows the way to the solution.

At this stage of life, thinking cannot be studied alone, but only through the complex system of all cognitive activity, because *thinking is not yet an independent mental activity*. As the years go by, a serious qualitative change can be observed in the thinking of 3-6 year olds. From **active-perspective thinking**, it gradually moves to the level of **visual-imaginative thinking** and finally to the level of abstract language. This means that a preschooler at the level of active-perspective thinking understands only the problem situation that is linked to action and perspective, i.e. he can act and observe the given problem situation himself. For example, does the larger red cube fit into the smaller green cube? This will only become clear to him if he can try it out, i.e. if he acts and listens and observes.

At the level of **visual-imaginative thinking**, there is no longer any need for specific manipulation, it is enough to see the problem situation and carry out the solution in your mind. In this case, even without a practical test, you can see which is the smaller cube and which fits into the other.

The child's thinking becomes more effective as his language develops. The more he can process everything verbally, the more he goes beyond the action-perspective and visual-imaginary levels of thinking. This is how you get to **abstract linguistic thinking**, where you don't even need visuals or illustrations to solve a problem. At this point he does everything in his head.

(Lightfoot, Cole & Cole, 2018; Leman, 2019; Keil, 2013; Thavakugathasalingam, 2022).

The Swiss psychologist Jean Piaget (1896-1980) has written the most comprehensive and influential description of children's intellectual development. The basic theme of his theory is development as a series of successive qualitative changes. In his view, intellectual development takes place in several successive stages, the beginning and end of which may change, but the sequence of which is constant. In Piaget's stages, cognitive abilities are formed relatively independently of the environment, as a result of internal maturation, and they reach the form characteristic of adults through active experience.

He divides intellectual development into four main stages and several sub-stages. The main stages are *the sensorimotor stage (0-2 years), the pre-operational stage (2-6 years), the concrete operations stage (6-12 years) and the formal operations stage (12-18 years).*

The typical pre-school stage is the **pre-operational stage**. Piaget says that the pre-school child's thinking is egocentric, he cannot take other people's points of view, he is not able to decentre, he is not able to change mental perspective, it is difficult for him to learn relationships, he does not yet have invariance. More specifically, all this means that symbolic operations

develop in the second year of life. The child begins to speak, objects and words can symbolise another object. Internal images appear and postural intuitive thinking becomes characteristic. The child is mentally unable to separate itself from what is available to its senses, its available experiences divert its thinking. For example, if we pour water from a high, thin glass into a low, thick glass, an adult knows that the amount of water has not changed (*principle of conservation*) and that the same amount of water could be poured back, whereas the child believes that the amount of water has decreased. According to Piaget, in a **conservation process**, the child is unable to take into account more than one of the quantities characterising an object at the same time (*one-dimensional thinking*), i.e. he takes one or the other as a basis, because he does not yet recognise the reversibility of action and thought sequences, i.e. he is not yet able to use the logical operations essential to thinking. For example, if a pile of money is placed in a straight line, the child believes that there are more discs in it than in the pile, because he only takes into account the most characteristic size for him, the length. This is one of the basic features of the pre-operational phase. (Figure1)

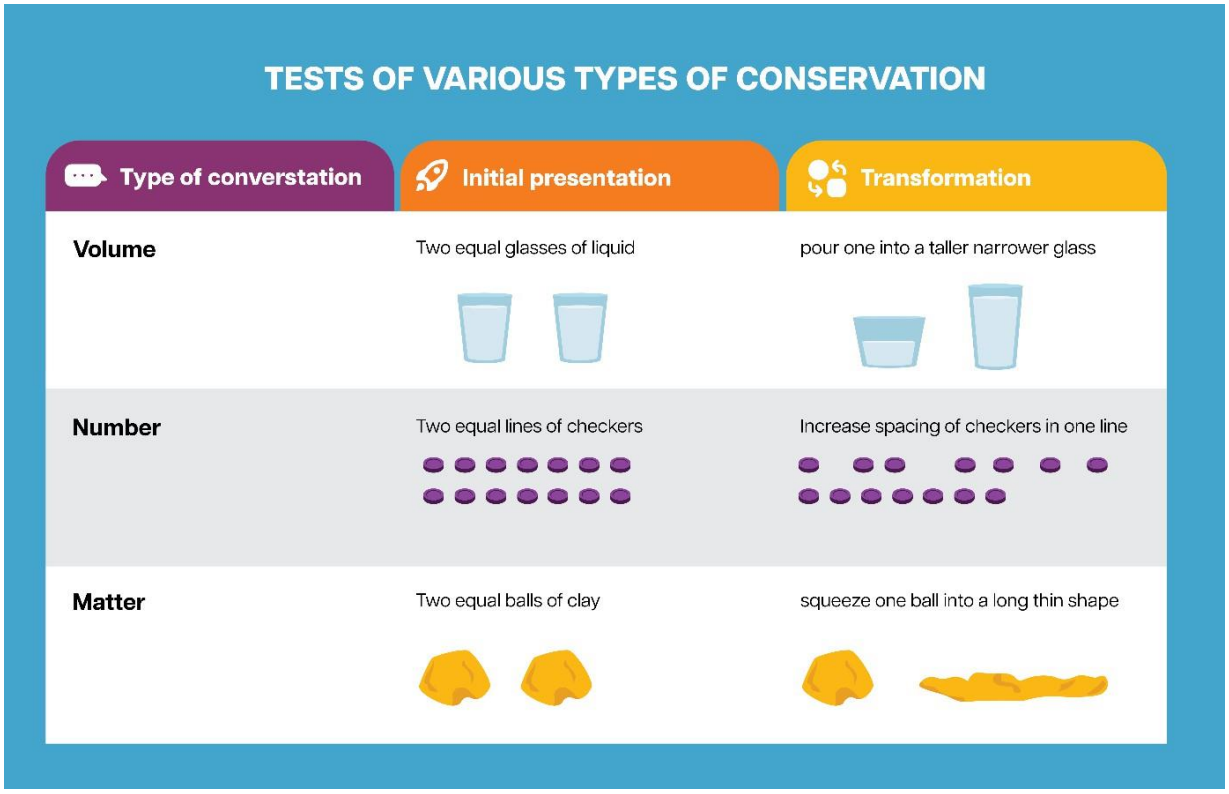


Figure 1 Conservation (source: Preoperational Stage: Definition & Examples (simplypsychology.org))

The other is **egocentrism**, that is, a kind of self-centeredness; the child is not able to imagine more than one point of view of a situation, and this only point of view is his own point of view (he thinks that everyone thinks the way he does; everyone sees and feels what he does). (Figure 2)

Figure 2 Egocentrism (source aka pastor guy Three Mountains and the Echo Chambers We Live In (jphdenis.com))

Difficulty distinguishing between **appearance and reality**: not knowing what objective reality is and what is 'as if'. **Precausal reasoning**: unable to see cause-and-effect relationships and use such reasoning. " We want to go sledding, that's why it's snowing".

At this stage, development affects not only the understanding of the physical world, but also the social world. At this stage, the child is characterised by **moral realism**, believing that morals and rules are constant, unchanging truths; for example, if he offends his parents, he will be punished immediately, even if his parents do not punish him. For the child, moral laws are just as much laws as physical laws.

(Piaget, 1966, Mooney, 2000, Parrat-Dayan, 2023)

6. Speech development

During the preschool years, the child's language activity increases by leaps and bounds. He comes into contact with countless new stimuli, activities, people, objects and knowledge that make him think and therefore speak. *Speech is the linguistic expression of thought*, so these two things develop together, in parallel, i.e. the more you speak and communicate, the more you mobilise and develop your thinking. At the age of small groups, situational speech is even more characteristic, and at the older preschool age, speech gradually changes into self-interpretable, connected, *so-called contextual speech*. Contextual speech develops only when the child's thinking has moved beyond the action-conceptual level, i.e. concrete action is not a prerequisite for his thinking.

Around the age of 3-4, the *"first why-era"* begins. It is characterised by an endless, uninterrupted series of questions in which one question follows another, but it happens that, for example, the fifth question has nothing to do with the first. The adult must recognise the motivation behind the questions, that the child does not want to be alone, and maintains the

communication relationship with continuous questions so that the adult cannot ignore him. This is why the phenomenon is called social why. If the child experiences rejection and never or very rarely receives answers to his questions, on the one hand he will stop asking questions (this endangers the intimacy of the parent-child relationship), and on the other hand various psychological problems may arise due to the loss of his sense of security.

7. The child's emotional development

Emotions play an important role in the life of a pre-school child, all his actions and behaviour can be influenced or approached through his emotions. At this stage, their emotions are still labile (*they can be happy and well-balanced one moment and completely desperate the next*) or polarised (*they can go from one extreme to the other extremely quickly*), but this does not mean that the child is capricious or hysterical.

The development of the preschooler's emotions is reflected in the high degree of differentiation and gradual intellectualisation of emotions. At this age, the child is characterised by a high degree of emotional irritability and low emotional stability. In comparison with childhood, the child's emotions expand, including the so-called higher emotions: intellectual, moral-social and aesthetic emotions.

8. The child's volition life

The activities of the nursery school child are characterised by voluntariness, but there are also areas of his life where he has to adapt to certain rules. There is an increase in the expression of emotions in their behaviour, which is increasingly differentiated, sustained and rich in content. He is characterised by an **increased striving for independence** and, depending on his individual characteristics, he does not tolerate help from his environment. However, the development of his abilities is not always in proportion to his aspirations, desires and ideas, so he often suffers from failure, but he is not always able to deal adequately with frustration. Either he does nothing, becoming inactive, or a defiant reaction is triggered. **Self-control** increases significantly during the preschool years, by the end of which he is able to manage his will and emotions adequately, self-motives are replaced by social motives (while at the beginning of the preschool years emotions still dominate the will, by the end of the preschool years the exclusivity of emotions ceases to be active in motivating and controlling behaviour). It is important to develop a **sense of responsibility** that prepares the child for school life. The member of the small group does not knead, play and build for the pleasure of the function, the activity itself, not for the result, but the member of the large group already strives to finish his creation. In the course of his activities, he is able to overcome increasing difficulties for the joy of completing tasks. The achievement of the game and the work goal is satisfying even without praise or other rewards, and the completion of the task itself motivates him (in longer-term activities, however, he needs to be motivated several times). The work and the purpose of the work are the source of pleasure, so they experience it as a reward in itself. **Awareness of rules.** In preschool there are defined rules, and although these rules often do not correspond to the child's interests, they nevertheless become motives for his actions, because the child wants to secure the love, recognition and praise of the adult through obedience. By repeating

these actions several times, the child becomes accustomed to them, not only automatically, but also by imagining what to do and what not to do. Later, consciousness joins the action, and the rule gradually becomes conscious. The ability to adapt to the rules becomes more and more characteristic at the age of 5-6, when he follows the rules even when they are not favourable to him.

(Lightfoot, Cole & Cole, 2018; Leman, 2019; Keil, 2013; Thavakugathasalingam, 2022).

Erikson's theory of psychosocial development

Erikson's eight-stage development model, which also includes adulthood, is called the **psychosocial development theory**, which is one of the least controversial and popular theories. Its popularity is due to the fact that it considers a person as a creative being who always develops new and new strengths during his life, who is capable of positive changes and active management of his life. At each stage of life, we experience psychosocial crises and conflicts, which need to be adequately resolved in order to enter the next stage of life. Erikson's division is based on the crises and attainable values typical of the given age. *The stage boundaries are approximate, it is not possible to tie them to the exact age, because each person progresses according to a different rhythm.* (Figure 3)

ERIKSON'S PSYCHOLOGICAL STAGES

Stages	Basic Conflict	Virtue	Description
Infancy 0-1 year	Trust vs. mistrust	Hope	Trust (or mistrust) that basic needs, such as nourishment and affection, will be met
Early childhood 1-3 years	Autonomy vs. shame/doubt	Will	Develop a sense of independence in many tasks
Play age 3-6 years	Initiative vs. guilt	Purpose	Take initiative on some activities - may develop guilt when unsuccessful or boundaries overstepped
School age 7-11 years	Industry vs. inferiority	Competence	Develop self-confidence in abilities when competent or sense of inferiority when not
Adolescence 12-18 years	Identity vs. confusion	Fidelity	Experiment with and develop identitiy and roles
Early adulthood 19-29 years	Intimicy vs. isolation	Love	Establish intimacy and relationships with others
Middle age 30-64 years	Generativity vs. stagnation	Care	Contribute to society and be part of a family
Old age 65 onward	Integrity vs. despair	Wisdom	Asses and make sense of life and meaning of contributions

Figure 3 Erikson's Stages of Development (source: Erikson's Stages of Development (simplypsychology.org))

The third stage can be assigned to the pre-school age (3-6 years) and can be interpreted in terms of the dimension of initiative or guilt. Initiative - based on autonomy - gives the child the knowledge of intention, striving, planning, where intention is built on play, fantasy, successful and less successful attempts. In this way he learns the purpose of things, learns to regulate his social relationships, in role-playing he can experience feelings that are not realistically available in the adult world, the continuity of past, present and future intentions. At this age, the child begins to separate from his environment, becomes independent and shows a great deal of initiative. They want to experience everything and initiate independent actions. If there are no obstacles and the child is given the opportunity to work independently, he or she will later become an initiator, be creative and enjoy his or her achievements. Otherwise, he will be accompanied by a constant sense of guilt, he will always be afraid that he is not doing something right, he will have doubts about his own resources.

(Erikson, 1950, Erikson, 1998, Lightfoot, Cole & Cole 2018, Mooney, 2000, Maree, 2021, Orenstein, 2022, Okunev, 2023).

What are the difficulties in communicating with children?

1. Emotions that affect caregiving

Children evoke strong emotions in most people. We usually think of them with love, we think of them as sweet, kind and happy. However, a sick child struggling with health problems evokes bad feelings: it can make adults feel sad, pitiful, frustrated or helpful. In addition, a child who is struggling with a problem and feeling bad or in pain is likely to be anxious, tense, nervous and even angry. Children may also be afraid of unfamiliar surroundings, they may be dismissive of people they do not know, and they may be particularly afraid of medical staff with whom they may have had many unpleasant experiences. For this reason, children may be dismissive and hostile towards physiotherapists.

Children can therefore generate many emotions which can affect the relationship with them, communication and even their care. Similarly, **the physiotherapist may be affected by the parents' strong concerns and expectations** about the treatment. Therefore, the physiotherapist needs to be constantly aware of his or her emotions and the impact of his or her emotions in order to avoid the possibility of making mistakes related to them, either by trivialising the problems of a child who is behaving unpleasantly, or by overtreating because of the child's anxiety or the parents' strong concern. (Pilling, 2020.)

2. Difficulties in adapting to different ages

Babies, toddlers, preschoolers and teenagers can and should be communicated to at different levels and in different ways. But this diversity is also a difficulty. According to research**, it is a common problem that medical staff/physiotherapists do not communicate with children according to their age, cognitive development and level of knowledge**. (Pilling, 2020.)

3. Using inappropriate communication methods

There are many communication methods that are sometimes used with children in the health sector, but their use is not recommended at all. Many people even **babble** to children of pre-school age, speaking to them in a voice much higher than their usual tone of voice. This patronising, contrived style of speaking is often confusing; **it would be sufficient to speak to the child in a warm tone instead.**

Other ways of communicating can be downright harmful. It is common, for example, to try to **deceive** a child before a painful examination by saying "don't be afraid, it won't hurt". **This lie fundamentally shakes the child's faith in health care workers and adults, undermines trust**, and in the future will also fear examinations that are not actually painful. **The child should never be falsely threatened with serious consequences**. If, for example, the health-care worker says, "If you don't stop crying, it will hurt more", in order to get the child's cooperation, he or she is at the same time **casting doubt on the legitimacy of the child's feelings** and causing further anxiety. Such sentences are particularly damaging. (Pilling, 2020.)

4. Lack of involvement of the child

Medical staff communicate mostly with parents, **the child is mostly excluded from communication.** An analysis was carried out in paediatric clinics to see what percentage of all verbal expressions in paediatric clinics were to/from the child. The child spoke in only 4 per cent of the time spent in verbal communication; in the research, almost two-thirds of the time the doctors dominated the conversations and almost one-third of the time the parents spoke. In thirty-six per cent of consultations, the children who could already speak did not speak at all. **Nowadays, it is more likely that the health professional will inform the child at an age-appropriate level and try to involve them in their own treatment**. (Pilling, 2020., Howells & Lopez, 2008. Pérez-Duarte Mendiola, 2024.)

5. Difficulties in the relationship with parents

The physiotherapist almost always comes into contact with the parents when examining or treating a child. Communicating with them is much more difficult for most physical therapists than communicating with the child. Parents are usually very concerned about their child, which is easy to understand, but at the same time, heightened emotions and excessive and often quite firm parental expectations can be the source of many communication difficulties. Another complicating factor is that the simultaneous presence of the child and the parents creates **a triadic relationship**, which can be the source of many communication problems (when and with whom should the specialist talk, who to ask, to whom and how to provide information)? If the physiotherapist is not able to handle these situations well, the parent will be less satisfied and will most likely not follow the therapy recommendations.

It can make communication with parents easier if we know **the types of parental behaviour** that occur when a child's health problems occur. We distinguish between the following four types of parental behaviour:

- The **supportive parent** is sympathetic and calm. He notices and acknowledges the child's experience of procedures and hospital conditions. With words they say: "I'm here with you, calm down" and with body language they say, "I know you are feeling bad or in pain right now, but I am here with you and together we will get through this".
- The **normalising parent** acts as if the hospital treatment is just a new, albeit previously unfamiliar, everyday task that can be dealt with routinely, e.g. I don't feel like brushing my teeth at home in the evening. It keeps the child busy with interesting activities, diverts his attention from procedures, pain and boredom, and at the same time greatly appreciates the child's achievements, e.g. in tolerating pain or complying with medical and nursing instructions.
- The **distant parent** (apparently) withdraws from uncomfortable situations both emotionally and physically, e.g. leaving the room when the infusion is started, or the feeding tube is inserted. In a hospital situation, he is not able to get close to his child in the usual way because he always focuses on (and suggests this pattern to his child) "what is expected,

what we have to do". This is what the literature says: "passively cooperates": he is with his child but does not take the initiative. At the same time, he actively cooperates with the medical staff and other relatives, even encouraging them. This pattern is fed by the adult experience of having to deal with situations in life alone. As a result, the parent comes across as an "external relative" rather than a close relative, suggesting: "You're in this situation, it's your job and I won't be able to be there all the time".

- The **invalidating parent** doubts and "overwrites" the authenticity of his or her child's experiences, or even if he or she acknowledges them, sees them as an educational task. They are irritated by the child's anxiety, fear of intervention, or signs of pain, or they don't respond at all, or they mock or trivialise the child's reactions. The unconscious message is: "Life is hard, don't run away, don't pretend, bear what you have to bear, just like me". Obviously, the messages of this type of parent reflect their own childhood patterns.

The impact of communication patterns:

Based on the survey, the most commonly used parenting model was supportive, followed by normalising, distancing and invalidating. Individual communication patterns also changed according to treatment phase.

Children of 'supportive' parents reported less pain than those of 'invalidating' parents but did not differ in their outcomes from those whose parents were 'distant' or 'normalising'. The worst results were obtained by the "invalidating" group. *The role of the parents is therefore crucial in the triangle, and for this reason the paediatrician must observe the parents' behaviour and try to encourage "supportive" behaviour. If there are signs of "invalidating" behaviour, it is advisable to talk to the parent separately and try to persuade them to cooperate in order to achieve a successful therapy.* (Picture 11)

Picture 11 The supportive proximity of the parent

During a longer examination, the physiotherapist must also make sure that **the child can rest and satisfy his physiological needs** if he needs it (fatigue, hunger, etc. are factors that can affect the result of the examination)

(Pilling, 2020., Wassmer et al., 2004., Howells & Lopez, 2008., Kolucki & Lemish, 2011., Pérez-Duarte Mendiola, 2024.)

The general rules of the communication

In order to provide the most effective communication strategies, it is important to understand some details about the young child and the parent/carer. Here are some questions to consider:

- Communication techniques vary depending on the child's age, developmental stage, personality and emotional state.
- Understanding specific behavioural elements that the child is currently experiencing can help to tailor communication.
- Understanding the cultural background of the parents/caregivers will make it easier to understand their cultural norms and even the reason for the child's developmental differences.
- It is always worth highlighting positive changes in behaviour and acknowledging the efforts of parents/caregivers.
- Always be aware of cultural beliefs and practices regarding discipline. If necessary, offer more culturally appropriate alternatives.
- Avoid technical terms or jargon unfamiliar to the layperson. Use clear, concise language and provide information and resources tailored to their level of understanding. Avoid overloading them with complicated theories; let's talk slowly. Pictures and demonstration tools can be useful for children, but also for adults who absorb visual information more easily. So let's try to share the information in different ways and modalities.
- Always assess the parents' knowledge of the child's developmental progress and possible delays
- Be patient and use clarifying, open-ended questions. Listen to underlying concerns and use open-ended questions to encourage elaboration.
- Provide a safe space for questions and concerns. Validate their feelings and acknowledge their role in managing the behaviour.
- Remember that effective communication requires active listening, empathy and respect for the role and feelings of parents/caregivers. By adapting your approach to the situation, you can build trust and help create a collaborative environment for dealing with the child's behaviour that is complicating the evaluation/therapy.

(Pilling, 2020., Wassmer et al., 2004., Howells & Lopez, 2008., Kolucki & Lemish, 2011., Pérez-Duarte Mendiola, 2024.)

What can help you communicate with children?

1. Preparing the child for the examination

- If possible, we ask the parents to prepare the child for the visit to the physiotherapist and the examination during the preliminary consultation. It is good if the child knows where he or she is going, what the purpose is and, in general, what will happen. Picture books about the human body, the specific problem and its treatment can help to prepare. (Pilling, 2020.)

2. Create a child-friendly environment

- Walls decorated with colourful fairy tale characters and drawings make the healthcare facility and examination room more child friendly. The dominance of blue and green colours and the preference for natural materials have a calming effect.
- As the white coat causes anxiety in many children, it is helpful if, for example, the physiotherapist wears colourful clothes, perhaps decorated with cute Pictures.
- It is important to have toys, educational materials and books for children of different ages in the waiting room and examination room. It may be useful to place these at different heights, for example on shelves, so that each child can encounter toys and tools appropriate to their age. (Pilling, 2020.) (Picture 12)

Picture 12 Child-friendly environment (source: Improve the Experience of Pediatric Therapy Patients | IDS Blog (idskids.com))

3. Establishing a relationship

- **Introduction** - greet the child by calling them by their name, preferably the name they are used to being called (e.g. "Hi, Andris") and then introduce yourself. Already at this stage it is possible to assess how the child feels about the situation and about us. (Picture 13)

Picture 13 "...and how can I call you?"

- **Following and leading** - one of the best ways to connect. The point is to enter the child's world first. Let's talk to them about it, and only when the right rapport has been established can we begin to steer the conversation in the direction that is more important to us. For example, we might start by praising her clothes or asking about the toy she is holding, and then suggest that she do what we want, such as come into the examination room with us.

- **Yes-set** - When communicating with a child, suggestive methods of communication can be particularly effective, and an anxious child may be particularly receptive to what the physiotherapist is telling them due to their emotional state. The yes-set method can be used by asking questions that are likely to be answered with a yes. For example: "Hello, is my name Andris?" "Is this your mum?" "Do you go to kindergarten?" "Did you come by tram?" and then as questions 3, 4, 5 (when we feel that we have succeeded in getting the child to say yes) there is already a question that moves the work with the child forward: "Will you come to the gym with me?"

- **Introducing the environment** - it can be very helpful if the child is first introduced to the environment. This method works well with the follow-lead method.

(Pilling, 2020.)

4. Taking an anamnesis

- **Talk to the child at eye level**. Sit at the same height as the child or crouch next to him/her. Avoid bending down, and if possible, do not talk to the child from above. (Picture 14)

Picture 14 Always speak to the child at eye level.

- **Ask the child for personal information**. For children over the age of three, we also ask the child for personal information such as name, date of birth and address. This is important for building a relationship with the child and for the child's involvement, also because of the partnership.

- **Ask simple questions**. The first questions should be sufficiently open-ended, e.g. "Tell me what happened to you? "How did you hurt your leg?"

- Always ask one thing at a time.

(Pilling, 2020.)

5. Communication during examination or treatment

- **Parental presence provides reassurance.** Infants or toddlers should be examined on the lap of the parent, young children with the parent beside them.

- **Observe non-verbal communication**. In many cases, careful observation of a child's non-verbal communication can be of diagnostic value. The child will show how serious his or her condition is, how anxious he or she is about the examination or how worried he or she is about the situation, and an attentive physiotherapist may also notice signs that are the result of changes associated with the given condition.

- **Develop cooperation by asking the child for help**. During the examination or treatment, things should not be done against the child, but preferably with his or her active participation. We do this by asking for the child's help beforehand, for example: "I want to help you so

that your feet don't hurt. I want to examine you first. Will you help me?" (Do not ask young children if we can examine them, as they will probably say no).

- **Double-bind**. We give the child two alternatives, both of which are good, whichever one he chooses. However, once the child is allowed to choose, he or she is no longer a passive participant, but an active one. For example, "Which leg do you want to jump on first?"

- **Playfulness,** the children are much more willing to participate in the investigation if the form is playful, for example similes can be used, "Now stretch up high like a giant" or "Stand on one leg like a stork". We can also use playful equipment. (Picture 15)

Picture 15 "Our hands will become big, big spiders"

- **Use of analogies**. When the physiotherapist has to talk to the child about examinations that he or she may not be familiar with, we can use analogies that make the essence of the examination understandable to the child.

- **Say-show-do method**. Let's start by briefly explaining what will happen at a level appropriate to the child's age. For example, "Now I'm going to see why your leg hurts. The next step, if possible, is to show the tool we are going to use. The third step is the examination itself, which can be done with the child's knowledge, consent and co- operation. (Picture 16)

Picture 16 "We're playing Supermen... this is how you have to lean forward"

- **Distraction** is a method that can be used mainly for short examinations. Again, the child must first be told what we are going to do. Without this, the distraction method cannot be used because it would be deceiving the child, which leads to a loss of trust. We can then divert the child's attention from the examination itself. For example, we can give him a task that will temporarily occupy him, such as holding his left ear with his right hand and his right ear with his left hand, or starting a conversation with him about a topic he has already mentioned.

- **Give the child control**. In the case of a long, uncomfortable examination or procedure, it is important to give the child control over what is happening. Let's talk to him about a sign he can use to do this. For example, "I want to help you, so I am going to examine your leg. If you like, we can stop for a while. Just raise your hand. In most cases, the children will try to see if we are telling the truth and use the agreed sign. In such cases, of course, you really have to stop, praise the child, and then continue with the same rules.

(Pilling, 2020., Wassmer et al., 2004., Howells & Lopez, 2008., Kolucki & Lemish, 2011., Pérez-Duarte Mendiola, 2024.)

6. Informing the child

- **The child has a right to be informed.** Health professionals most often ask the child questions. It is much less common to inform the child about the results of the examination and the proposed treatment. This information is usually given only to the parents. There is no doubt that, in the case of a child, the parents must have the necessary information, but children also have a right to information. CLIV of 1997 on Health, paragraph 13, point (5) of the Act reads as follows: "Incapacitated minors, minors with limited legal capacity and patients with mental illness shall be informed." (According to Hungarian law, a child is considered to be incapacitated until the age of 14, and between the ages of 14 and 18). Of course, children should not be informed about the pathophysiological background of their illness; they are mostly interested in practical questions such as how often they have to go

to the physiotherapist, how long they have to do the exercises at home, whether their problem will get better.

- **Provide age-appropriate information**. Of course, the child needs to be given information at a level appropriate to his or her age. In this case, we should use simple expressions and deliver information more slowly and in smaller chunks. Let's encourage children to ask questions!

- **Involve the child in his or her own treatment**. Treatment can be more effective if the child is also cooperative. Ask the child to help with the treatment. For example, say the following "To help your leg heal, you need to do some exercises every day. Please remind your parents that you will do exercises every afternoon.

- **Conclusion of contract.** We ask for the child's cooperation in exchange for a future reward. For example: "There are only two tasks left and then we will go on the trampoline". (Pilling, 2020.) (Picture 17)

Picture 17 We should always keep our promises to the child.

7. The importance of praise

Praise is important for all children, but especially for younger children. For longer tests, simple, **general, positive feedback** can be very important: "how clever you are", "that's it, you're doing very well" - we can keep them motivated with this, but it may not be enough on its own. At the same time, positive feedback is also very important from the point of view of the physiotherapist-child-patient relationship, so that the child feels safe in receiving feedback and therefore responds positively to the physiotherapist's comments.

Specific, positive feedback is what can clearly give the child something to hold on to in a task situation, as it tells and emphasises what the child has done well. For example, "You threw the ball with just the right amount of force so that it fell into the stool!" "It was great how you paid attention the whole time you were cutting with the scissors!"

Constructive, corrective feedback is not negative feedback, but a sentence like "You didn't swing your leg well!" instead of "Swing your legs higher, Hanna!", which includes the method of correction.

The so-called **"sandwich model"** can help you learn this. According to this, feedback consists of three steps in a specific order:

1. positive statement

2. developmental feedback

3. praise

"Hannah! The throw was good, but the arc of the throw was a little flat. Try harder to get the ball up in your next attempt. You are very good!"

(Arends, 1994, Tates & Meeuwesen, 2001) (Figure 4)

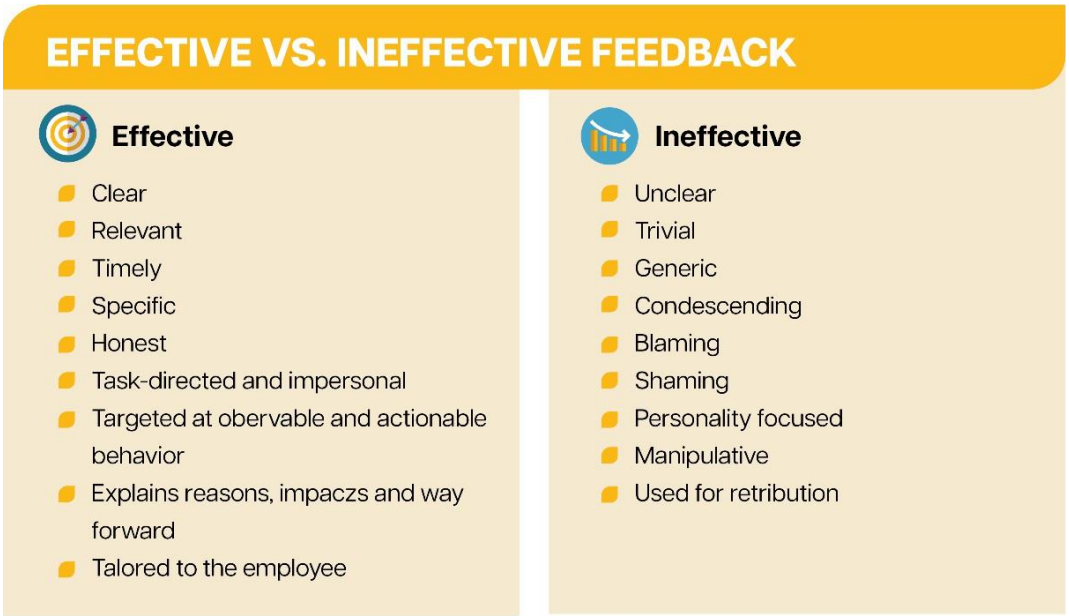


Figure 4 Effective vs ineffective feedback (sources: Effective vs ineffective feedback in the workplace between employees (symondsresearch.com))

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3 FOOT DEFORMITIES IN THE CONTEXT OF THE POSITION OF THE LOWER LIMBS AND PELVIS IN A PATIENT WITH A DERMATOLOGICAL DISEASE

Katarzyna Wódka

3.1 Introduction

Man is the only mammal that has mastered the function of bipedal walking. The formation of the curvatures of the spine, the high position of the general centre of gravity and changes in the foot must have entailed a number of changes in the arrangement of the entire skeleton. The latter (foot) is assigned important functions: support, cushioning and locomotion. Injuries, disorders of the structure or function of the feet can contribute to abnormalities of the higher segments. These abnormalities may manifest themselves not only in the incorrect position observed during the examination in statics (e.g. positioning of the feet in excessive external rotation in relation to the lower leg, dysfunctions of the forefoot, valgus position of the hindfoot), but also, as research indicates, may contribute to a change in the pattern of movement, e.g. gait. This, in turn, may be the cause of m.in pain reported by the patient, the appearance of previous degenerative changes. On the other hand, the position of the feet while standing and walking may be conditioned by the specific anatomical structure of the lower limbs above the ankle joints. This may explain why some people walk with their feet outwards and others inwards (excessive femoral sprain, shin torsion). It is also worth considering the position of the other elements of the lower limb in the assessment of the feet.

3.1.1 Development and physiological changes in the lower limb

From the moment of conception, a number of changes take place in the body of a growing little person. The three basic germ layers of the endoderm, ectoderm and mesoderm develop the entire human body. From the latter develop limbs. Limb primordia appear in the 3rd-4th week of pregnancy and joints in the 6th week of pregnancy. The lower limbs at birth account for about 15% of body length, and at the time of reaching skeletal maturity they account for 30% (Dormans et al., 2019; Napiontek, 2021, Bartel 2004). Along with changes in the length of the limbs, physiological changes in the position of the entire lower limbs are also observed. These changes concern, m.in the femoral angle inclination, the femoral antetorsion and the tibiofemoral angle, which change with the growth of the limb. The femoral angle inclination after birth is about 135°, successively by the end of the 2nd year of life it increases to 150°, and then at the end of growth it reaches the value of about 125° (Zukunft-Huber, 2013).

According to other researchers, the femoral angle inclination in a newborn is 150° and begins to decrease with static load (Bochenek et al. 1968; Platzer, 1997). The average value of the femoral antetorsion after birth is about 30-40° and gradually decreases as the child grows to reach a value between 8 and 14° in adulthood (Gulan et al., 2000; Scorcelletti et al., 2020). On the other hand, the tibiofemoral angle from birth to the first year of the child's life shows significant varus (value greater than 175°), between 1.5 and 2 years of age the lower limbs position themselves neutrally, and then between 2 and 3 years of age this angle changes to values indicating the position of the lower limbs in valgus (value less than 175°) so that at school age, i.e. around 7 years of age, it can be self-corrected and remain in the neutral position (Dormans et al., 2019; Zukunft-Huber, 2013). In the case of the foot, these changes concern the length, the height of the longitudinal arch, the position of the hindfoot. The foot is the first structure to undergo an upward leap of puberty. In an adult, the length of the foot is about 15% of the body length. The most intense increase in foot length is observed in the first three years of the child and during puberty. The change in the appearance of the longitudinal arch depends on many factors, among which the following are remodelling and disappearance of adipose tissue (Spitzy's fat pad) located in the medial part of the foot and histological and functional changes in the connective tissue (the construction of collagen, which has a much lower number of connections). As the available literature indicates, the formation of the longitudinal arch is influenced by many factors such as: age, sex, race, footwear worn and age when the wearing of shoes began (Razeghi et al., 2002; Hoey et al., 2023, Napiontek, 2021). According to Kapahdi, there are 3 types of feet, the specific structure of which may predispose to the occurrence of certain pathologies within the feet. These include: the Greek foot (the second toe is the longest, and the big toe and the third toe are of similar length), Egyptian (the longest is the toe and subsequent toes are characterized by shorter and shorter length, ending at the fifth toe) and Polynesian (or square – at least the first three toes are of similar length). As the most susceptible to the occurrence of deformities in the forefoot, the author indicates the Egyptian foot, which may predispose to the occurrence of such deformities, such as: hallux valgus, hallux rigidus (Kapandji , 2014).

3.1.2 Links between disorders of foot structure or function and effects on higher elements

The dynamic development of science cites a number of studies indicating the existence of connections between tissues. Different authors present these connections in different ways. It seems that the foot, which is the first link in the biokinematic chain of the lower limb, may be of key importance. Studies indicate that the presence of abnormalities within the foot (foot deformities, as well as injury) may be associated with previous degenerative changes, pain, changes in body posture, but also with a decrease in the broadly understood quality of life. In the available literature, there are reports indicating links between disorders of the structure or function of the feet and their potential impact on higher segments. However, there is no consensus among researchers and the potential impact should be considered on a case-by-case basis. Researchers indicate that the presence of hallux valgus can often be associated with previous degenerative changes in the knee joint, patellofemoral pain, greater internal rotation in the hip joint, higher Q angle values, greater hindfoot valgus, reduced flexibility of the

iliotibial band, higher anteroposterior body inclinations and an increased risk of degenerative changes in the spine compared to the control group. Another abnormality in the foot that can result in a potential impact on the higher segments is the presence of the toe limitus. Its occurrence results in reduced internal rotation in the hip joint, a different range of motion within the ankle joint and pelvis during gait compared to the control group. Torsion injuries in the ankle joint, on the other hand, can result in problems related to pain in the spine and knee joint, and the occurrence of flat feet can often be associated with knee pain, pain in the lumbar spine and more frequent occurrence of degenerative changes in the hip joints. Therefore, it seems that covering the patient with a broadly understood holistic assessment is crucial. Below is a summary of selected problems occurring in the forefoot and their potential impact on other elements in the body.

Table 6 Selected foot disorders and potential impact on other elements in the body – a review of the literature.

Author	Title	Journal	The sample	Dysfunction in the foot or other part of the lower limb	Effects on other parts of the body
Kaya, D., Atay, O. A., Callaghan, M. J., Cil, A., Cağlar, O., Citaker, S., Yuksel, I., & Doral, M. N. (2009)	Hallux valgus in patients with patellofemoral pain syndrome	*Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA*	99 subjects (24 men, 75 women); average age 43 years	Hallux valgus	People with hallux valgus are more likely to have patellofemoral pain
Steinberg, N., Finestone, A., Noff, M., Zeev, A., & Dar, G. (2013).	Relationship between lower extremity alignment and hallux valgus in women.	Foot & ankle international	49 women (25 women with hallux valgus, 24 women without hallux valgus); average age between 51 and 80 years without and with hallux valgus	Hallux valgus	Women with HV are characterized by significantly higher internal rotation in the hip joint, higher values of the Q angle, higher values of the range of motion in the ankle joint (flexion and extension) and in the joint in I MTP. In addition, these women are characterized by a more valgus rearfoot position compared to the control group.
Kim, S. J., You, K. J., & Jung, D. Y. (2018).	Between-side comparisons of iliotibial band flexibility and the tibial torsion angle in subjects with an asymmetric hallux valgus angle	Journal of Musculoskeletal Science and Technology	14 subjects (the necessary number calculated on the basis of the power of the test) (5 women 10 m). Average Age 33.0±10.3 years	Hallux valgus	The flexibility of the iliotibial band was significantly lower on the side with the greater hallux valgus. The tibial torsion angles did not differ

					significantly between the two sides.
Roddy, E., Zhang, W., & Doherty, M. (2008)	Prevalence and associations of hallux valgus in a primary care population	*Arthritis Care & Research: Official Journal of the American College of Rheumatology*	Questionnaire conducted on a group of 1,194 people with hallux valgus, mean age 63.2±13.4, 2,674 people from the control group 54.5 ±14	Hallux valgus	Hallux valgus is associated with the occurrence of osteoarthritis, knee pain
Kozáková, J., Janura, M., Svoboda, Z., Elfmark, M., & Klugar, M. (2011).	The influence of hallux valgus on pelvis and lower extremity movement during gait.	Acta Gymnica	17 subjects (6 patients with bilateral HV deformity – mean age 57.8 ± 5.64, 11 patients without hallux valgus deformity – mean age 50.7 ± 4.41)	Hallux valgus	Subjects with bilateral hallux valgus deformity differ significantly: in the achieved range of motion in the ankle joint (greater plantar flexion during the St phase (LR), lower dorsiflexion during the St phase), the range of motion of extension in the knee joint (phase swing) and the range of motion in the hip joint. In addition, significantly lower values of pelvic mobility in all planes during gait were noted compared to the subjects from the control group.
Shih, K. S., Chien, H. L., Lu, T. W., Chang, C. F., & Kuo, C. C. (2014).	Gait changes in individuals with bilateral hallux valgus reduce first metatarsophalangeal loading but increase knee abductor moments	Gait & posture	12 women with bilateral hallux valgus deformity (mean age 45.5 ± 9.2 and 12 women without this abnormality; mean age 46.8 ± 9.8 years	Hallux valgus	In subjects with hallux valgus deformity, lateral displacement of COP away from the first metatarsophalangeal joint (MPJ) was found. This strategy increased abduction moments in the knee, an index closely correlated with medial load in the knee, and a predictor of the onset and progression of

					medial osteoarthritis of the knee
Fotoohabadi, M., Spink, M. J., & Menz, H. B. (2021).	Relationship between lower limb muscle strength and hallux valgus severity in older people.	The Foot	157 people (99 women and 58 men) aged between 65 and 91. Hallux valgus deformity was found in 54 subjects, while no deformity was found in 103 patients.	Hallux valgus	The higher the value of hallux valgus, the lower the force hallux plantar flexion muscles
Omae H., Ohsawa T., Hio N., Tsunoda K., Omodaka T., Hashimoto S., Ueno A., Tajika T., Iizuka Y., Chikuda H.	Hallux valgus deformity and postural sway: A cross-sectional study.	*BMC musculoskeletal disorders*.	169 people (106 female, 63 male) median age: 66.0 ± 12.4 years. Hallux valgus deformity was found in 44 subjects, while no deformity was found in 125 patients.	Hallux valgus	People with hallux valgus deformity are characterized by significantly greater the anteroposterior postural sway than the control group. The muscle mass of the lower limbs in the group with hallux valgus was significantly lower than in the group without hallux valgus.
Hsu, T. L., Lee, Y. H., Wang, Y. H., Chang, R., & Wei, J. C. C. (2023	Association of Hallux Valgus with Degenerative Spinal Diseases: A Population-Based Cohort Study	International Journal of Environmental Research and Public Health	Retrospective cohort study (from 01.01.2000-31.12.2015). 1000 people with hallux valgus deformity and 1000 people from the control group	Hallux valgus	The researchers noted a relationship between the presence of hallux valgus and an increased risk of developing degenerative spinal diseases (1.7-fold higher risk), a higher risk of spondylosis and intervertebral disc diseases.
Lafuente, G., Munuera, P. V., Dominguez, G., Reina, M., & Lafuente, B. (2011)	Hallux limitus and its relationship with the internal rotational pattern of the lower limb	Journal of the American Podiatric Medical Association	80 subjects (45 patients with a slight stiff toe and 35 controls) aged between 20 and 45 years	Hallux rigidus	People with hallux rigidus had significantly less internal rotation in the hip joint. The greater the rotation restriction, the more limited the movement of the dorsiflexion of the big toe.

Cansel, A. J., Stevens, J., Bijnens, W., Witlox, A. M., & Meijer, K. (2021).	Hallux rigidus affects lower limb kinematics assessed with the Gait Profile Score.	Gait & Posture,	15 patients with hallux rigidus (mean age 63.7 ± 10.5 years and 15 controls (59.1 ± 5.1 years).	Hallux rigidus	The presence of hallux rigidus affects the kinematics of the lower limbs, where compensation occurs on many levels.
O'Leary, C. B., Cahill, C. R., Robinson, A. W., Barnes, M. J., & Hong, J. (2013)	A systematic review: the effects of podiatrical deviations on nonspecific chronic low back pain	Journal of back and musculoskeletal rehabilitation	Literature review	Various abnormalities and deformities within the foot	Overpronating the foot may be associated with low back pain.
Brantingham, J. W., Lee Gilbert, J., Shaik, J., & Globe, G. (2006)	Sagittal plane blockage of the foot, ankle and hallux and foot alignment-prevalence and association with low back pain.	Journal of chiropractic medicine,	100 people with chronic and 104 people without lower back pain between the ages of 18 and 45.	Limitation of mobility in the ankle joint	Limitation of dorsiflexion is associated with ailments of the lower spine
Friel, K., McLean, N., Myers, C., & Caceres, M. (2006)	Ipsilateral hip abductor weakness after inversion ankle sprain	Journal of athletic training	23 subjects with unilateral chronic ankle sprain (mean age 26.65 ± 8.35 years)	Ankle sprain	On the ankle sprain side, the researchers noted reduced hip abductor muscle strength and a smaller range of plantar flexion in the ankle joint.
Powers, C. M., Ghoddosi, N., Straub, R. K., & Khayambashi, K. (2017).	Hip Strength as a Predictor of Ankle Sprains in Male Soccer Players: A Prospective Study.	Journal of athletic training,	185 men from football clubs in various age categories aged between 14 and 34. In 25 people, non-contact ankle sprain was recorded, while the rest were in the control group.	Ankle sprain	Reduced isometric force of hip abductors predisposes male soccer players to non-contact lateral ankle sprain
Theisen, A., & Day, J. (2019).	Chronic Ankle Instability Leads to Lower Extremity Kinematic Changes During Landing Tasks: A Systematic Review.	International journal of exercise science	Review Study - The purpose of this study was to provide a systematic review of the studies done on chronic ankle instability (CAI) and lower limb kinematics during landing tasks. The 6	Chronic ankle instability	Subjects with chronic ankle instability during landing tasks were found to have reduced knee flexion compared to the control group. Reduced knee flexion has been

			studies identified involved 338 people.		shown to be a key risk factor for non-contact knee injuries.
Pawłowska, K., Pawłowski, J., Mazurek, T., Piotr, A., Kołodziej, Ł., & Grochulska, A. (2019)	Feet deformities in patients with hip osteoarthritis	Medical Research Journal	60 people with osteoarthritis of the hip aged between 52 and 84. The control group consisted of 32 people without osteoarthritis of the hip aged 50-74 years.	Shape of the plantar part of the feet	In people with osteoarthritis of the hip, lower values of the Wejsflog index, lower values of the Clarke angle and higher values of the hallux valgus angle were noted.
Amraee, D., Alizadeh, M.H., Minoonejhad, H. et al.(2017)	Predictor factors for lower extremity malalignment and non-contact anterior cruciate ligament injuries in male athletes	Knee surgery, sports traumatology, arthroscopy: official journal of the ESSKA	53 men aged 25±4.83 years after complete anterior cruciate ligament injury	8 measurements of lower limb alignment were taken: Craig test, hip rotation measurement, foot-thigh angle, knee joint position, Q angle, navicular bone drop test, ankle dorsiflexion range,	Limitation of dorsiflexion in the ankle joint, internal rotation in the hip joint and a greater angle of anterversion are significant factors influencing the increased risk of non-contact ACL injury
Dahle, L. K., Mueller, M., Delitto, A., & Diamond, J. E. (1991).	Visual assessment of foot type and relationship of foot type to lower extremity injury	Journal of Orthopaedic & Sports Physical Therapy	77 athletes (68 men and 7 women) aged 13-18 years	Pronating/Supinating /Neutral Foot Positioning	Athletes with an overly pronating or supinating foot position may be more prone to knee pain than athletes with an overly prone foot position.

3.1.3 Other factors affecting the position of the lower limbs

When assessing the position of the lower limbs, it is worth remembering that the way of standing and walking may be conditioned not only by dysfunctions located within the foot, but also by the specific anatomical structure of the lower limbs above the ankle joints. An example is femoral anteversion, the size of which changes with growth and reaches a physiological value of 10°-15° around the age of 12. In the case of excessive femoral anteversion, both the kneecap and the feet will point inwards when walking (Harris, 2013). Femoral anteversion usually runs in families and is observed in both limbs. As the literature indicates, its presence may be associated with the presence of various functional problems, including more frequent falls, faster fatigue when covering longer distances, sitting in the "W" position. Some authors emphasize that the presence of femoral anteversion may affect the occurrence of symptoms

such as: pain located on the front part of the knee, patellar instability, femora-acetabular impingement and labral tear (Leblebici et al., 2019; Qiao et al., 2022; Eckhoff et al., 1996; Scorcelletti, 2022). Other researchers indicate that children with femoral anteversion are characterized by worse body balance (Tuncer et al., 2019). Others find links between flat foot and femoral anteversion in children between the ages of 3 and 6 (Zafiropoulos et al., 2009). As indicated by the literature, the presence of excessive femoral anteversion is associated with an increased risk of non-contact ACL injury. In the opposite situation, i.e. in femoral retroversion, patients will be characterized by the opposite pattern. (Lerch et al., 2022). Patients with femoral retroversion are characterized by reduced internal rotation in the hip joints. Pain is often reported in the anterior part of the hip joint due to femoroacetabular impingement (Meier et al.,2022). In addition, research conducted by Tsagkaris et al. indicate that the posterior position of the femoral head relative to the axis running through the condyles may affect gait and running patterns (Tsagkaris et al., 2024).

With this information in mind, try to look at the position of your feet in a slightly broader way, taking into account the position and the impact of one element on another.

3.2 Foot disorders – epidemiology

In adults, abnormalities and pain in the feet are a common problem. Pain in the foot, depending on the literature, is observed from 13%-36% of the respondents. It is more often observed in women, in obese people (BMI > 30.0 kg/m²). These ailments tend to intensify with age. In two large cohort studies conducted on Caucasians, pain appeared from 13% (Chingford 1000 Women Study) to 36% (Johnston County Osteoarthritis Project). In these recent studies, the frequency of pain in Caucasians compared to African Americans. The prevalence in these groups was comparable (35% to 36%, respectively). The least frequent pain was reported in Asians (Gates et al., 2019).

The most common abnormalities in the forefoot include hallux valgus, hallux rigidus, hammer toes, calluses (Nix et al., 2010). Their frequency of occurrence, depending on the literature, is as follows: hallux valgus 23% (and increases with age – after the age of 65 - 35.7%), hammer toes 8,9%, rigid painful toe (it is believed to affect 1% of people over 30 years of age). Research indicates that the presence of these abnormalities may affect quality of life, may be associated with the occurrence of pain, reduced quality of functioning and may create difficulties in choosing comfortable footwear (DiGiovanni et al., 2018; Nix et al., 2010; Şaylı et al., 2018). Another equally common dysfunction within the foot is flat feet. Salinas-Torres, V. M. et al. (2023) conducted a systematic review of the literature on the prevalence of flat feet. They analysed 12 publications including 2509 cases of flat feet in the assessment. The results of their research indicate that flat feet are more common among males, younger individuals (3-5 years, 11-17 years), Asian and obese. Female and Caucasian are less associated with flat feet (Salinas-Torres et al., 2023). The literature indicates that one of the most common injuries in the ankle joint is inversion torsion injury of the ankle joint. It is estimated that every thousandth person suffers an injury during the day due to ankle sprains or dislocations and about 6% of young representatives of athletes (Doherty et al., 2014; Bilewicz et al., 2012)

3.2.1 Consequences of foot abnormalities

Abnormalities in the feet can affect various areas of life. The literature on the subject indicates that abnormalities within the foot may be associated with: the occurrence of pain, reduced quality of life (López-López et al., 2018; Jalali et al., 2021; Menz et al., 2006), functional limitations (Badlissi et al., 2005; Nix et al., 2012), problems with choosing the right footwear (Menz et al., 2005; Dawson et al., 2002), cosmetic problems (Menz, 2022), deterioration of gait quality and in older people with an increased risk of falling (Menz, 2006). The most frequently mentioned abnormalities within the foot include pain, longitudinal and transverse flat feet, excessive pronation position of the foot, forefoot anomalies (hallux valgus, hammer toe, calluses, hallux rigidus).

3.3 Diagnostic tests used in the assessment of foot shape

In clinical practice, the gold standard for diagnosing foot and lower limb dysfunctions is an X-ray. In physiotherapy practice, podoscopes can be used to assess the shape of the plantar assessment of the feet. After the examination, information is obtained on: the length and width of the foot, the quality of the longitudinal and transverse arch, the position of the big toe and the fifth toe. To complement the foot alignment test, it is worth using the commonly used and highly reliable FPI (Foot Posture Index) Test (Oleksy et al., 2010; Redmond et al., 2008).

3.3.1 Assessment of the shape of the rates using the FPI questionnaire

This test is a simple and quick test that does not require any additional equipment. This examination evaluates the alignment of six elements (palpation of the head of the talus, curves below and above the lateral malleolus, position of the calcaneus, convexity of the ankle-navicular joint, medial longitudinal arch of the foot, adduction/abduction of the forefoot relative to the hindfoot). For each test element, the tested person receives a certain number of points, and the sum of the points obtained allows the foot to be classified into one of the categories. A five-point scale (-2 to +2) was adopted to assess the position of each of the evaluated elements. Negative values indicate a more supinated position of the element, while positive values indicate a pronation position. In the case of a neutral position, the subject receives 0 points. The sum of the points qualifies the assessed foot to one of five categories: correctly set foot (from 0 to +5 points), slight pronation foot (from +6 to +9 points), significant foot pronation (from +10 to +12 points), slight supination rate (from -1 to -4 points), severely supinated foot (from -5 to -12 points). The following is an assessment of the individual elements of the foot:

Table 7 FPI questionnaire – own source based on Oleksy et al. 2010

Patient's starting position	Therapist's starting position	Rated item	Supination setting		Neutral	Pronation Positioning	
			-2 points	- 1 point	0 points	+1 point	+2 points
Habitual standing, arms alongside the body	The therapist in front of the patient, places the thumb and index finger on the lateral and medial sides of the talus head	Palpation of the head of the talus*	talus head clearly palpable on the lateral side and imperceptible on the medial side;	talus head palpable after side and faint on the side of the medial	talus head palpable similarly on the lateral and medial sides	talus head palpable after medial side and faintly felt on the lateral side	talus head clearly palpable on the medial side and imperceptible on the lateral side
	The therapist stands behind the patient, observes the appearance of the line above and below the lateral ankle	Curves above and below the lateral ankle	curve below the lateral ankle flat or convex	curve below the lateral malleolus concave, but flatter than above the ankle	curves above and below the ankle the same	curve below the lateral ankle more concave than the curve over the ankle	curve below the lateral ankle clearly more concave than above the ankle
	The therapist stands behind the patient, assesses the course of the calcaneal axis in relation to the axis of the lower leg	Calcaneal alignment	more than 5° varus;	between the correct setting a 5° varus	correct (vertical) alignment calcaneus	between the correct setting and 5° valgus	more than 5° valgus
	The therapist observes the ankle-navicular joint area.	Convexity in the ankle-navicular joint area (TNJ)	ankle-navicular joint area clearly concave	ankle-navicular joint area slightly concave	ankle-navicular joint area flat	ankle-navicular joint area slightly convex	the TNJ area is clearly convex
	The therapist assesses the height of the medial longitudinal arch of the foot	Arch of the medial longitudinal arch	a high, clearly curved arch near the end of the medial arch	the arch is moderately high, slightly sharp backwards	arch of the correct height, gently	lowered arch with flattening in the middle parts	arch strongly lowered with a clear flattening in the middle part

					bent along the entire length		
	The therapist stands behind the patient, assesses the position of the forefoot in relation to the hindfoot.	Forefoot adduction/abduction in relation to the hindfoot	fingers on the side invisible/ fingers on the medial side clearly visible	fingers on the medial side more visible than the fingers of the side	fingers on the lateral and medial sides equally visible	fingers on the side more visible than the fingers of the medial side	fingers on the medial side invisible/ fingers of the lateral side clearly visible

*Palpation of the talus bone – to palpate the head and neck of the talus, place the index finger of one of your hands transversely on the front part of the ankle joint, directly in front of the tibia. In this position, your finger is on the neck of the talus. By placing your middle finger against your index finger, you will place it directly on the navicular bone. Notice how clearly the head of the talus protrudes medially during the turning movement and to the lateral side during the foot inversion movement (Jorritsma, 2004).

3.3.2 Arch Assessment

Feiss line test

This test is used to assess the height and flexibility of the longitudinal arch. The patient sits on a couch. The therapist marks three points on the medial side of the foot: the top of the medial malleolus, the tuberosity of the navicular bone and the head of the first metatarsal bone. Then the patient stands on both feet, evenly distributing the weight of the body on both feet, the therapist again marks the tuberosity of the navicular bone. Correctly in the unloading position, the tuberosity of the navicular bone is located on the Feiss line. A positive test result is evidenced by a marked decrease in the tuberosity of the navicular bone below the Feiss line after the patient assumes a standing position. This indicates functional flat feet. The location of the navicular tuberosity below the Feiss line, both in relief and in load, indicates permanent flat feet.

3.1 a 3.1b

Picture 3.1 a, b. Feiss line test – how to perform it

Functional and structural flat foot differential test

This test allows you to differentiate functional flat feet from structural flat feet. The subject stands on both feet, stands on tiptoe, then sits with his lower legs and feet hanging freely. The therapist visually assesses the height of the arch. Longitudinal flat feet are considered functional, resulting from muscle and ligament weakness if the medial arch, lowered or abolished while standing, appears in a sitting position or when climbing on toes. Longitudinal flat feet are considered structural if no change in the shape of the arch is noticed during the test, despite the change in position.

3.2 a 3.2 b 3.2 c

Picture 3.2 a, b, c Test differentiating between functional flat feet and structural flat feet

Longitudinal arch index

This test allows you to assess the longitudinal arch. The subject stands and then sits on a chair. The therapist stands next to the subject. The therapist measures the height of the foot in the middle of its total length and the length of the foot without the toes. Then divide the height of the foot by the length of the toeless foot. The correct value of the index is about 0.33 in a standing position and 0.36 in a sitting position and is similar in each age group.

Picture 3.3 Longitudinal arch index

Hallux lift test (Jack test)

This test is used to diagnose the cause of longitudinal flat feet. The patient sits on a chair, feet resting on the ground. The therapist passively raises the big toe towards extension in the metatarsophalangeal joint of the big toe. This test uses a windlass mechanism. If the cause of longitudinal flat feet is the lowering of the navicular and medial cuneiform bones , passive extension of the big toe causes the elevation of the arch of the foot. However, if the lowering of the medial arch is due to an incorrect position of the talus, no changes will be observed. The windlass mechanism does not create enough leverage to lift the navicular bone, as it is blocked by the head of the talus being too vertical.

Picture 3.4 Hallux lift test (Jack test)

Navicular Alignment Test

This test is used to assess the longitudinal arch. The patient stands in a tandem position (the heel of the forward leg touches the toes of the crooked leg). The therapist marks three points on the foot: the head and metatarsal bone, the tuberosity of the navicular bone and the point above the Achilles tendon at the top of the lateral ankle. Then he measures the angle between the line connecting the head of the metatarsal bone and the tuberosity of the navicular bone and the tuberosity of the navicular bone and the point above the Achilles tendon at the level of the apex of the lateral malleolus. The axis of the goniometer is placed over the tuberosity of the navicular bone, and one arm aims at the head of the first metatarsal bone, while the other at the point above the Achilles tendon at the level of the top of the lateral malleolus. In the case of a correct formation of the longitudinal arch, the described angle is close to zero.

Picture 3.5 Navicular alignment test

3.3.3 Hindfoot tests

Coleman Block Test

This test is used to assess the correctness of varus foot. The patient is in a standing position, the therapist places a 2.5 cm high wooden block under the lateral edge of the patient's foot. The metatarsal bones I-III remain unsupported. If, after placing the pulley, the heel returns to the correct position or positions itself valgus, the deformation of the hindfoot is functional and results from permanent disorders at the forefoot level (Bac et al., 2022).

3.6 a 3.6 b

Picture 3.6 a, b Coleman test – how to perform it

Symptom of too many fingers

This test is used to assess the abducted flat-valgus foot. The patient stands in a habitual position, the therapist observes the position of the feet. In a normal situation, when viewed from behind, the fifth toe and half of the fourth toe are visible on the lateral side of the heel. A positive test result is indicated by the position of the forefoot in excessive abduction, the position of the tibia in excessive external rotation and the position of the calcaneus in valgus. The therapist looking from behind sees more fingers on the lateral side.

Looking from the back, on the side of the heel, how many toes do you notice?

Picture 3.7 Symptom of too many fingers

Tiptoe test

This test is used to assess the function and efficiency of the posterior tibial muscle. The patient stands with hip-width apart facing the wall. He stands on the toes of both feet, and the therapist observes the position of the hindfoot. Then he repeats the same task but standing on the toes of one of his feet, trying not to bend his knee, torso and not to rest his toes against the wall. He repeats the same task on the other foot. If no symmetrical hindfoot inversion is observed

during the toe test of both feet, it indicates insufficiency of the tendon and the posterior tibialis muscle. What change did you observe in the position of your hindfoot when standing on the toes of both feet? Was the change symmetrical?

Picture 3.8 a, b, c Tiptoe Stand Test

3.3.4 Forefoot tests

Morton's test (Gänsslen's grip)

This test is used to provoke forefoot pain. Patient in the position of lying backwards on the couch. The therapist stabilizes the foot from the medial side with one hand. With the other hand, the therapist squeezes the forefoot at the level of the first and fifth metatarsal bones. If the patient reports pain in the area of the heads of the metatarsal bones during the test, it may indicate the presence of Morton's neuralgia or severe transverse flat feet. In the case of neuralgia, pain may radiate to adjacent fingers.

Picture 3.9 Morton test – how to perform it

Navicular Bone Drooping Test

This test is used to assess overpronation of the forefoot. The patient stands in a habitual position. The therapist marks a point at the level of the tuberosity of the navicular bone with a marker, then measures the distance of this point from the ground. Then the patient puts the foot in a neutral position and the therapist again takes the measurement from the ground to the marked point. If the difference between the measurements is greater than 10 mm, it indicates excessive pronation of the forefoot

Picture 3.10 a Navicular Bone Drooping Test - Habitual Position

Picture 3.10 b Navicular Bone Drooping Test – Neutral Position

3.3.5 Muscle flexibility tests

Silfverskiöld test

This test is used to assess the elasticity of the gastrocnemius and soleus muscles. Patient in a backward lying position. The therapist, standing on the patient's side with one hand, stabilizes the area just above the knee joint. The other hand covers the hindfoot area, resting the plantar side of the foot against his forearm and placing the foot in a neutral position. In the case of deformities, e.g. flat-valgus foot, the therapist corrects to a neutral position. Then he performs passive dorsiflexion in the ankle joint. Maintaining the above position, he bends the patient's limb at the knee joint to an angle of 90° and again performs maximum passive dorsiflexion of the ankle joint. In the case of normal flexibility of the triceps calf muscle, the dorsiflexion range is approx. 10° in the position of the straight knee joint and 20° in the flexion position of the knee joint.

Picture 3.11 a Silfverskiöld test – assessment of the triceps calf muscle

Picture 3.11 b Silfverskiöld test – assessment of soleus muscle

3.3.6 Tests to assess the dynamics of foot and lower limb work

Pronation test

This test is used to assess the dynamics of the foot and the entire lower limb during the transfer of body weight to the supporting limb. The subject stands in a small step and tries to detach the heel of the crooked leg and shift the weight of the body from the leg to the forward leg. A physiological reaction during the transfer of body weight to the forward limb (due to the structure of the joint) is the inclination of the calcaneus inwards, which forces medial rotation of the talus. This, in turn, allows pronation to move. The presence of this movement triggers movement within the lower leg bone and further on the femur (Earls J. et al., 2017).

Picture 3.12 a, b, c, d Pronation test – how to perform it

Supination test

This test is used to assess the dynamics of the foot and the entire lower limb during the supination movement. Subject in a small lunge position. The examined leg is positioned in front. The patient tries to perform a lunge movement combined with limb rotation and external pelvic rotation with the crotch leg. From the side, from the tested side, the therapist observes the movement of the fibula combined with the external rotation of the calcaneus (on the side of the examined leg – right) (Earls J. et al., 2017).

Picture 3.13 a, b, c Supination test – how to perform the test

Squat Test

This test is used to assess the movement control of the entire lower limb. Subject in a habitual standing position. The task of the subject is to perform 1/4 of the squat. The patient bends the lower limbs in a triarticular manner, trying not to lift the feet off the ground, the knees do not exceed the line of the toes. From the lateral side of the patient, the therapist observes mobility in the heel and lateral ankle area. He also pays attention to the quality and quantity of the movement performed. Physiologically, as a result of the weight of the body and the forces acting there, the calcaneus should retract. Observe how your knees position during the examination? How do the tuberosities of the tibia align? Do they "escape" inside? Do you notice any asymmetry in the work between the knees? Looking at the examined person from the side, observe what range of motion in the ankle joint is achieved by the examined person on the right and what range of motion on the left side? Do you notice any asymmetries?

Picture 3.14 Squat test

3.3.7 Assessment of the lower limb in the context of foot position

Craig's test

This test is used to assess the anterior/posterior tilt of the femoral neck. patient in forward lying position. The therapist bends the examined limb to an angle of 90° at the knee joint, with the other hand palpates the greater trochanter area** of the femur on the examined side. Then the therapist performs a slow movement of internal and external rotation in the hip joint, looking for the position in which the trochanter is most palpable. The result of the test is the value of the angle between the axis of the lower leg and the vertical line. In adults, this angle should be between 8 and 15° of internal rotation. Values lower than 8° indicate that the femoral head is positioned backwards in relation to the axis running through the condyles (retroversion). Values greater than 15° indicate that the femoral head is in an anteroversion.

Picture 3.15 Craig's test – how to perform it

** The greater trochanter lies a hand's width from the iliac crest downwards and is the most laterally located bone structure in the hip joint area. The position of the greater trochanter is often visible in a standing position, when the patient performs an abduction movement with one of the legs. Directly above the trochanter and below the iliac crest, a depression (buttock fossa) is visible. In addition, ask the subject to alternate the movement of external and internal rotation – you will easily notice and feel the movement of the greater trochanter of the femur (Jorritsma, 2004).

Test - foot-femur angle

This test provides an indicative assessment of torsion in the shins. Test subject in the supine position, limbs flexed to a 90° angle at the knee and ankle and shin joints. The patient's feet placed in an intermediate position between valgus and talus. The angle included between the long axis of the thigh and the axis of the foot determined by the second radius is evaluated. Under normal conditions, the foot should be twisted outward by 10°-20°.

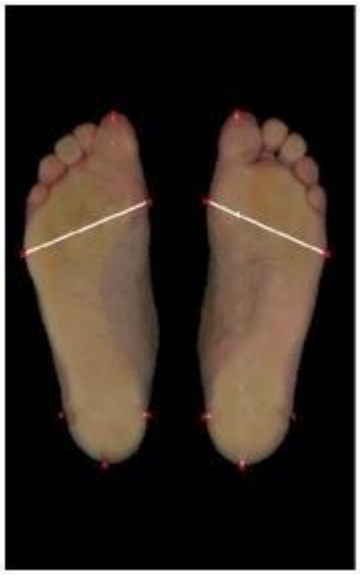
Picture 3.16 Test - foot-femur angle – incorrect result

3.4 Assessment of the shape of the plantar part of the feet

The shape of the plantar part of the feet can be examined by making a print of the plantar part of the foot. An imprint of the plantar part of the foot can be obtained in several ways. One of them is the imprint of the sole part of the foot previously painted with paint on paper. On the other hand, in clinical trials, an electronic (computer) print obtained during an examination with the use of a podoscan is more often used. Regardless of the choice of the form of the print, the result obtained allows for the determination of various indicators describing the shape of the plantar part of the feet, such as: foot length, foot width, longitudinal arch, transverse arch, position of the big toe and fifth toe. In the case of using subscanners, the diagnostic possibilities can be much greater and allow, for m.in, to cooperate with software for designing orthopedic insoles. Below are selected indicators that allow to assess the shape of the plantar part of the feet.

Picture 3.17 Method of determining the length of the foot

Foot length – is determined by measuring between the end of the longest toe and the most protruding part of the heel



Picture 3.18 How the width of the foot is determined

Foot width - is determined by measuring the widest part of the forefoot between the medially and laterally protruding point

Wejsflog Index – allows you to assess the transverse arch and reflects the proportion of length to width of the foot. Ideally, this ratio should be 3:1. It is assumed that values between 2.55-3.00 indicate a correct transverse arch. Values below this range indicate transverse flat feet (Kasperczyk, 2004)

Picture 3.19 The Clarke angle method

Clarke's angle - is the angle that is determined between the tangent of the medial edge of the foot and the line that connects the point of greatest depression and contact of the medial tangent with the edge of the forefoot. It is assumed that for adults, values between 42 and 54° indicate a correct longitudinal arch and above 55° indicate a hollow foot. Values between 31 and 41° indicate a decrease in the longitudinal arch, while values below 31° indicate a flat foot (Bac et al., 2020)

Picture 3.20 Method of determining the angle of hallux valgus (α) and varus of the fifth finger (β)

The hallux valgus angle α – is the angle that is determined between the tangent to the medial edge of the foot and the tangent led from the point at the widest point of the forefoot to the outer edge of the big toe. The norm for this angle is 0-9°. Values higher than 9° indicate hallux valgus.

The varus angle of the fifth toe β is the angle measured between the tangent to the lateral edge of the foot and the tangent led from the point at the widest point of the forefoot to the

outer edge of the fifth toe. The norm for the beta angle is a value between 0 and 5°. Values higher than 5° indicate a varus position of the fifth finger.

3.5 Conveying unfavourable news

A visit to a specialist (doctor, physiotherapist) is a challenge for most people. For most of us, this can be associated with a lot of anxiety and stress. That is why it is so important to provide the examined person with a friendly atmosphere, a sense of comfort and security. Below are some sample tips that you may find helpful when you conduct the examination.

During the examination and therapy, try to provide as much comfort as possible, taking into account the sense of dignity and intimacy. In practice, this means:

- creating an appropriate space for the patient to freely prepare for the examination (changing room)
- ensuring comfort during the examination (separating the space with a screen, not answering the phone by the examiner)
- avoiding addressing the patient as "you." In Poland, we address an adult using the word "Mr.", "Mrs."
- referring to the other person with due respect
- avoid commenting on the appearance, lifestyle and worldview of the patient in question
- it is good practice during the examination to inform the patient about the activities being performed (e.g. in a moment I will conduct a mobility assessment of the sacroiliac joints)
- if monitoring is used - the patient's consent is required
- not to have third parties present during the examination (unless the examined person agrees)
- no sharing of medical records with non-medical personnel.

Sometimes during a visit, we have to convey unfavourable news to the person being examined. Unfavourable information to be conveyed poses a major challenge for both the communicator and the patient. From the patient's (client's) perspective, unfavourable information for the patient is any news that materially and adversely changes the patient's perception of his own future. Remember that receipt by the patient of inauspicious information is associated with great stress for him. You may encounter a variety of reactions from momentary surprise (shock), disbelief, denial to the release of emotions (crying, anger, anger, anxiety, fear). Each of us in difficult situations needs time to get acquainted with the new difficult situation as well as to accept the "new conditions". Remember that each of us reacts differently to difficult situations!

In conveying unfavourable news, pay attention to:

- the place, time and environment where this information is to be conveyed,
- try to speak calmly and confidently,
- avoid medical jargon incomprehensible to the patient. When conveying information, use clear and simple wording understandable to the patient,
- the therapist's body language is also the transmission of information - try to maintain eye contact, be sincere and empathetic,
- when sharing unhelpful news, try to divide it into smaller "portions",
- allow the patient to be emotional,
- express understanding,
- present a plan of action (treatment),
- ask if the information provided is understood by the patient

3.5.1 Example protocols for the transmission of unfavourable messages

If you find it difficult to send unfavourable messages, you can use specially prepared protocols for this purpose. Protocols organize how bad (difficult, inauspicious) news is transmitted. It is a kind of set of tips and hints for various situations that you may encounter. Communicating the news of a poor prognosis is difficult for both the patient and the person who conveys the news. Perhaps it will be easier for you to imagine this difficult situation and try to put yourself in the shoes of a patient who is just waiting for information.

One of the most commonly used protocols in medical communication is the SPIKES protocol according to Baile (Baile et al., 2000). It consists of six stages of unfavourable information communication, including the following parts:

- stage one - **Setting up** the interview, i.e. preparing the interview. Try to choose the right place to provide a sense of intimacy and security, reserve enough time for the patient only, if the patient wishes, involve someone from the immediate environment to be next to him, take a sitting position when talking to the patient, try to maintain eye contact.
- stage two – assessing the patient's **Perception.** At this stage of the conversation, try to ask open-ended questions about the patient's perception of their medical situation and their attitude to the problem they are facing. You may ask, "What have you been told about your medical situation so far?" or "How do you understand the reasons why we had an MRI?"
- stage three – obtaining the patient's **Invitation.** In this part of the dialogue, we find out to what extent the patient wants to obtain full information about their health. Some patients do not want to talk about test results. They prefer this news to be passed on to someone close to them. Questions may be helpful: „Would you like me to discuss the results of the study in detail?" or "Would you like me to give you all the information, or would you like to outline the results and spend more time discussing the treatment plan?"

- stage four – giving **Knowledge and information to the patient**. This is the stage in which we provide the patient with information about his or her health condition. Try to use simple, understandable vocabulary, avoid medical jargon, convey information in "small" portions, try to observe the patient to see if it is understandable to the patient, avoid excessive directness

- stage five – addressing the patient's **Emotions with empathic responses.** Try to understand what emotions the patient is struggling with, give the patient some time to get used to the new situation, show understanding for these emotions, react with empathy

- Stage six – **Strategy and Summary.** At this stage of the conversation, try to make sure that the information you provide is fully understood by the patient, and then present treatment options, provide simple and specific actions

3.5.2 Recommendations for the transmission of unfavourable information, including intercultural communication

In the Polish context bad news is communicated in a direct way. While the patient is offered possibilities of further treatment, it is made clear, their aim is to preserve the current state rather than improve it. Some health issues (e.g. fungal infections) are considered shameful for the patient. Even a discussion about them with a therapist makes the patient embarrassed. It is important to keep the conversation about these health issues as private as possible.

Intercultural communication recommendations:

- Physiotherapists should undergo training or workshops on cultural sensitivity and diversity. This can help them understand how cultural backgrounds can influence patients' perceptions of health, illness, and treatment.

- If there's a language barrier, it's essential to use professional interpreters or translation services to ensure accurate communication. Avoid relying on family members, as they may not provide unbiased translations or may not be fluent in medical terminology.

- Be mindful of nonverbal cues, such as body language and gestures, which can vary across cultures. What may be considered appropriate in one culture may be offensive or misunderstood in another.

- Take the time to build rapport with the patient before discussing sensitive issues. Establishing trust and a comfortable environment can encourage open communication.

- When discussing foot deformities and fungal infections, use clear and simple language to explain the condition, treatment options, and expected outcomes. Avoid medical jargon that may be confusing or intimidating.

- Some cultures place a high value on modesty and privacy. Observe the patient's reactions and ensure that they are comfortable with the level of exposure required for examination or treatment.
- Encourage patients to share their concerns and preferences by asking open-ended questions. This allows them to express their thoughts and feelings without feeling rushed or pressured.
- Practice active listening to understand the patient's perspective fully. Validate their experiences and feelings and show empathy towards their concerns.
- Be prepared to adapt your approach based on the individual patient's cultural background and preferences.
- In some cultures, patients may prefer to be treated by healthcare professionals of the same gender. Respect these preferences whenever possible.

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4 POSTURAL AND MUSCULOSKELETAL PROBLEMS OF THE VISUALLY IMPAIRED, FOCUSING ON THE SHOULDER GIRDLE AREA

Tünde Lebenszkyné Szabó, Nóra Simon, Dóra Kiss-Kondás, Andrea Lukács

4.1 Occurrence characteristics of shoulder joint harms

Shoulder pain is a complaint that occurs in middle-aged, active, working people, and can place a significant barrier on the performance of daily activities. In most cases of shoulder pain, no clear structural abnormality is found, which can be confirmed by imaging (physiotherapy). However, several factors are usually involved, and the pain syndrome negatively affects functional abilities and becomes recurrent or chronic in up to half of the cases. The prognosis of diseases associated with shoulder pain is very varied; only about half of the new onset cases become asymptomatic within half a year of my start-up. (Masters, 2007) Data on the prevalence of shoulder pain vary, as it is not always reported as a diagnosis in the health care system due to its variable severity and duration. In addition, the data differ significantly due to country case definitions, economic differences, health system deviations, etc. (Luime, 2004) However, it is agreed that lesions associated with shoulder pain, as with other degenerative processes, show an increasing tendency. This is likely to be explained by an increase in age and years at work. (Lucas, 2022) Based on some data, its 1-year prevalence can reach 55% (Lowry, 2023), *with a maximum* life prevalence of up to 70% (6.7-66.7%), making it estimated to be the third most common musculoskeletal complaint in the world (Luime, 2004, Singh, 2015). As a result, shoulder pain is a significant financial burden to the patient and his family, as well as to individual countries due to the loss of work and the burden of the health care system. (Eubank, 2021)

The diagnosis of these disorders, which are associated with a different functional status and impair quality of life, is based primarily on the results of clinical examinations. The sparing at the onset of shoulder pain may result in a further increase in the loss of range of motion. An upset muscle balance in any age group slows and complicates the rehabilitation of the shoulder joint.

The predictability of expected rehabilitation results is an important consideration for professionals working in the clinic, as these can be used to determine common treatment goals with the patient. Understanding the structure and function of the shoulder structures and

complex interpretation of complaints and circumstances is essential for this and the most appropriate physiotherapy program.

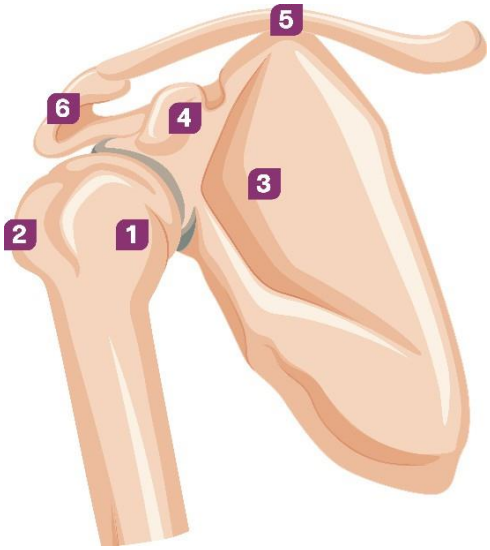
4.2 Functional aspects of shoulder structure

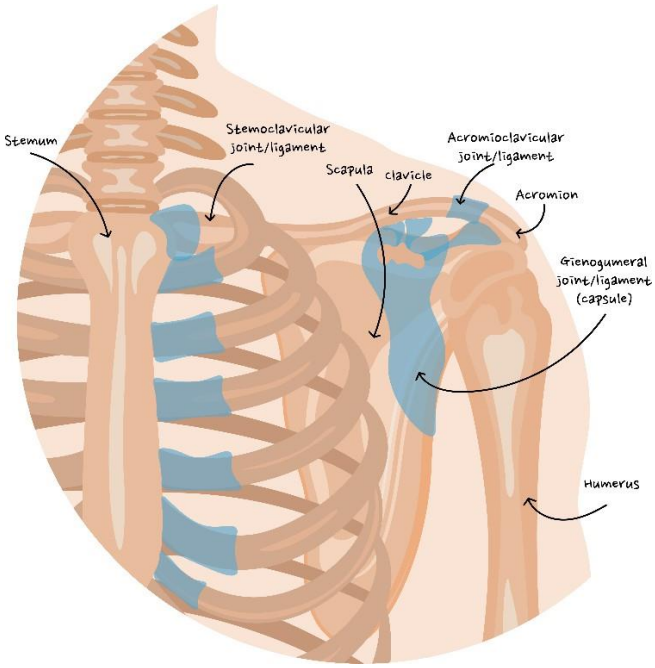
Only a third/quarter of the glenohumeral joint head (caput humeri) is covered by the shallow joint trench provided by the scapula (cavitas glenoid) and the fibrous element attached to it (labrum glenoid). This makes the shoulder joint one of the most mobile joints in the human body. However, due to the known anatomy, ensuring proper head position is highly dependent on the passive and active elements. The role of the labrum in the proper functioning of the shoulder joint is unquestionable. It is also involved in promoting stability by increasing the surface (deepening and widening), centralizing the head and supporting the maintenance of intra-articular pressure. (Almajed, 2022) Passive stability in the shoulder is primarily due to the combined effect of non-contrast elements. In the lower part of the joint capsule, the integrity and mobilization of the fascia (recess) contained therein are conditions for full-motion displacements (especially in the elevation directions). However, the case can only provide static stability independently with its relative loose and strengthening tapes (ligamentum glenohumerale, coracohumerale). Otherwise, stabilizer muscles support this task. Therefore, the role of static stabilizers is to eliminate the gravity effect, most often in the neutral position of the upper limb (e.g. carrying a bag). The work of contractile elements (e.g. supraspinatus, biceps, triceps brachii) increases proportionally to the load and weight bearing. The dynamic stabilizer aids in eliminating superior translational forces and pulling the head into the acetabulum during movement (primarily during abduction). (Maruvada, 2024) These muscles are primarily the members of the rotator cuff (m. subscapular, supraspinatus, infraspinatus and terres minor) and the long head of the biceps Brachii. The reduced work of these structures results in differences in joint arthricokinetic movements, which can cause excessive and abnormal movements and undesirable forces in the joint. Rotator cuff members have a variable role in centralizing the head during movements, but their task increases during mid-travel and load movements, as well as during closed kinematic chain exercises. (Gombera, 2015)

A subacromial, subdeltoidal envelope located near the joint is important for proper functioning, whereby reducing friction in the tendons (m. deltoid, rotator cuff) they contribute to more efficient working of the muscles. Acromion, coracoacromial ligament, and process coracoideus form the coraco-acromial curve creating a channel for the supraspinatus. When lifting the upper limb, the supraspinatus tendon will slip medially by sliding the layers of the bursa here. The channel is rigid, thereby any space-sparing process (increase in the diameter of the structures) affects the mobility of the supraspinatus tendon. (Kapandji, 2019)

However, the latter structures often become involved (inflammation, pain, adhesions, calcification) alone or in connection with other shoulder problems, limiting the extent and/or strength of shoulder joint movements. Their role is also being evaluated in relation to their effect on the regeneration of rotator cuff involvements. **(**Klatte-Schulz, 2022)

The biceps brachii tendon originates from the supraglenoid bulb and the upper part of the labrum glenoid. At the sulcus bicipital, the humerus is flexed, causing the tendon to be subjected to significant mechanical action during muscle contraction. Repetitive traction, friction and movement of the tendon during rotation of the glenohumeral joint often causes inflammation. The long head tendon has a rich sympathetic nerve network in the upper third, which leads to the development of an inflammatory and then chronic degenerative process. (Manpreet, 2024) The tendon is secured by a transverse ligamentous structure and the biceps ring, which stabilizes the tendon in the bicipital fissure under normal conditions. (Nakata, 2011)





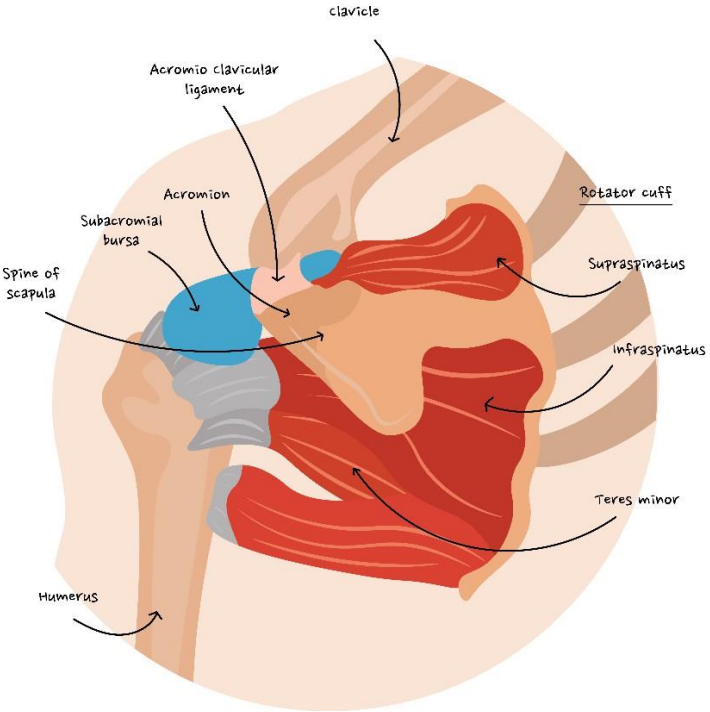


Figure 5 Shoulder joint and major structures 1: Kadi, 2017. 2: Woodward, 2000. 3: Hopman, 2013.

The shoulder joint and shoulder belt form a functional unit, thus affecting each other's function in their stability and mobility tasks, i.e. they depend on each other. A scapulo-humeral rhythm of adequate rate and scope provides the full range of motion of the shoulder joint. Do this to ensure that the "executive organ" (the hand) of the upper limb is involved in almost everything we do (Moscato, 2010) is in the most optimal position in the space.

The upper extremity connects to the axial frame through the acromioclavicular and sternoclavicular joints and through the scapulothoracal functional link. Muscle groups of the shoulder belt, such as trapezius, levator scapulae, rhomboides, and serratus anterior, contribute indirectly to the function of the glenohumeral joint by adjusting, manipulating, and stabilizing the scapula. The synergistic relationship between the scapula and glenohumeral joint allows the arm under normal conditions to perform high-volume, yet precise motions without becoming unstable. The variable position of the shoulder belt, such as the protraction shoulder support, contributes to reduced range of motion in the shoulder joint or compensation movement patterns.

The normal position of the scapula can be determined relative to the chest and spine (height, distance, rotation) and other factors (e.g. symmetry, axis, plane). The position of the scapula is highly dependent on the position of the vertebrae (neck, back) and the condition of the stabilizing muscles. (Rees, 2021)

The scapula movements are arthokimatically complex, as it must not only conform to its shape in the scapulo-thoracic connection, but also create the consistency of rotational-like

movements through its joint with the clavicle at the same time. The changes in his movements also involve a change in the scapulo-humeral rhythm (diskinesis), which is not a musculoskeletal diagnosis on its own, but may be a cause of the development of certain shoulder complaints. Proper coordination between anatomical structures and muscle groups can be an important key to preventing and treating shoulder injuries. However, it cannot be clearly stated that the discrepant pattern of scapula movement is always a pathoanatomic factor in the background of shoulder joint complaints. (Lange, 2021) During the elevation movement of the shoulder girdle, the movement is accompanied by extension and lateral flexion of the spine, so keeping the spine flexed or not fully extending can limit free shoulder movements. (Land, 2017)

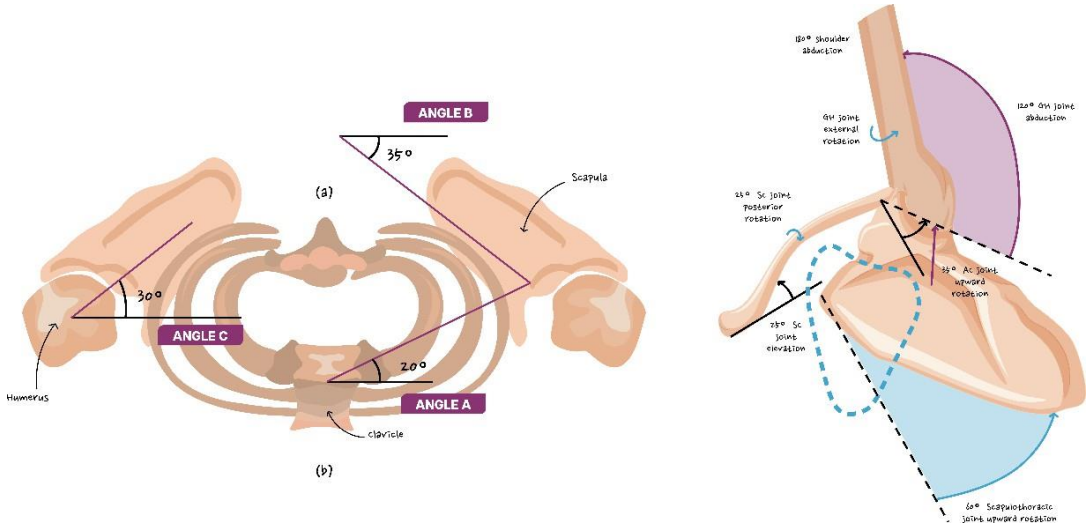


Figure 6 Shoulder-shoulder joint relationship (Crookes, 2023)

4.3 Proprioception and shoulder support of visually impaired persons

The relative position and movement of the body segments is ensured by a serious, coordinated neuromuscular background. Appropriate movements are based on inter- and intra-synchronisation of muscles, for example, for which extra-, inter- and proprioceptive information can be obtained. Vision is an important source of information for coordinated movements and postural and equilibrium skills among human senses such as proprioception, somatosensation and exteroceptive stimuli. (Moon, 2021) Proprioception is “afferent information from the internal peripheral areas of the body that contributes to posture control, joint stability and a variety of mindfulness.” Somatosenization is a broader concept, which, in addition to proprioception, means all other information coming from the periphery, including information from the receptors of mechano-, thermo- and pain. Thus, proprioception can be considered an important part of somatosenization. The term used to summarize the factors necessary to

accomplish the task is called neuromuscular control, which provides dynamic stabilization of the joints. (Riemann, 2002)

Despite the high prevalence of vision loss and blindness, relatively few studies have looked at postural and musculoskeletal problems in visually impaired people.

Due to the complications caused by diabetes with an increasing incidence, it is expected that vision injuries will continue to increase. Visual information strongly supports proprioceptive information for postural adjustment. Persons with visual impairment may have different functions due to lack of visual control in their coordination, posture and balance control mechanisms. (Walicka-Cupry, 2022)

One of the most important senses is vision, which affects other senses and motor control. In this way, it affects essentially the performance of all functional tasks. Loss of vision can occur at any age, but most often occurs in the elderly due to macular degeneration. Individuals with poor vision have pronounced musculoskeletal complaints such as muscle pain, neck and scapula stiffness, fatigue, and other symptoms. In addition, other musculoskeletal problems may occur due to the impaired coordination of the eyes and hands. In the absence of vision, the information provided by proprioceptive receptors may result in misfeed-back. Thus, the absence of visual motor stimuli may necessitate the use of a compensation strategy, resulting in a different retention and movement pattern. (Zetterlund, 2009) Reduced vision, but especially blindness, causes abnormal sensorimotor interaction. Insufficient visual information due to reduced or lost vision leads to an increased incidence of musculoskeletal problems. (Alghadir, 2019)

Overuse of non-physiological muscle and joint movements and positions typically leads to recurrent or long-lasting symptoms of stiffness and pain, typically in the shoulder girdle and neck area. (Zetterlund, 2016)

4.4 Shoulder pain

Therefore, the complex anatomical system of the shoulder region may be due to a variety of abnormalities from many structures, therefore its differential diagnosis may be difficult. It makes analysis even more difficult, because in many cases, shoulder problems do not involve an imaging-proven abnormality. Chronic shoulder pains result in muscle imbalance, loss of range of motion and functional deterioration. Rehabilitation is slowed by the appearance of a violent reaction (sensitization) to pain in patients, fear of movement due to fear of pain, and/or compensatory shoulder and trunk movements.

The effect of pain on motor function is unclear but may interfere with the pattern of movement. Individuals who experience pain may exhibit poor motor performance and may have a reduced ability to learn certain motor patterns. At the same time, pain adaptability seems to be striving to accomplish functional tasks through the nervous system's operating strategy. The path is to find the movement pattern with the least pain. Over time, repeating these movements will reduce pain. (Arieh, 2022) These mechanisms may be important to support the body's self-

healing mechanisms, however, if altered patterns of movement persist, they may become a rehabilitation task.

Studies also link the severity of avoiding fear of painful movements with measures of pain-functional deficiency. (Gonez, 2023) The development of pain is multifactorial and varied in its characteristics (intensity, localization, nature, etc.), which, in addition to the unique characteristics of the client, affect the effectiveness of the therapy. The severe pain sensation results in less rehabilitation success, i.e. in this case, a more moderate and difficult rehabilitation result can be predicted. However, there is no clear, strong evidence that the longer duration of pain and complaints, or the initial greater degree of limitation, would clearly project a weaker result in advance. In addition, the effect of psychosocial factors cannot be negligible in the rehabilitation process. (Kuijpers, 2004) In the case of atraumatic shoulder pain, psychological factors such as the level of pain, the patient's goals, and the perceived disability, influence the level of perceived discomfort. The same cannot very often be said for the clinical picture (physical examination findings, structural abnormalities). Higher levels of self-efficacy lead to greater improvement in shoulder pain during rehabilitation. (Grandizio, 2022)

In case of persistent pain, it is important to judge the severity of the patient. This includes an individual's adaptation, attitude, and employee coping strategies for pain. Myths about pain determine what the patient does with this feeling (prevents, reduces, or amplifies it). This different pain sensation and processing should also be considered during physiotherapy in case of chronic pain (Bahadir, 2023)

4.5 Classification of shoulder complaints

One way of classifying shoulder complaints is to classify those that are related to an accident or traumatic event and those that are not. However, it is certainly a very common and significant individual and social burden problem that is often associated with other diseases (e.g. stroke, diabetes, hypertension, thyroid dysfunction, psychological disorders).

Periarthritis (43.1%) and sub-acromial pain syndrome (26.9%) are high as causes of shoulder pain, but typically vary between younger and older ages. Periarthritis and subacromial pain syndrome are more typical in younger ages. People over 40 years of age are at increased risk of chronic rotator cuff involvement (inflammation, rupture), adhesive capsulitis or arthritic process of the glenohumeral joint (osteoarthritis). Although, in the case of the latter, it is possible to talk about processes that are still starting, so these cause slight complaints, which usually have intermittent appearance, and then increase with age, they thicken. People over 61 years of age have a lower cure rate due to a worse prognosis of periarthrotic involvement. Frozen shoulder syndrome and calcified tendinopathy peak in the middle-aged (40-70 years).

Appearance of shoulder symptoms is accompanied by repeated or chronic involvement of individuals in about half the time. Regardless of the cause of the disorder, pain in the shoulder is the most common cause for a person to seek medical attention. In addition to pain, loss of movement (extreme limitation when the shoulder is frozen) and weakness are the most common complaints. (Murphy, 2010)

The medical history and the common shoulder complaints during the physical examination can be grouped according to the following division: subacromial pain syndrome, adhesive capsulitis, glenohumeral instability, and other common diagnoses. (McClure, 2014)

Rotator cuff involvement involves one or more muscle tendons. The most common is the involvement of the supraspinate artery, which is often associated with the irritation of the long head of the biceps brachii and/or bursitis, but they may also have independent inflammatory processes. Its causes are varied: it can have functional, degenerative and mechanical backgrounds.

Impingement syndrome refers to the mechanism of the disease, in which case the tendon injury develops with a collision and pinching mechanism between bony structures, which results in inflammation, consequently picking and then partial or complete rupture of the tendon. (Murphy 2010) This process may also be associated with inflammation of the subacromial bursa. **(**Yang, 2021)

Newly, an effort is being made to unify the nomenclature of shoulder involvements, as there are several forms of division and naming (e.g. rotator cuff syndrome RCS, subacromial pain syndrome SAPS).

It **is customary to distinguish between two forms of** impingement syndrome, its external type, subacromial impingement syndrome (SIS, SAIS), which is caused by the narrowing of the subacromial space (primary form) or occurs due to the decrease in stability caused by the imbalanced muscle balance (secondary form). In this form, irritation of the supraspinous tendon of the m under the acromial arch occurs. In addition, the internal impingement type can be distinguished, which, in connection with overhead workflows, causes repeated impingement of the lower deep fibers of the rotator cuff to the glenoid fossa (anterior, posterior). Subcoracoideal syndrome is also differentiated in other divisions. (Garving, 2017)

Subacromial pain syndrome is the summarized name of all problems associated with complaints in the subacromial area. Thus, it includes, for example, impingement syndrome, tendinopathy affecting the rotator cuff, primarily supraspinous, tendinitis and bursitis. (Rees, 2021)

Adhesive capsulitis or frozen shoulder syndrome is a condition of characteristic symptoms and unknown etiology. In the event of its development, severe pain, increasing at night, severe passive and active range of motion (mainly abduction, flexion and rotation) and persistent functional impairment can be encountered. The characteristic of the disease is that several periarticular structures are affected, and despite the reduction of pain, connective tissue limitation may make further improvement impossible for conservative treatment. Imaging does not usually confirm any particular abnormality. It may be primary and secondary in shape. In the case of the primary form, there is other organ involvement, which means an increased risk factor for the development of shoulder joint complaints (e.g. thyroid disease, Parkinson's disease). The secondary form is created in case of immobilization due to shoulder injury or

other pathology associated with shoulder pain (e.g. impingement, biceps tenosynovitis, sclerotic tendonitis).

The disease itself can be divided into three stages. The first is a period of “freezing”, which typically lasts for 2-9 months, and is mainly determined by pain (diffuse, severe) which often causes the patient to complain of lack of sleep and sensitivity.

The second is a period of “frozenness”, which lasts 4 to 12 months from the first symptoms. In this case, in addition to gradual pain reduction, significant progressive loss of movement (flexion, abduction, rotation and rotation) can be found in the tight, rigid shoulder joint. In the third phase, during the period of “melting” (5-26 months), in addition to cessation of pain, the return of movements is typical. Although the disease is self-reliable, complications resulting from inactivity may cause permanent or permanent damage, disability, and functional difficulties at the end of the entire healing period of 1-3 years. (Chan, 2017)

Glenohumeral instability is usually caused by congenital conditions (joint incongruence, ligament laxity, etc.) or traumatic injuries. The extent, nature, and lifestyle of the individual of stability deficiency basically determines the need to manage the involvement.

In **glenohumeral arthritis**, cartilage degeneration affects all joint components as the process progresses. It often appears in association with other diseases and creates functional limitations with increasing and sustained pain in the shoulder joint.

Scapular dyskinesis can be associated with any shoulder joint problem. In fact, it is a term used to describe the position and movement of the scapula and is not a musculoskeletal diagnosis. The significance of the glenohumeral joint angle may be therefore in the change of its movements, in the increased tension of the acromioclavicular joint, in the modification of the size of the subacromial space, and in the activation abnormality of the shoulder muscles. Its development can be influenced by a number of factors, such as thoracic kyphosis, shortened thoracic connection, AC joint involvements, glenohumeral joint lesions, cervical radiculopathy, etc. It is also influenced by tension and stiffness of the short head of the pectoralis minor and biceps. Periscapular muscle function typically changes in dyskinesis, so the anterior and trapezial muscles of the serratus rotating the blade outwards. Impingement syndrome, shoulder pain can also cause the movement of the scapula to change (posterior tilt, upward rotation), thereby forming dyskinesia. Similarly, prolonged scapula dyskinesia may reduce the strength of the rotator cuff, increase the impact symptoms, and increase the tension of the glenohumeral ligaments. (Kibler, 2013)

4.6 Risk factors

Each musculoskeletal region affects each other's function, so the pain in the neck and/or back previously developed increases the chances of shoulder pain. Shoulder pain is also influenced by psycho-social factors, as well as environmental factors such as work processes, leisure activities, sleep quality, etc. **(**Roe, 2013) There is no benefit to lying down on the shoulder by compression, but prolonged lying can also cause joint and nerve pressure: weakness, sensory disturbances and pain. (Zenian, 2010)

Repetitive work, especially in obsession, increases the chances of periarticular complaints. (Hopman, 2013)

Shoulder complaints can often be linked to lifestyle and workplace harms. Persistent static, repetitive movements, extreme path of motion movements all support the development of the shoulder pathomechanism. Other risks include prior injury, lifting heavy objects, working with a vibration device, working in cold or humid environments. (Liger, 2015)

Shoulder pains often appear as complications on the ground of certain diseases, such as inflammatory or other diseases (rheumatoid arthritis, gout, systemic lupus erythematosus, polymyalgia rheumatica, diabetes mellitus). Or shoulder complaints may be increased in certain conditions (stroke) or conditions. An example of the latter is sustained immobility. (Murphy, 2010)

4.7 The Examination

The effectiveness of a patient examination is an important consideration in shoulder pain. Physiotherapists play an important role in ensuring that treatment can be started as soon as possible. The first step is to obtain a thorough medical history and physical examination to identify, if possible, the disorder underlying the shoulder syndrome and to determine whether the treatment or other professional examination can be started within the professional competency limit. In other words, one of the main functions of the diagnosis is to identify whether the source of pain originates from the cervical spine, the glenohumeral joint, the periarthicular units, or a connection to the shoulder girdle. It may be difficult to detect real backgrounds that a problem in one region may help cause one or more of the other segments to become asymptomatic (e.g., effects of the shoulder or cervical or thoracic spine on the shoulder joint, or in case of shoulder joint pain, excessive pain in the shoulder belt or elbow joint area due to compensation). When complaints are reduced, the original cause may appear. Cause and causality are also essential to determine treatment goals and methods as quickly and accurately as possible. Delayed initiation of therapy or inappropriate selection will clearly result in worse results during rehabilitation. (Lowry, 2023)

A method of assessment of shoulder pain symptom complexes and guidelines to support the decision on the patient's future life course are available, but the decision must always be individualised in the context of the individual and the environment.

The design and results of the study are also determined by the scientific knowledge, preparedness and experience of the specialist, as there are very diverse study opportunities available. It's also worth remembering that the current state of the clinchers, their performance level of that day's mood, pervasive environmental factors, etc. They affect which may distort the results when measuring back. However, it is important to be as objective as possible in the patient study, so in the past decade, several research teams have tried to develop a more consistent evaluation strategy for physiotherapists, taking into account the results of the functional studies. (Ristori, 2018) Examples include: modified Delphi consensus approach (Eubank, 2021), the shoulder symptom modification procedure (SSMP) (Lewis, 2009), the staged approach for rehabilitation classification: shoulder disorders (STAR-shoulder) (McClure, 2015), and the Klintberg proposal (Klintberg, 2015), Algorithm for Clinical Reasoning (Santy, 2022)

The patient examination starts with the recording of the medical history. When obtaining medical history, it is important to record the patient's gender, age, activity, occupation, pre-existing medical conditions, present complaints, and information related to previous injuries, treatments, and other factors that may affect the symptoms developed. The latter is primarily aimed at identifying risk factors.

Regarding "red flags" and "yellow flags" phenomena. During the interview with the patient's, ask about the characteristics of the indicated pathologies: Red Flags.

What are the present symptoms and complaints? Where and when does pain occur? (pain at night: inflammation, tumour, hot area, redness, swelling - infection)

Has the patient had any accidents or injuries in the last few days? (acute injury: bruise, sprain, accident, haemorrhage, deformity, pain - dislocation = TRAUMA), no instability

A possible injury that causes weakness and pain, as this is exclusionary for physiotherapy treatment. Similarly, signs of inflammation (warm, redness, swelling) and connective tissue proliferation (tumour) require discontinuation of the patient examination, suggesting further medical examination. Radiant symptoms may also be caused by the heart, gastrointestinal complaints (MI - myocardial infarction - cold sweats, chest pain, dizziness, nausea; tension, muscle fever-like pain - compartment syndrome, thrombosis; side injury, panic disorder, etc.), and should be considered. Complaints from the neck section should also be excluded. For example, cervical spine involvements, neck nerve involvements (cervicobrachialgia, thoracic outlet syndrome), in addition to the medical history, physical examinations, e.g. special tests, may be performed. (Rees, 2021)

In the case of painful diseases, the issue of pain is always in focus. The division of shoulder pains can be accomplished through an anatomical structure - either tissue or a pathanatomic mindset based on causality analysis. However, this type of approach does not clearly define physiotherapy diagnosis and rehabilitation strategies, because due to differences in extent of involvement, comorbidities, personal characteristics of the client (quality of life) individual level evaluation is always necessary. (McClure, 2015)

The characteristics of pain affect the identification of the origin of the problem. Typical questions about shoulder pain are about the location of symptoms, duration, day part characteristics, nature, enhancing and mitigating factors. In case of severe pain occurring during moderate movements or even at rest, the number of feasible examinations becomes severely limited, making it difficult or impossible to make an accurate diagnosis.

Assistance with medical history questions may be obtained from several literature sources. Such as A revised Delphi approach to address the following as part of the core set of questions: Can you characterize your pain?

- When in your shoulder do you feel the most pain?
- How long have you been symptomatic (i.e. date)?
- Is the shoulder problem the result of an injury?
- Do you have any pain in your shoulder?
- Can you determine the pain?
- Where do you feel the pain the most?
- How long have you been feeling?
- What is your pain severity?
- Is there pain during specific activity?
- Is there presence of night pain?
- Is there pain at rest?
- Does anything aggravate the pain? If yes, specify.
- Does anything help to relieve the pain? If yes, specify. (Eubank, 2021)

Pain intensity is usually determined using a visual analogue scale. Its nature is more circumscribed (e.g., rip, sharp, dull, pull). Of course, these answers, along with the information we get from other questions, will be really useful. It is worthwhile to carefully investigate complaints with several questions, as the causes of shoulder complaints often manifest in similar symptoms, and their functional picture is often not consistent with the clinical picture (a slight deviation may cause an explicit complaint and vice versa). It may be useful to use condition-specific scales or functional focus questionnaires for thorough investigation. (Roe, 2013)

Questionnaires and functional scales specifically for use in shoulder problems are specific questionnaires that specifically assess pain characteristics and functionality. They do not mostly require a physical examination; asking the patient will determine the level of difficulty, limitation, and pain based on their subjective judgment. However, there is also a combined form that, in addition to asking questions, attempts to further investigate the circumstances and impact of the complaint from a strength and range of motion perspective. This multi-item metric form also requires the recording of measurement parameters by a professional.

Examples of these questionnaires, scales, which may be used for shoulder complaints include:

- Shoulder Pain and Disability Index (SPADI)
- Disabilities of the Arm, Shoulder and Hand (DASH)
- American Shoulder and Elbow Surgeons Score
- Constant-Murley Shoulder Outcome Score (CMS)
- Shoulder Disability Questionnaire (SDQ)
- Simple Shoulder Test (SST)
- Oxford Shoulder Score (OSS),
- Western Ontario Shoulder Instability Index (WOSI)
- Constant-Murley Shoulder Score (Constant)
- American Shoulder and Elbow Surgeons standardized form for assessment of the shoulder (ASES)
- University of California at Los Angeles Shoulder Rating Scale (UCLA)
- (for advanced instability: Western Ontario Shoulder Instability Index (Wosi), Walch-Duplay Score, Rowe Scores)

As previously described, there are a number of algorithms that help with the planning and process of the patient study and, more recently, the treatment. For example, the test sequence diagram created by Rees et al. makes it easier to decide whether to treat shoulder pain. As you can see in Picture 3, following the medical history, a physical examination can be performed to rule out the reasons necessary to identify non-shoulder areas or other cases requiring special treatment (red flags, acromioclavicular joint, cervical segment involvements).

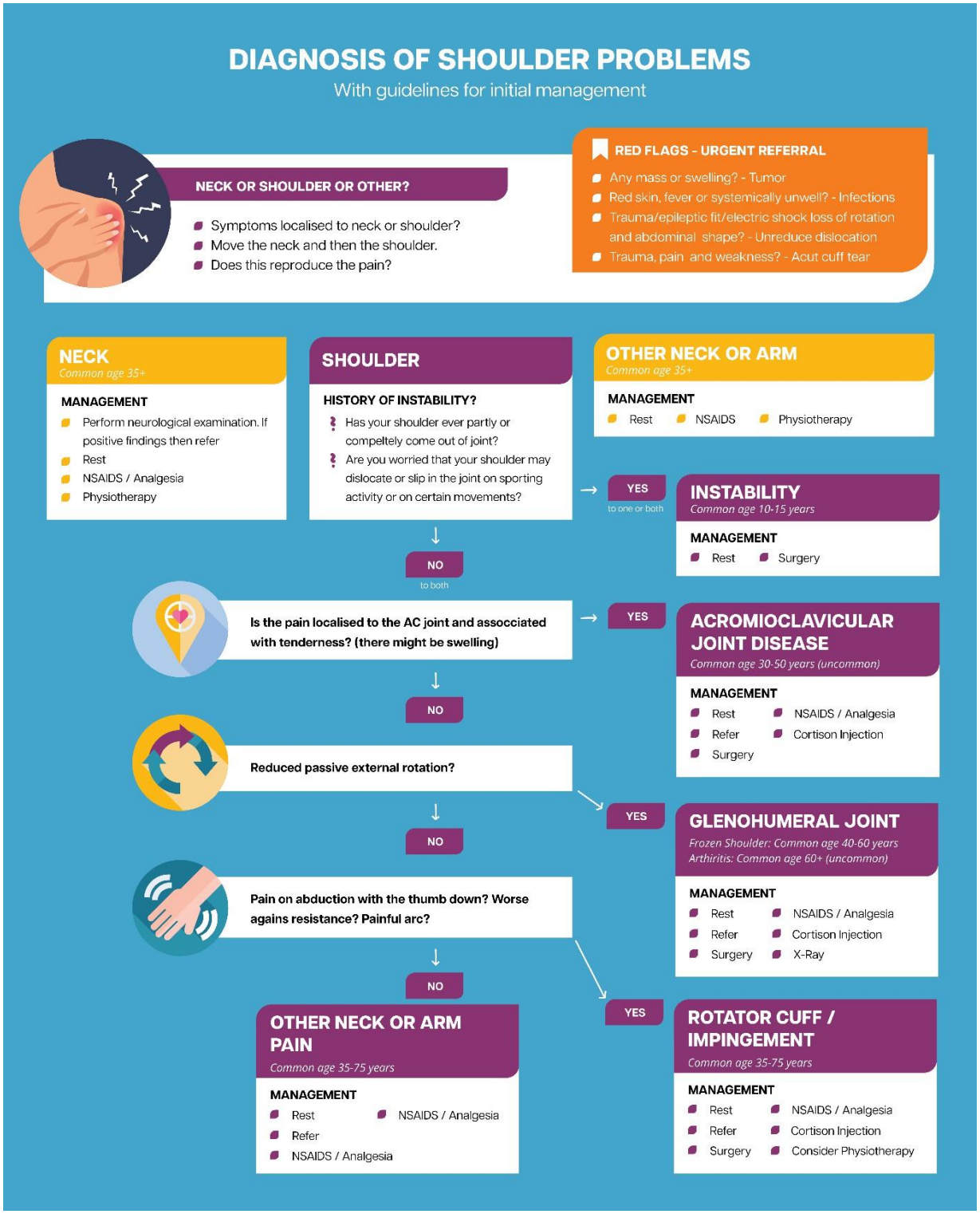


Figure 7 . Diagnosis of shoulder problems in primary care. Guidelines on treatment and referral. (Rees, 2021)

4.8 Physical examination

Using the conventional scan sequence, useful information about the symmetrical, normal, or different shapes of the client shoulder can be obtained from a single view. Deviations can be identified, such as asymmetrical shoulder support or upper limb support abnormalities, muscular atrophy, other disorders (redness, wound, scar, swelling, hemorrhage). For complete analysis, it is also important to view the posture and position of the shoulder belt from the front, back, and side. At the time of the patient's arrival, introduction, and medical history, the movement or absence of upper limb can be seen. In case of pain, the person tends to squeeze the upper arm (with the adductive support of the shoulder joint) due to the gentleness of the upper limb, so the expected synchronization does not occur during walking. Viewing is often done with touch. During viewing, examination of the shoulder belt and the cervical and thoracic spine is recommended, as they also affect the position of the shoulder joint, which affects the feasibility of movement. Keeping the head and neck in place by overloading the muscles between the shoulder belt and neck vertebrae can cause abnormal scapula position or disabling of the muscles that define this. The position of the scapula also affects the position of the shoulder joint as previously described. Because of these overloads, we often find painful muscle nodules (trigger points) resulting from postural defects, even in healthy individuals. Both bony and soft tissue structures can be palpated, which may be sensitive to pressure. (Eubank, 2021) When testing the sensitivity to pressure, it is also worth checking the supraspinatus and biceps brachii tendons, but also in other areas, such as the adhesion of the deltoid muscle or cervical muscles, the tenderness seen in many cases, but also in the area of the acromioclavicular joint can be provoked. (Yang, 2021)

In addition to the size of the postural characteristics and deviations, the measurements can be performed as well as the gonio- or inclinometer or centimeter tape tests of the range of motion. In this case, as seen during the viewing, it is worth specifying a comparison study of the two sides in cm as well.

During the inspection and palpation, the posture can be analysed in several planes, paying particular attention to the shoulder girdle area. This involves a comparative examination of the two sides, analysis of the line of gravity and the location of reference points. The Lennie test shows, in centimetres, whether the points defined on the thoracic spine coincide with the three reference points of the scapula. Physiologically, the superior angulus is palpated at the level of the second dorsal vertebra, the spina scapulae at the level of the fourth dorsal vertebra and the inferior angulus at the level of the eighth dorsal vertebra. Meanwhile, it is also checked that the distance of the marked points of the scapula from the spine is symmetrical with respect to the two sides. A deviation in the position of the scapula also implies a change in the position of the shoulder joint. (Sobush, 1996)

Because the cervical spine and shoulder belt affect the chin of the shoulder joint, determining their position may be an important consideration during the study. These can be determined or followed by measuring the distance of bony structures from the wall (for example, occiput or acromion) in the patient's usual standing position. You can also use apps that can be downloaded to your phone to check the position of your head, neck and shoulder. These tests

may be useful to objectively determine the position of the shoulder girdle and cervical spine, which will allow the effectiveness of the treatment to be monitored.

These phone applications are often free and allow more thorough measurements.

Simple and easy to use protractor. The app allows you to measure angles from images or from camera, in real time. With Angle Meter 360 an unlimited number of angles can be measured simultaneously. Adding new devices to an object or removing old items allows you to compare data from multiple angles at once. Scaling, moving the measured object, as well as the ability to change the colours of the tools, allows you to measure angles easily, quickly, very accurately.

Measurement of neck angles: two Pictures are taken of each participant according to defined criteria. To take the Pictures, the pendant pewter is fixed to the wall next to the chair and the mirror is placed opposite the participants at eye level. The subject is seated on the chair and then the points defining the planes are marked on them using marker dots: vertebra C7, the middle of the two eyebrows, the tragus and the tip of the acromion. The Picturegraphs are taken at a distance of 1.5 m from the participants, first in a neutral position (corrected position) and then also in a habitual position (relax, siting in usual position). The gravitational force acting on the pendant ensures the vertical orientation during the test. The perpendicular lines projected onto the vertical vector point to the right in the digital Picturegraphs and form the X-axis, the Y-axis being the vector provided by the pendant itself. The Pictures are evaluated using the Angle Meter program, first the auxiliary lines are drawn and then the CVA, HTA and SHA angles are measured as shown in the Picture.

- CVA: craniovertebral angle, the line drawn through the points of the tragus and C7 processus spinosus and the angle enclosed by the horizontal.
- HTA: head-tilt angle, the angle enclosed by the line joining the points of the tragus and labella and the vertical (y-axis) drawn on the tragus.
- SHA: angle characterising the position of the shoulder, the line joining the acromion and the spinosum of the C7 processus and the angle enclosed by the x-axis. (Ormos, 2010)

As well as clear shoulder joint and joint shoulder joint movements, the degree of scapula movement can also be examined. In the meantime, it is important to monitor and correct the quality of movement to avoid compensation. It is the responsibility of the examiner to position the examiner properly and perform the requested task as expected for accurate data and repeatability. At the end of the passive range of motion, the implementation of a pressure - controlled end-state sensation may be important for further examinations and treatments. For example, a hard bony or capsular state of end may call attention to the need for additional scans.

The information about pain that disappears, increases or decreases during movements also

helps to make the diagnostic evaluation as accurate as possible. This can often be read from the patient's gestures and physical reactions, but questions can also be asked to find out about the nature and strength of the pain.

The most accurate method of measuring muscle strength is instrumental, machine measurements, but if these are not available, conventional muscle strength measurement (Medical Research Council Muscle Grading System) is recommended. In addition, functional or special tests can be performed to determine whether the level of muscle function is appropriate (for example: wall push-up test - anterior serratus m). This can often be obtained in tests that do not have the main purpose of measuring muscle strength, but require proper muscle effort to perform the test (for example: Jobe test-m. supraspinatus)

When carrying out special tests, the patient's pain level should be taken into account, as these tests often increase it. It is not the purpose of the study or the treatments to induce intolerable, large pain.

4.9 Special tests

These tests will help further clarify the origin of the pain. Unfortunately, there is no test to clearly determine the source of the problem, but you can confirm what has been thought up to this point in previous studies.

For the following examinations, the patient needs to be aware that pain may be induced during the examination and that pain may sometimes be provoked to identify the underlying cause(s).

Special tests may be performed to rule out problems of cervical spine origin. (Jones, 2023)

Spurling test - for radiculopathy testing

The purpose of further examinations is to rule out the origin of the cervical spine.

Spurling test - to examine radiculopathy

Standing behind the seated patient, the treating physician moves the head into extension, lateral bending, and contralateral rotation, and then applies axial pressure to the cervical spine. The goal is to create cervical nerve root compression.

The test is positive when symptoms appear:

- occurrence of local pain, e.g. arthritis, degenerative processes
- radiating pain in the direction of the upper limb, e.g. nerve root involvement

Other provocative tests for the cervical spine:

Shoulder abduction (relief) test – the patient places the side arm of the radiating symptoms on their head. If this causes a reduction in nerve symptoms, the test is considered positive.

Cervical distraction test - when the patient is in the correct position in a sitting position, the examiner will hug the head under the chin and at the back of the neck. Then, distraction removal force is applied. The test is positive if the symptoms are reduced. (This can also be combined with a compression test. If compression increases, dstraction reduces symptoms, even more likely spinal nerve involvement.)

Additional tests may be performed, such as Arm squeeze Body Nerve Stretch Tests

L'hermitte sign: When the patient is seated, the examiner passively flexes the patient's cervical spine. A positive test result is a sensation of electric shock in the spine or extremities. In many diseases, positivity may occur, but is predominantly in neurological diseases, such as multiple Sclerosis. (Khare, 2015)

Hoffman sign: A test can be performed in case of spinal cord abuse (degenerative myelopathy), in which the examiner taps the distal wall of the middle finger on the patient's hand (passive downward movement). Positive test if flexion-aduction of thumb and index finger of the same side is achieved in response. (Johnes 2023)

Examples of tests that may be performed in case of suspected **thoracic outlet syndrome** include: Adson, Wright, Eden, Roos, etc.

Shoulder instability tests:

Load and shift test: A test performed while the patient is lying down or sitting, in which the examiner stabilizes the scapula with his/her close hand while with the other hand, he/she will hold the proximal part of the upper arm (finger on humeral head, front), the patient relaxes his/her muscles. The examiner then shifts anteromedial (anterior stability) and posterolateral (posterior instability). The normal anterior motion should not be greater than half of the humeral head.

Anterior drawer test:

The patient is lying on her back, the examiner encapsulates the patient's arm, stabilizing the scapula entirely proximally with her other hand (finger I on the coraoid process, others looking back). From here, the patient moves the relaxed arm to an abduction of 80-120°, 20° flexion, and 30° rotation, and then moves forward. Positive for high displacement of the other shoulder joint (about a quarter of the head).

Posterior drawer test:

The patient is lying on her back, the examiner circles the patient's arm all the way proximally and stabilizes the scapula with her other hand (finger I on the coraoid process, others looking

back). The examiner moves the shoulder joint into 90° flexion with the patient's elbow flexed and relaxing muscles. Axial pressure is then applied from the patient's elbow in the posterior direction. Positive for high displacement.

Inferior instability, Sulcus sign:

The patient is in a sitting position with an arm next to her body with an elbow flexion of approximately 90°. The examiner pulls the humerus in the inferior direction by covering the patient's upper arm distally. The test should be performed with a neutral, then outwardly rotated arm. Positive test if fissure appears in subacromial region.

(Valencia, 2017) (Eshoj, 2018)

Tests of shoulder structures

The cross-body adduction test (scarf test)

This is also the very simple test. With the patient in the sitting position, the examiner moves the arm in 90° of forward flexion and was adducted across the body. The test was considered to be positive if it caused pain in the shoulder, pain may occur in the AC joint (possibly the SC joint).

Painful arch body

In the standing position, the patient performs an abduction movement of the upper limb throughout the full range of motion. The patient's complaints can identify the involvement: pain between 150-180° indicates involvement of the acromioclavicular joint, while pain between 60-120° indicates involvement of the glenohumeral joint (e.g. impingement syndrome).

The test can also help to identify other characteristics: it shows muscle strength - 3 on Oxford scale (0-5)

Apley scratch test

The test is a quick range-of-motion test that can provide information on pain and ejection difficulties. The patient attempts to touch the opposite scapula in two steps to test shoulder range of motion.

1- During abduction and external rotation testing, the patient tries to touch the opposite scapula from above.

2- During adduction and internal rotation testing, the patient tries to touch the opposite scapula from below.

If not one or both attempts are unsuccessful, a more thorough examination of shoulder-shoulder girdle mobility may be necessary.

In case of pain, further detailed examination of the shoulder joint is recommended (e.g. impingement, rotator cuff involvement). (Batool, 2016)

Modified Apley test: the previous test can be done with both arms at the same time. In such cases, the vertical distance between the two arms can be measured by bringing the fingers closer to the other, which can be an objective measure of the improvement during the treatment. With normal shoulder mobility, the fingertips reach each other.

Hawkins Kennedy Test | Shoulder Impingement

The examiner sets the patient's arm in 90 degrees of shoulder joint flexion, the elbow is also in a 90-degree flexion position and from there (with or without supporting the upper arm), and internally rotates the shoulder joint. The test is positive if there is pain during the test.

Infraspinatus test

During the infraspinatus test, the elbow is also included at 90° and the upper arm is locked next to the trunk. The examiner then asks the client to hold the arm against resistance and applies inward rotational pressure to the forearm. The test is positive if there is pain or weakness during the test.

Jobe / Empty Can Test | Subacromial Pain Syndrome (SAPS)

The patient is tested at 90° elevation in the scapula plane and full internal rotation (empty can) or 45°external rotation (full can). Patient resists downward pressure exerted by examiner at patients elbow or wrist. The test is positive if there is pain or weakness during the test.

Scapular retraction test

The examiner's forearm rests on the border of the patient's scapula (at its medial edge), fixing it to the chest. Maintaining this case, the empty can test is performed. The test is positive if the strength of the rotator cuff is restored. (Kibler, 2006)

Shoulder dyskinesis / Scapular Assistance Test (SAT)

This test indicates weakness of the scapula stabilizers. To perform the test, the patient is in a standing position, the examiner is behind an increment and fixes the clavicle and scapula with one hand, while the other hand grasps the lower angle of the scapula. The patient’s phone raises the arm forward or to the side while the examiner supports the movement of the scapula.

The SAT test is positive if the patient feels less pain with the assisted empty can than with the unassisted empty can. (Rabin, 2006)

Lateral scapula slide test

During the examination, the degree of asymmetry between the two shoulder blades is measured during the patient's active shoulder movements, at the height of the inferior angle (performed up to the spinous processes of the dorsal vertebrae, on the same horizontal plane). Position 1 with the shoulder in a neutral position, then the humerus is medially rotated and abducted to 45 degrees by placing the patient's hands around the waist, and the humerus is placed in maximum medial rotation and abducted to 90 degrees. The test is positive if there is a difference of 1.5 cm or more when comparing the measurements bilaterally. (Curtis, 2006)

Closed kinetic chain upper extremity stability test

Closed kinetic chain upper extremity stability test During this test, the athletes performed the modified PU position (with knee support), and both hands placed on two adhesive tape markers to the ground at a distance of 91.4 cm. The athlete remained in the modified PU position with one hand on each piece of tape. Then, for 15 s, the athletes alternatively touched the opposite hand. The hand touch count is the score for this test. The athletes completed as many repetitions as possible during 3 sets and rested 45 s between sets. examiner controlled the stopwatch, and the other the touch counts. Then the examined person indicates how much pain it feel in their shoulder joint on the Numerical Rating Scale (NRS). (Tucci, 2014)

Additional muscle tests may be performed, such as:

- Suscapular test: Lift off test, Passive lift off test, Belly-press test, Belly off sign, Bear hug test
- External rotators: External Rotation Lag Sign (Full Thickness Rotator Cuff Tears), Hornblower's sign
- Supraspinate tests, impingement: Neer's test, Full can test, Whipple body test
- Biceps: Speed's test, Yergason's test, Bicipital groove tenderness, Uppercut test

(Jain, 2017)(Ackmann, 2021)

Additional stability tests may be performed, such as:

- Anterior instability: Apprehension test, Shoulder release (surprise) body, Relocation test
- Posterior instability: Posterior apprehension test, Jerk test, Kim test, Fukada test, Push-pull test
- Inferior instability: Inferior apprehension test, Gagey test (hyperabduction test), (Goldenberg, 2020)

Additional tests:

- Labrum involvement: O'Brien test, Anterior slide test, Crank test
- AC joint: AC resisted extension test, O'Brien test

(King, 2014)

If necessary, additional examinations may be performed to detect the suspected problem, for example: neurological tests (sensory examination, nerve stretch tests), circulatory examination.

4.10 Treatment

The treatment decision is mostly made based on the nature of the tissue damage detected, the characteristics of the pain and the degree of functional impairment resulting from them. The basic purpose of treatment is to achieve painless and powerful full-motion movements of the shoulder joint, if possible. (Chan, 2017) By completing the study steps, it was already mentioned that a number of author groups recommended different organizing mindsets regarding the treatment goal based on the results and the principles and methods used in the implementation.

Considering the rating scale of the pain VAS, McClure used the results of the medical history and physical examination to form three groups. Categories are created based on tissue irritability reflecting the physical stress-tolerance of the tissue. The ability to tolerate stress is affected by the individual's physical condition and current level of inflammatory activity. Based on the classification, the extent of the intensity of the treatment can also be determined. One group is those with severe, severe pain (high values between 7-10) who have persistent pain at night or at rest, which also affects the range of motion. When measuring the range of motion (ROM), they are more active than passive. In their case, this high degree of limitation requires the use of minimal physical stress, reducing the activity level. Preferably, physiotherapy in a painless range is recommended, i.e., careful treatment with gradual progression is required. For the second group, pain is moderate, and range of motion is less affected. Moderate pain (values 4-6) occurs intermittently and a minor difference between the active and passive ROM is observed. In their case, mild to moderate intensity treatment can be used. Graduality is of course a concern here, but here, movements in the end range and excessive loading should be avoided. The third group displays low pain with little limitation (values 3 or below). A strong physical program can be given to them, avoiding underloading, striving for high levels of functionality and motor control development.

Treatment planning should take into account a number of factors, such as the patient's clinical condition, functional status, mental and cooperative abilities, capabilities, and other factors that determine treatment goals.

The extent to which outcomes are achieved is based on the joint teamwork of the practitioner and the person being treated, so this type of relationship should be characterised by adequate information and shared responsibility from the outset. The highest level of cooperation (coherence) influences the effectiveness and sustainability of outcomes, so the aim is to establish a partnership from the patient assessment onwards.

Of course, this responsibility comes with risk. Diagnosis is not always clear, many underlying causes may only surface later and misdiagnosis leads to inefficiency. The patient should be aware that the physiotherapist, however well trained, and however "often seen" the problem, cannot be relied upon to make safe predictions.

The ambiguous causal background often arises from simple interrelationships, generalising, affecting multiple segments and formulas (spinal segments, upper limb), triggering neurological effects (e.g. proprioceptor problems, antalgic movement fixation, chronic pain syndrome, fear of pain).

In addition, in the case of shoulder problems, the combined results of the clinical and functional examination can be well evaluated, providing guidance for setting treatment goals and determining the techniques to be used.

In order to start the examination, it is advisable to make use of the available guidelines, which, in simple or more complex form, include the pathologies that should be excluded, if possible, before starting treatment.

When determining treatment options, it is worth using the information obtained during the previous examination, and then regular attention should be given to the feedback and effectiveness to help determine if a good therapeutic course has been achieved.

Treatment should not be used to increase pain, but if moderate pain is present, it should resolve within 12 hours. The physiotherapy should be used to actively contribute to the patient, and to exercise independently. In addition to active/guided active exercises, passive methods such as manual techniques for mobilization may be used to reduce symptoms or causes.

Proper patient positioning and adjustment of the body position are essential for the tasks (both in the trunk and in the upper vesicle). This is useful to use a mirror during the period of body awareness. Without proper practice, erroneous patterns of movement will be followed through home practice. Strive to consciously eliminate compensating movements should also be taught to the patient. The sooner you start to pay attention to the quality of your movements, the easier it will be to apply the exact finish that initially made you harder and slower.

Initially, while pain is greater, it is recommended to perform unloaded situations or non-resistance analytic exercises. In cases of severe functional impairment, at this stage, the primary goal is to carefully increase pain relief and range of motion. In this case, positioning of the limb may be useful at rest. During exercises, shuttle exercises, table, wall slides can be used. (Crookes, 2023) May help increase the range of motion even with tasks performed on the auger system, hand-catched exercises, ribbed movements, etc. In a suitable room, a

suspension grid, CMP or subequal exercise can be performed. If the pain is extremely great, during the day, releasing the arm with a cloth or brace can help relax the muscles in the short term. In other cases, muscle strengthening in the existing range of motion can be started immediately, often with static exercises that require isometric muscle activity, reducing the need for a painful range of motion. For endocrinopathy, external support of concentric activity work and eccentric exercises may be beneficial. The effectiveness of progressive resistance exercises has been demonstrated in terms of pain relief and function improvement as opposed to passive methods (ultrasound, short wave, etc.). At the same time, the types and parameters of these types of applications vary greatly, so careful weighing and gradual combination is recommended. (Augusto, 2024) In some cases, the use of cooling (cryotherapy) may also be recommended to reduce pain and inflammation, or irritation after exercises, for a minimum of 10 minutes and a maximum of 30 minutes. (Hanchard, 2004)

Muscle strengthening not only aims to increase muscle mass and strength, but also to improve joint stability through motor learning, both in the scapula and shoulder joint. An important area of rehabilitation is functional movements, closed kinematic-chained exercises, and the performance of dynamic tasks. Other useful methods and exercises such as scapular stabilization, soft tissue and nerve mobility techniques, shoulder and neck manipulations may be added. (Ibrahim, 2022) During rehabilitation, it may also be important to manage the position of the girdle, the balance of the muscles surrounding the scapula, the movement of the scapula, to implement long-term plans, and to minimize recurrence. Scaping exercises can be beneficial as a motor control program, either separately or in conjunction with thinking in the kinematic chain. (Kibler, 2013) Although there is no clear evidence of its effect, in many cases manual correction of the scapula is routinely used in a targeted program for the reduction of shoulder symptoms. (Christiansen, 2017)

Complex therapy can be complemented by the use of hand-intensive exercises, as it appears that this has a beneficial effect on improvement of shoulder function through the neurological relationship. These types of practices facilitate the activation of rotator cuff members through optimized operation and joint protection. This is done by reducing the activation of the central anterior deltoid artery, which may improve the effectiveness of targeted rotator cuff muscular training. (AlAnazi, 2022)

The majority of cases of shoulder complaints improve with conservative treatments within 6 weeks. And within 12 weeks, we expect a pronounced improvement. Patients should learn good quality shoulder movements from the start of treatment, depending on the options available. However, this can only be expected from the client with painless or mild pain. Muscle pain and fatigue are acceptable to some extent. Quality movements are free from the compensatory movements of the trunk and shoulder belt. To do this, it is necessary to determine the optimum load level for the patient. Pain can be a sign of increased tissue stress, which can prolong rehabilitation time (inhibition of motor re-learning, maintenance of tissue irritation) and may also reduce patient motivation. Clients should be advised not to exercise excessively at home or to other endeavors during the day (carrying, lifting, etc.) as pain decreases, as these will also cause a drop in the results achieved. (Clintberg, 2015)

In the case of visually impaired individuals, it is especially important to improve the patient's coordination and proioception. In everyday life, the blinders should experience as many exteroceptive stimuli as possible, different textures and unstable surfaces. (Walicka-Cupry--2022) This may also be important for the proper functioning of the shoulder belt-shoulder joint, as unstable balance and worse feeling of position will also affect the position and use of this segment. Rehabilitation of blind persons may require the cooperation of several professionals. (Alotaibi, 2016)

Lifestyle advice should always be adapted to the current state. For example, unblocking the patient from carrying or leaning is necessary for an improving patient.

After complete rehabilitation, it is important to try to prevent recurrence, which involves thorough warming, including increasing the circulation of the shoulder, increasing the elasticity of the soft tissue, and increasing the efficiency of synchronized movements. Then, by applying the techniques and sequences learned, a regular exercise program, followed by a conduction combined with stretching techniques, can be provided with the opportunity to reduce shoulder problems. (Ankar, 2024)

4.11 Summary

So the aim of the assessment is always to decide whether we have the means and capacity to deal with the clients who come to us. This can be done through guided questions in the anamnesis, through physical examinations as deemed necessary following examination and palpation. Functional and specific tests can be of great help in this. Symptoms around the shoulder joint are often related to abnormal functioning of the shoulder girdle or abnormalities of the cervical and/or dorsal spine. It is up to the physiotherapist to decide which of the many tests to use and, in the case of a positive test, to confirm the test with further tests from a similar range. It is worth ruling out or just identifying a problem area and starting from there. This is often not easy, however, because there are no big, clear pointers. It should be remembered that tests should never look at a single structure, a wide scope and complexity is needed to get the right result. To summarise, let us now look again at what to look for in the decision-making process of a person with shoulder symptoms.

1. Ask about the present complaints, ask about any additional problems that may require the involvement of other professionals in terms of physiotherapy.

2. Examine and palpate the shoulder-shoulder-bone-neck complex, looking for abnormalities. Try to identify any deviations or asymmetry of the body parts in relation to the reference points. You can also use the application presented here.

3. Measure range of motion or lack thereof using conventional methods (goniometer, inclinometer), or, in case of minor deficits, using functional tests or special tests or during the performance of these tests (e.g. painful face test).

4. Carry out muscle strength testing using conventional methods e.g. British Medical Research Council (MRC) muscle grading or tests that provide information on muscle strength. E.g.: Dynamic Rotator Stability Test

5. Then, based on the results (information you have heard, seen, experienced), carry out the tests you think are necessary. Remember, a single test does not confirm a certain pathological background (specificity), but, taking into account the correlations, they provide a very good basis for a functional diagnosis.

6. Finally, it should be remembered that the relationship and interaction of each movement segment must also be taken into account. To this end, the examination of the shoulder girdle, the cervical and thoracic segments can and should be part of the examination of the shoulder joint. In the longer term, the results of treatment can only be maintained if quality movements are performed, based on good posture and dynamic stability. The latter includes stability provided by the muscles in both open and closed kinematic chain movements.

4.12 COMMUNICATION

In this part of the lesson, you will learn how to communicate with an adult patient with a sensory impairment, especially a blind adult, and what cultural rules should be followed in such a case.

What is a disability? What does it mean to have a disability?

The term "disability" is a complex and multifaceted concept. Despite various efforts, no universally accepted definition of disability has been created to date. The English word "handicap" and its Hungarian equivalents, the words "disabled" or "crippled", are no longer accepted as they are not in line with the contemporary understanding of disability. There may be differences in word usage preferences according to different groups of people with disabilities and also according to geographical areas. The individual wishes of people with disabilities must be respected as much as possible. (Ustun et al., 2003; Krahn et al., 2021)

The International Classification of Functioning, Disability and Health of the World Health Organization (WHO) considers disability not only as a "pathological health condition" or a "biological" disorder, but also takes social aspects into account. (United Nations Enable, 2006) The UN Convention on the Rights of Persons with Disabilities (2006) states that "disability is a changing concept, and that disability is the result of the interaction between persons with disabilities and attitudinal and environmental barriers, which prevent them from fully and effectively participating in society on an equal basis with others". (Leonardi et al., 2006) Disability is therefore a long-term physical, mental, psychosocial or sensory impairment that, together with many other limitations, may limit an individual's ability to participate fully, effectively and equally in society. (Mello et al., 2020)

The 1980 definition of the World Health Organisation (WHO, 2011/a) goes beyond disability as a collective term and distinguishes three concepts that differ in degree and content: impairment can be interpreted at the level of the body, as any abnormality or deficiency in the

physiological functioning of a person; disability or dysfunction manifests itself at the level of abilities, in a psychological context; and handicap appears at the social level, limiting and in some cases preventing the individual from fulfilling his or her everyday role, depending on age, gender, social and cultural factors. In this way, disability is the socialisation of impairment and disability. However, this interpretation still focused only on the disabled person: he/she can't walk, talk, he/she can't fit in, the handicap - as a kind of predestination - comes from him/her. Since the reformulation of the WHO interpretation of disability in 1997, it is no longer about the correlation of cause and effect, consequences moving along a line, a kind of predestined outcome, but - reflecting a significant change in attitude - about the interactions between impairment and social participation, which indicates precisely that the disadvantages resulting from impairment, its extent and perception (but also the deterioration of the condition) depend to a significant extent on social acceptance, the scope and opportunities provided by society. (Scotch, 1988, Leonardi et al., 2006; United Nations Enable, 2006, WHO, 2011/a, Beaudry, 2019, Krahn et al., 2021).

This interpretation states that the person with a disability is not at fault; disability is both personal (individual) and environmental (societal). Disability is therefore not just a fact, but a relationship and a value - it is the perspective of the latter that determines whether or not the phenomenon is interpreted as disability by a given society. We call this approach the 'social model of disability'. (Krahn et al, 2021)

Hungary was the second country in the world to ratify the UN Convention on the Rights of Persons with Disabilities and the first to join its optional protocol. According to WHO estimates, approximately 15% of the world's population, or more than one billion individuals, have some form of disability. Of these, only approximately 5% are congenital abnormalities. A survey conducted by the United Nations Development Program revealed that 80% of individuals with disabilities reside in developing countries. The World Bank estimates that 20% of the world's impoverished population lives with some form of disability. People with disabilities are often referred to as the world's largest minority, but in contrast to other minorities, this group is "open": any individual can join at any time due to an accident, illness or even aging. (WHO, 2011/b)

Visual impairment

A person is considered visually impaired if their visual functions (visual acuity, adaptation, contrast, colour vision, field of vision) and/or processing and interpretation skills (visual impairment in the perception of visual stimuli acquired as a result of brain damage) are impaired or absent. Visual impairment can be hereditary or acquired, organic or functional.

An individual is considered to be visually impaired if the visual performance, as measured with maximum correction in the right eye, is 0-30% of the normal vision and/or the visual field narrowing is 20° or more (WHO, 2011/b).

Visually impaired people are usually divided into three groups according to their existing vision: blind, partially sighted and visually impaired. In accordance with the conventional categorisation, those who are blind are those who have no residual vision. Those who are

partially sighted perceive light, see spots and possibly large objects, but their vision does not reach 0.1. Those who are visually impaired are those whose vision is 0.1 and 0.

However, the assessment of the visual function based on the value of vision is no longer considered authoritative, and this division is also problematic in many respects professionally. Nevertheless, since visually impaired individuals themselves frequently utilise these terms, it is undoubtedly prudent to be fully cognizant of these categorisations. (Brunner et al., 2009)

In a functional approach, a person is considered to be visually impaired if they are impaired in any of the following areas due to an eye disease or a disease of the central nervous system affecting visual functions:

1. Transportation orientation

2. Everyday life (self-care, housework, administration, etc.)

3. Information and communication (computer, reading and writing, etc.)

4. Psycho-social functioning (crisis resulting from visual impairment, difficulties in establishing relationships, isolation, deficiencies in social competence, etc.)

5. Conducting studies Career choice, employment

6. Use of vision and/or use of vision improvement devices

(Brunner et al., 2009; Vidonyiné, 2010)

The functional limitations of individuals with sensory impairments or blindness can present significant challenges to effective communication between physiotherapists and their patients. This chapter presents practical suggestions for overcoming the communication difficulties that are commonly encountered in this context. The objective is to instruct therapists on how to communicate with blind individuals in a confident and sensitive manner that is acceptable and comfortable for the patient, taking into account personality differences, from the initial encounter.

The psychological aspects of blindness

It is important to note that disability is not a disease; rather, it is the result of a congenital or acquired impairment or disease that may prevent a disabled person from participating in society. It is imperative that individuals with disabilities are afforded the same opportunities as their non-disabled counterparts, with equal respect and equal rights. Independence is a fundamental aspect of life that ensures that all individuals with disabilities have the opportunity to participate in society and assume an active role as citizens. It is a principle that excludes any form of discrimination or restriction in political, economic, social, cultural, civic, or any other field.

The process of accepting one's status

The process of accepting one's status is an essential aspect of the disability rights movement.

The condition of blindness does not define an individual. It is essential to gain an understanding of the individual behind the disability, rather than making assumptions based on their impairment. It is therefore imperative that we exercise caution to prevent the formation of stereotypes. The process of ascribing certain characteristics or motives to a group of people is referred to as stereotyping. Stereotyping is the process of ascribing similar characteristics to any individual belonging to a group, regardless of the actual diversity of the group members (Aronson & Aronson, 2018). In accordance with Aronson's definition, national stereotypes may be evoked when contemplating intercultural communication. However, this assertion is equally applicable to the formation of stereotypes pertaining to any other group. Allport provides illustrative examples that are both intriguing and pertinent. A blind person is so strongly defined by his fellow humans based on his blindness that his other characteristics are not even noticed at first glance. Despite the individual's extensive knowledge, dedication, and professional competence, they encounter significant challenges in securing employment due to the pervasive and limiting stereotype of blindness. (Allport, 2000) A blind person can experience a range of emotions, including happiness, sadness, equilibrium, and confusion. One must also consider the difficulties that the individual in question is currently facing. Perhaps the most crucial of these is the acceptance of one's condition. The most effective means of determining this acceptance is through the onset of visual impairment.

A person who is blind from birth or at an early age will experience a markedly different life trajectory. Their worldview, creative output, and conceptualisation of reality will be shaped by their blindness. Their cognitive and physical development will be influenced by their visual impairment. Their movements are distinct from those of their sighted peers, characterised by a stereotypical, "blind" style of movement. It is possible that individuals with visual impairments may experience difficulties in self-realisation and in carrying out their daily routines. The numerous specific situations that they encounter can cause psychological strain, which may result in a withdrawn, lonely, insecure personality. Alternatively, individuals with visual impairments may overestimate their abilities, which could lead to them becoming selfish and arrogant towards their environment. A child who is blinded at an early age is only affected by the consequences of his lack of vision. The lack of vision itself usually does not manifest itself, because the child has never seen and does not know what he has lost.

In contrast, the personality of a ***child or young adult who later becomes blind*** has already been formed. Therefore, there is less chance of a developmental disorder. In contrast, trauma has a more profound impact on the personality, as the entire life must be reevaluated, habits and daily routines must be changed. During adolescence, the loss of vision and the recognition of a disability can easily lead to a "crisis of blindness". The trauma of this condition can prompt a young person to rethink their life and habits, which must now be adapted to blindness. Furthermore, the individual may also disengage from their previous social circles, seeking out new social groups and affiliations. The trauma of blindness can also give rise to self-identity issues if the blind person is uncertain about how to navigate their new reality.

The loss of vision in adulthood represents a profound and negative event that fundamentally alters the frameworks within which individuals have communicated with the world until that point. The changed circumstances set new frameworks for the individual, both in terms of his communication with the world and others, and his relationship with his own body and identity. The pivotal question is whether these frameworks will be constraints or a challenging space of opportunity, whose rules and boundaries are revealed and filled with new skills and attitudes, and the world immediately becomes livable and homely again. (Karlsson, 1996; Keenan et al., 2014; Jessup et al., 2018; Ingram et al., 2019; Földiné, 2020.)

Work with a blind person

The objective of this lesson is to familiarise the learner with the techniques required to work as a physiotherapist with an adult, disabled patient. In particular, the lesson will examine the communication techniques that should be employed when examining and treating a blind person.

The specific elements of the lesson that appear in the videos are as follows:

- An analysis of how personality affects the experience of disability and how this affects and determines the work of a physiotherapist. (Video 1.)
- How to greet and accompany a blind person. (Video 2.)
- How to avoid well-intentioned but ineffective or inappropriate elements of communication. (Video 3)
- How to help a blind person communicate their complaints properly.
- What effective and simple communication techniques can help you communicate with the blind. (Video 4.)
- What to do if the blind person has a companion (person or dog). (Video 2.)

General rules of communication

It is also important to note that the basic rules of verbal and non-verbal communication, as well as their consistency and congruence, are essential when communicating with a blind person. ***It is crucial to express our attention and openness to the patient not only verbally, but also non-verbally, even if he does not see us.***

- Face-to-face interaction, although not necessarily complete.
- Open posture, with limbs uncrossed if possible.
- Facial expression of interest and engagement.

- Direct eye contact (!!!)
- Relaxed, stress-free posture.

(Please, Pease, 2017; Rogers, 1951)

The images below illustrate the active and empathic communication and its elements, as exemplified by Carl Rogers, an American psychologist and the creator of the person-centred approach. (Picture 4)

Picture 4. Communication that is open, attentive and accepting.

Special rules for communication with a blind person

It is important to note that although blind individuals may exhibit considerable variation in their abilities and preferences, there are general and specific recommendations for communication that a practicing physiotherapist should consider. (Pilling, 2020.)

General recommendations:

- Communication with blind individuals is often challenging, and their examination or treatment may require more time than usual.

- It is crucial to avoid preconceived notions about how communication with blind individuals will unfold. Individuals with similar disabilities may utilize distinct forms of communication more effectively. It is imperative to adapt to the individual in question.

- It is a common misconception that a person who is blind is also hard of hearing. In reality, the volume of speech is not an issue.

- Furthermore, it is crucial to ascertain whether the individual in question requires assistance before offering it. Many individuals with disabilities are adept at utilising their abilities to overcome obstacles. If the patient accepts the offered assistance, it is advisable to enquire as to the most appropriate method of providing help. The patient is likely to be best placed to judge this, given their intimate knowledge of their own abilities.

- In the case of a disabled person being accompanied by a relative, it is important for the physiotherapist to be careful with whom they communicate. As a specialist, it is their responsibility to prioritise contact with the patient, so address questions and requests to them. The patient should only engage in conversation with their companion about matters that they specifically wish to discuss. (Due to the instinctive acceptance of eye contact, the sighted specialist usually talks to the sighted attendant and informs him of the things he should inform his blind patient about. It is advisable to avoid this, so the attendant should really only be present as a helper, while the visually impaired – especially if he is an adult – as an equal to be handled.)

- It is not necessary to be embarrassed when using certain words. It is not uncommon for individuals to be hesitant to utter the word "see" in the presence of blind individuals. This is an unnecessary concern. When saying goodbye, it is acceptable to say, "see you later."

- As previously mentioned, it is crucial to express attention and openness to the patient, both verbally and non-verbally, even if the patient is unable to see.

- It is important to remember to turn towards the blind person when talking, as the direction of the voice is precisely perceived by your blind companion, including the fact that you are speaking to him. (Pilling, 2020.) (Picture 5)

Picture 5. Turn towards the blind person when talking

The most basic, special recommendations:

- If you want to contact a blind person, call them by name, if you don't know them, touch their shoulder or forearm so that they know that you are asking them, calling them. Let's introduce yourselves and then tell him/her what you want to discuss.
- If he/she comes to us as a patient, we can also shake hands when introducing yourself (this is a basic custom in Hungary). We say our names in preparation for a handshake. If he/she responds by extending his/her hand for a handshake, we can hold it and shake hands with him/her. We can also offer our hands, but we must indicate this verbally ("I offer you my hand")! Do not grab the hand hanging next to the patient's body without saying a word!
- If we want to help him/her, for example, to get somewhere, first of all, we ask him if he wants help. Let's also accept rejection - there are people who want to act independently. When helping the movement, place the blind person's palm on one of our forearms or offer our elbow so that he/she can put his arm around us, or gently hold the patient's elbow. If he/she drives with a white stick, always stand on the other side! Let's be one step ahead of the visually impaired! While walking, we verbally indicate upcoming obstacles, such as stairs. When passing through a door or a similar narrow place, it is most appropriate for the driver to lead the blind person one step behind him/her. In this case, the driver receives appropriate feedback about possible obstacles that may arise in front of him/her. (Picture 6)

Picture 6. Helping them to move

- The white cane is a valuable aid for the visually impaired individual and a clear indication to those around them. The white cane provides both tactile and acoustic signals to blind people, the perception of these signals, the analysis of the acquired information and the quick and adequate response to them make up the assistance to the blind person using the white cane in a complex way.

- Prior to seating, it is essential to ascertain the precise characteristics of the seat in question. This includes whether it possesses a backrest, armrests, wheels, and whether it is situated in front of a table. In the event that the chair is equipped with a backrest, the hand of the blind patient is placed on the chair's backrest, from which he can ascertain the dimensions and shape of the chair or other seating and subsequently sit down. (Picture 7)

Picture 7. The hand of the blind patient is placed on the chair's backrest

- Verbal instructions can be employed to assist patients in navigating their environment. These instructions can be provided in the form of a verbal map, which describes the location of specific points of interest and the route to reach them. In this manner, we compare the new information to a previously known point of reference, such as "the bathroom is to the left of the door." Alternatively, we can illustrate the directions with the face of a clock, with the patient looking in the direction of 12:00. For instance, the bathroom is located at the 5 o'clock position, while the examination bed is situated at the 7 o'clock position. Indicative words (e.g., "there," "here," "there," etc.) are to be avoided.

- For a blind individual, it is of paramount importance that the physiotherapist verbally communicates their actions and intentions. For instance, upon the physiotherapist's arrival, it is advisable to inform the patient of their presence. Should you wish to leave the room, it is advisable to inform the patient of your intention in advance. It is similarly vital to be informed of the procedure to be followed prior to the commencement of any examination or intervention.

- It is important to note that the blind individual must always respond verbally. A smile or a nod are meaningless to the blind individual.

- In the event that a device is to be provided to a blind patient, it is first indicated verbally, for example, "I'm handing you the ball." In addition, the device can be gently touched to the patient's body, for instance, the ball can be placed on the chest or abdomen. It is of paramount importance to observe the movements of the other person and to move in unison with them. (Picture 8)

Picture 8. Device can be gently touched to the patient's body

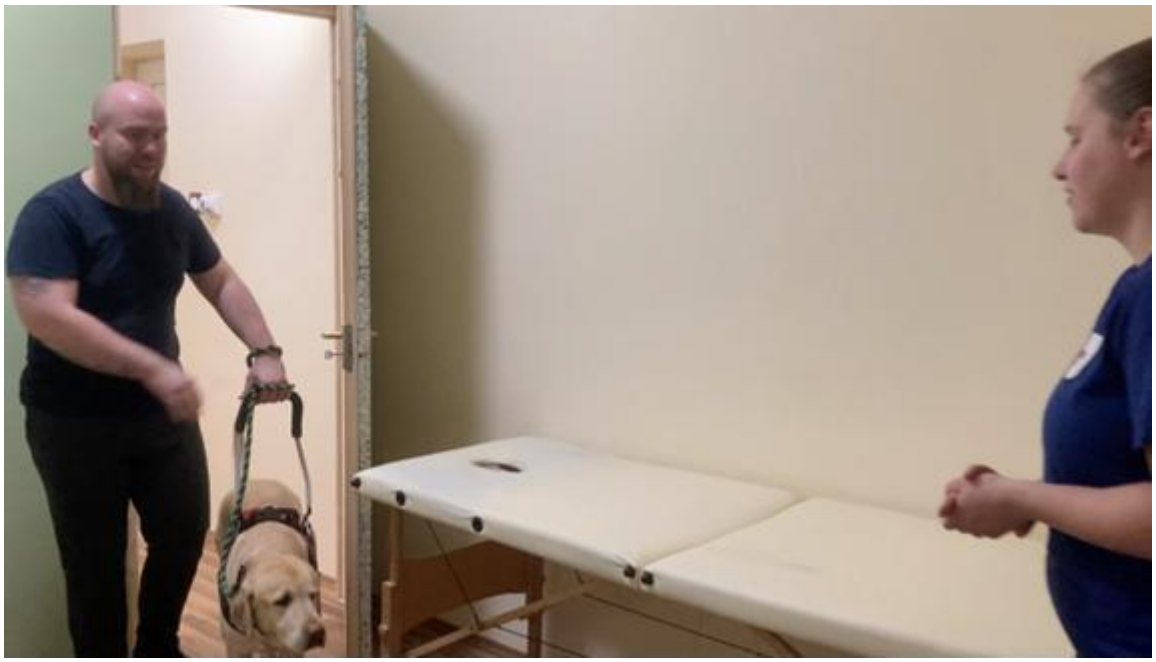
- If a blind patient regularly visits a healthcare facility for treatment over an extended period, it is possible to assist them by maintaining a consistent environmental arrangement. The order of events is of fundamental importance in the lives of visually impaired individuals. The following tenets must be observed: it is of the utmost importance that all belongings and objects are placed in their designated locations and remain there at all times. Furthermore, it is crucial that the doors are either fully open or fully closed. Where the blind person is moving, do not leave objects behind! Adherence to these regulations will enhance

the sense of security and reduce the vulnerability of the visually impaired individual, thereby facilitating independent living.

- In the event that a visually impaired individual is required to sign a document, it is advisable to ascertain the method employed. Some individuals utilize a signature frame, while others may request assistance in positioning the index finger of their non-writing hand in the appropriate location. Prior to the signing of any document, it is the responsibility of the health professional to inform the patient of the size of the document to be signed and the location of the signature.

- In the event that a visually impaired individual is accompanied by a guide dog, it is imperative that any interaction with the assistance dog be preceded by a request for permission. Petting, inviting, or feeding the assistance dog without first obtaining consent is not advised. Should one wish to accompany or lead a blind person on a walk with a dog, it is imperative that one does not run over the dog. Instead, it is advisable to stand on the opposite side. Should a blind person arrive at the examination room accompanied by a dog, we will accompany the blind person to a secluded location, such as a walled area, prior to the commencement of the examination. This will allow the dog to be placed in a quiet area for the duration of the examination.

(Pilling, 2020) (Picture 9)



Picture 9. Visually impaired individual is accompanied by a guide dog

A number of audio devices can assist the blind and partially sighted in their daily lives. One such device is a talking blood pressure monitor, which can help to improve the quality of life for those who are visually impaired. In the event that one requires tools for use with a blind individual, it is advisable to ascertain whether a specialised version exists.

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5 DIAGNOSIS AND THERAPY OF DIAPHRAGM DISORDERS IN PATIENTS WITH OBESITY

Teresa Gniewek, Agnieszka Kreska-Korus, Joanna Golec, Agata Milert

Every healthy individual performs approximately 20,000 respiratory movements within a day, primarily regulated by the diaphragm. This muscle is twice as vascularized as other striated skeletal muscles in humans and continuously functions from birth to death. Besides its respiratory role, the diaphragm plays a part in maintaining body posture, proper functioning of the vascular and lymphatic systems, and is involved in gastrointestinal activities such as swallowing, vomiting, acting as an anti-reflux barrier. The diaphragm influences the functioning of all abdominal organs (Bordoni et.al., 2016). The interdependence of the diaphragm with various structures in the human body results in dysfunctions leading to discomfort in different areas of the body.

5.1 Anatomy of the diaphragm

5.1.1 Diaphragm structure

The diaphragm constitutes a transverse partition dividing the torso into the chest and abdominal cavities. It has the shape of a dome, with its upper part forming the floor of the pleural cavity, and its lower part creating the vault of the abdominal cavity (Kokatnur, & Rudrappa, 2018).

The central part of this dome (the center of the diaphragm), situated highest in the chest, with fibres running horizontally, forms the central tendon composed of a fibrous layer that creates three leaflets (divisions): anterior (rich in lymphatic vessels), right lateral, and left lateral

The peripheral part of the dome consists of muscle fibres that are arranged radially around the chest. It is divided into sections:

- Sternal part: Connects to the xiphoid process of the sternum and the aponeurosis of the transversus abdominis muscle.
- Costal (lateral) part: Attaches to the cartilage of the sixth to seventh rib, interlocking with the attachments of the transversus abdominis muscle.
- Lumbar (posterior) part: Comprising two crura and arcuate ligaments:

- The right crus attach to the L1-L4 vertebral bodies, intervertebral discs, and the anterior longitudinal ligament. During growth, the right crus gives branches to the esophageal hiatus and serves as a natural element functioning as the sphincter of the cardiac orifice of the stomach.
- The left crus attach to the L1-L2 vertebral bodies and the anterior longitudinal ligament.
- The median arcuate ligament (lumbocostal arch) runs from the transverse process of L1 to the vertebral body, above the upper part of the psoas major muscle, connecting with its fascia.
- The lateral arcuate ligament (lumbocostal arch) extends between the transverse process of L1 and the apex of the 11th and 12th ribs. It covers the transverse process, then, connecting with the transversalis fascia, runs toward the abdomen, where it transitions into the pelvic fascia (Lierse 1990). The costolumbar hiatus is formed from this ligament.

5.1.2 Diaphragmatic apertures

In the diaphragm, there are apertures through which structures from the abdominal cavity pass into the chest (Bochenek 1990).

Three main physiological openings:

- Aortic hiatus (descending aorta, thoracic duct): Located in the lumbar part, medially between the crura of the diaphragm and reinforced by the middle arcuate ligaments.
- Esophageal hiatus (esophagus, vagus nerves, branches of the left phrenic nerve): Located in the lumbar part in the right crus, entirely surrounded by muscles.
- caval opening (inferior vena cava and branches of the right phrenic nerve): Positioned on the right side, ventrally in the area of the central tendon.

Other anatomical openings:

- sternocostal triangle, Larrey's space (superior epigastric artery and vein): Located in the sternal and costal parts.
- Lumbocostal triangle:
- Medial part (greater and lesser splanchnic nerves, azygos vein, and hemiazygos vein): Located in the lumbar part.

- Lateral part (sympathetic trunk): Positioned in the lumbar part, between the medial and lateral parts.

5.1.3 Innervation of the diaphragm

Diaphragmatic innervation is multi-neural:

- Central tendon (originating from the transverse septum): Phrenic nerve.
- Muscular domes (partially originating from the transverse septum and partially from the muscular walls of the trunk): Intercostal nerves innervate the lateral portion.
- The crura of the diaphragm (originating from the dorsal attachment of the esophagus - vagus nerve).

Course of the phrenic nerve

The phrenic nerve, arising from the C3/C4/C5 level, carries sensory, motor, and sympathetic fibers. After leaving the cervical plexus, it travels along the anterior scalene muscle between the subclavian artery and vein. It then passes between the mediastinal pleura and the pericardium, where it branches to supply the pericardium and pleura. It branches out to innervate the upper parts of the diaphragm, and after piercing it, it supplies the lower part (Bordoni 2016), (Bordoni, 2020). The phrenic nerve then runs towards the liver, stomach, and kidneys through its phrenic-abdominal branches, partially innervating them sensorially (Bochenek & Reicher, 1990). Irritation of the phrenic nerve leads to unilateral elevation of the diaphragm, impairing respiration. Bilateral phrenic nerve irritation is very rare.

Intercostal nerves

Intercostal nerves consist of motor and sensory fibres, originating from the anterior branches of spinal nerves and running within the intercostal spaces. They motorically innervate the intercostal muscles, serratus posterior superior muscle, subcostal muscles, and the transversus thoracis muscle. The lower intercostal nerves also supply the abdominal muscles. Sensory fibres run to the diaphragm and innervate the anterior part of the thorax and abdomen as cutaneous branches (Bordoni, 2020).

5.1.4 Blood supply to the diaphragm

The diaphragm is supplied with blood by the:

- Superior phrenic arteries
- Inferior phrenic arteries

- Pericardiophrenic artery
- Musculophrenic artery

Most of the arterial blood is supplied by the inferior phrenic arteries, which arise directly from the abdominal aorta (Bochenek & Reicher, 1990). The remaining blood supply comes from the superior phrenic artery, pericardiophrenic artery, and musculophrenic artery, which arises from the internal thoracic artery. The costal part of the diaphragm is supplied by the subcostal arteries and the five pairs of lower intercostal arteries.

The veins draining blood from the diaphragm include:

- Superior phrenic veins
- Inferior phrenic veins
- Pericardiophrenic vein
- Musculophrenic vein

Venous drainage from the upper part of the diaphragm comes from the superior phrenic, pericardiophrenic, and musculophrenic veins. The lower surface of the diaphragm is drained by the left and right inferior phrenic veins.

5.1.5 Lymphatic pathways of the diaphragm

The lymph nodes directly associated with the diaphragm are:

- Superior phrenic lymph nodes
- Inferior phrenic lymph nodes

The diaphragm is a crucial lymphatic center, possessing its own lymphatic vessels connected to the mediastinum and abdominal cavity (Kocjan et.al. 2017). The diaphragmatic lymphatic network is unique due to its location at the boundary of different hydrostatic pressures: negative pressure in the pleural cavity and positive pressure in the peritoneal cavity (Schumpelick, et.al., 2000). The lymphatic vessels form a drainage system parallel to the blood vessels, responsible for removing interstitial fluid (or extracellular fluid), cellular debris, and introducing it into the venous system as lymph. The lymph from the diaphragm is abundant and drains into the mediastinal lymph nodes, connecting with the bloodstream through the thoracic duct. Lymph absorption depends on the respiratory rhythm and diaphragm stretching, intra-abdominal pressure, and body posture. Dysfunction in any of these factors can cause diaphragmatic disorders, negatively impacting the lymphatic system.

5.1.6 Diaphragmatic ligaments

Supradiaphragmatic attachments include:

- Phrenicopericardial ligaments connecting the diaphragm with the fibrous pericardium
- Phrenicoesophageal ligaments connecting the diaphragm with the esophagus and the right and left diaphragmatic domes
- Inferior pulmonary ligaments, thickened pleura connecting the diaphragm with the lung hilum; the right ligament is near the inferior vena cava, and the left is near the descending aorta (Bordoni & Zanier, 2013)

Subdiaphragmatic attachments include:

- Falciform ligament of the liver, extending in two layers from the superior surface of the liver to the anterior abdominal wall and diaphragm
- Coronary ligaments, anterior and posterior, surrounding the bare area of the liver on both sides
- Triangular ligaments, arising from the coronary ligaments, connect the right diaphragmatic dome with the right liver lobe and the left diaphragmatic dome with the left liver lobe, preventing intestinal structures from being wedged between the liver and diaphragm
- Gastrodiaphragmatic ligament connecting the stomach to the diaphragm
- Phrenicocolic ligament connecting the splenic flexure of the colon to the diaphragm at the level of the 11th rib
- Ligament of Treitz connecting the duodenojejunal junction to the right diaphragmatic crus (Bordoni & Zanier, 2013)

The diaphragm also connects functionally through fascia with:

- The pubic bone via the linea alba
- The bladder via the falciform ligament of the liver and the round ligament, running to the umbilicus and further to the bladder through the vesicoumbilical ligament
- The skull via the pericardium, carotid sheath to the temporal, mandibular, and occipital bones

5.1.7 Functions of the diaphragm

The diaphragm serves various crucial roles in the body:

- Respiratory function: the diaphragm plays a vital role in breathing, satisfying approximately 80% of the body's oxygen demand.
- Enhancement of spinal stability: contraction of the diaphragm contributes to increased intra-abdominal pressure, thereby improving the stability of the spine.
- Improvement of motor control of the spine.
- Facilitation of fluid flow.
- Barrier to microbial spread: it acts as a barrier, preventing the spread of microorganisms between two body cavities.
- Activation of abdominal organs: through the fascial system, the diaphragm activates abdominal organs by transmitting the force of its contraction to individual organs.
- All the functions of the diaphragm in the human body are not fully understood, and ongoing medical research continues to explore and deepen our understanding of its multifaceted roles (Stephens, et.al., 2017).

5.1.8 Clinical symptoms of diaphragm dysfunction

Clinically, symptoms of diaphragm dysfunction may manifest as:

- Pain or tension in the thoracolumbar junction
- Pain below the costal arch
- Postural Disturbances
- Respiratory system disorders: conditions affecting the respiratory system, including bronchitis, bronchial asthma, and sinusitis.
- Gastrointestinal system disorders: conditions related to the gastrointestinal system, as the abdominal organs have direct or indirect ligamentous connections with the diaphragm.
- Peripheral circulation disorders of the lower limbs: associated with pathology of the inferior vena cava and abdominal aorta.
- Lymphatic circulation disorders: including swelling in the lower limbs and abdomen.

- Urinary-genital system disorders: the kidneys have a direct relationship with the diaphragm.
- Instability in the L5-S1 vertebrae.
- Developing disc herniation.
- Diaphragmatic hernia: symptoms may include heartburn, eructation, and substernal pain.
- Signs of quadratus lumborum muscle weakness.
- Manifestations of iliopsoas muscle weakness.

5.1.9 Consequences of respiratory failure

Respiratory failure can cause:

- Autonomic imbalance: compression of the vagus nerve leading to disturbances in organ trophics.
- Variable activity in the craniosacral rhythm: each phase of respiration influencing the activity of specific cranial bones.
- Esophageal widening: resulting in pressure on the cardiac portion of the stomach, disrupting its main function of breaking down complex proteins into simple amino acids, leading to impaired protein digestion.
- Decreased tone of the lumbar-pelvic muscle (incorporated in the diaphragm crura): leading to nephroptosis.
- Instability in the cervical spine: overloading the central part of the cervical spine, compression of the phrenic nerves.

Points of Reference (Picture1.) - Vertebral Levels of Selected Anatomical Structures for Examining a Patient with Normal Body Weight (Schumpelick et. al., 2000, Bordoni, 2020).

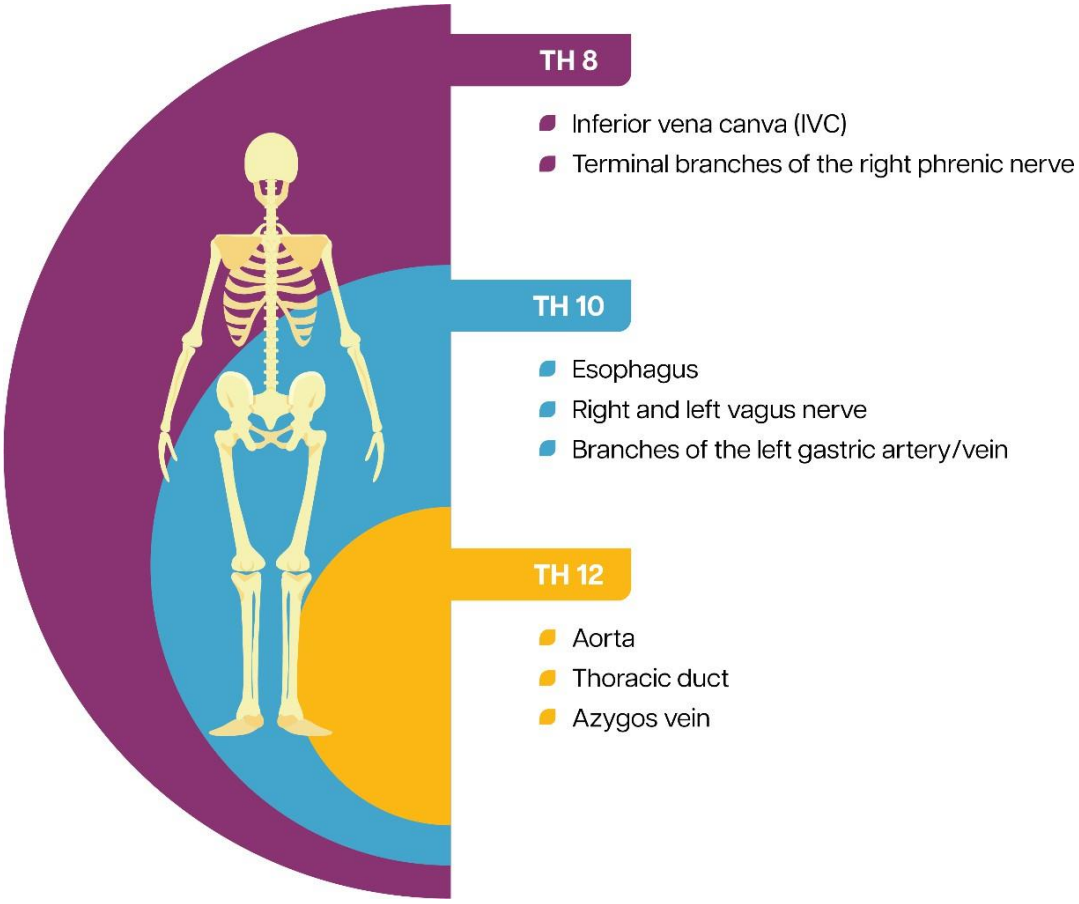


Figure 8 Location of selected anatomical structures in relation to reference points on the spine. Own source.

The diaphragm, besides its vital functions such as breathing and metabolism, also plays a significant role in maintaining proper body silhouette (Schwind, 2006), (Kocjan, et.al. 2017). When examining patients with excessive body mass, it is important to consider that the architecture of internal structures is disrupted due to increased adipose tissue in the abdominal cavity, chest, neck, and throat areas. Therefore, the anatomical layout described above may not correspond to the actual positioning of these structures.

During normal breathing, the diaphragm contracts, pushing the contents of the abdominal cavity downwards and forwards, while the external intercostal muscles contract, pulling the ribs upwards and forwards (De Troyer, 2016). Individuals with excess body weight have this mechanism disrupted because adipose tissue mechanically reduces the mobility of the ribs, diaphragm, and spine. Excess adipose tissue also unfavorably affects the patient's silhouette, leading to a Picturegraphic posture that alters the muscle length involved in the breathing process. Proper muscle length ensures their correct activation; otherwise, it can adversely affect the strength of respiratory muscle contractions, leading to changes in breathing depth and rate.

Studies show that diaphragmatic breathing forms the basis for functional movement (Fernandez-Lopez, et.al., 2021), (Rocha, et.al. 2015). Ineffective breathing can modify movement through muscle imbalance, changes in motor control, and physiological adaptations. The altered architecture of internal organs in the chest and abdominal cavities due to the accumulation of excessive adipose tissue leads to the development of compensatory breathing patterns that are difficult to reverse through physiotherapy if the patient does not reduce their body weight.

5.2 Respiratory muscles

The diaphragm is the main respiratory muscle but is assisted in the breathing process by other muscles (Table 1). The intercostal muscles attach to the ribs, while the abdominal muscles, the dorsal widest muscle or the quadratus lumborum have a connection to both the pelvic girdle and the ribs (Downey, 2011). In turn, muscles such as the scalene and sternocleidomastoid muscles, which attach to both the ribs and the cervical spine, take an active part in preparing the thorax for gas exchange (Bochenek & Reicher, 1990). Also, very important in this process are the muscles of the larynx and the muscles of the oral cavity and pharynx, which influence the resistance to gas flow through the upper airway both on inspiration and expiration. It should be remembered that some of these muscles also have a major contribution to a number of other functions, such as speaking, chewing, swallowing, coughing, postural functions.

Table 8 Respiratory muscles are divided into inspiratory and expiratory muscles.

	Inspiratory muscles	Expiratory muscles
Primary respiratory muscles	Diaphragm (diaphragma) - flattens, extending the vertical dimension of the thoracic cavity. External intercostal muscles - elevate the ribs and sternum, increasing the anteroposterior dimension of the thoracic cavity. Scalene muscles - when their attachment in the cervical region is stabilized, they elevate the upper ribs, assisting in inspiration.	The expiratory mechanism is ensured by: - Elastic recoil of non-muscular tissues: The expanded lung tissue returns to its original size, involving the pleura and costal cartilages. - Relaxation of expiratory muscles: -- The diaphragm relaxes, returning to its resting position, and the vertical dimension of the thoracic cavity decreases. -- The external intercostal muscles relax, lowering the ribs and sternum, decreasing the anteroposterior dimension of the thoracic cavity.

Accessory respiratory muscles:	Sternocleidomastoid - With a stabilized proximal attachment on the cervical spine, they elevate the sternum. Serratus posterior superior - Elevates the upper ribs, connecting the lower cervical spine and the upper thoracic spine to the ribs. Serratus posterior inferior - Connects the thoracolumbar fascia of the thoracic and lumbar spine to the ribs, pulling the ribs down to assist in expiration, and stabilizing the lower ribs to provide attachment stability for the diaphragm during inspiration. Pectoralis major - With fixed arms, both pectoral muscles participate in inspiration. Pectoralis minor - With a stabilized shoulder girdle, it serves as an accessory inspiratory muscle. Subclavius - Lowers the clavicle and moves it forward, expanding the subclavian vein during arm elevation. Quadratus lumborum - Pulls the rib cage downward and backward through the twelfth rib, assisting in expiration.	Internal intercostal muscles - Lower the ribs, aiding in expiration. Transversus thoracis - Located behind the sternum, it runs obliquely downward from the costal cartilage to the sternum. During contraction, it moves the costal cartilages down, assisting in expiration. Subcostal muscles - Located in the posterior part of the thorax, connecting two or three adjacent ribs, they assist in expiration. Transversus abdominis - Is the main muscle forming the abdominal press with the other abdominal muscles, diaphragm, and pelvic floor muscles. It brings the ribs closer to the median plane, narrowing the thoracic cavity. External and internal oblique abdominal muscles - Form the abdominal press in cooperation with the other abdominal muscles, diaphragm, and pelvic floor muscles. Rectus abdominis - Lowers the ribs and works with the other abdominal muscles, diaphragm, and pelvic floor muscles to form the abdominal press, aiding in expiration. Iliocostalis lumborum - Assists in expiration by pulling the ribs down along with the deep back muscles, the longest lumbar and lower thoracic sections. Latissimus dorsi - The rib portion assists in expiration, stabilizing the ribs during coughing and acting as a fixed attachment for the diaphragm, aiding in expiration.

5.3 Complications of obesity

Approximately one-third of the global population is currently suffering from overweight or obesity (www.who.int/news-room/fact-sheets/detail/obesity-and-overweight). In a medical sense, scientific studies confirm that excessive body weight is one of the most serious health threats worldwide, constituting a significant risk factor for non-communicable diseases such as

type 2 diabetes, hypertension, cardiovascular diseases, and certain types of cancers. The obesity epidemic is a global issue affecting both children and adults.

An incorrect position of the diaphragm can cause dysfunctions in organs such as the kidneys, liver, or stomach due to their direct proximity. It can also cause dysfunction in the diaphragm itself due to pathological processes in these organs. Excessive body weight can change the position of both the diaphragm and organs, leading to respiratory disorders (the diaphragmatic recess can fill with fat, the intestines may swell, etc.) (Xiang, et.al., 2023), (Bordoni, et.al., 2024).

Obesity is accompanied by complications affecting various organs and tissues (Ataey, et.al., 2020). These complications include both mechanical changes to surrounding tissues caused by excess adipose tissue and the maintenance of pro-inflammatory states, leading to adverse changes in organ physiology. Adipose tissue is an endocrine and paracrine organ, producing numerous cytokines and bioactive mediators, contributing to a pro-inflammatory state (Coelho, et.al., 2013), (Palma, et.al., 2021).

The most commonly mentioned complications of obesity include:

- Cardiovascular System: hypertension, coronary artery disease, varicose veins, stroke.
- Digestive System: gastroesophageal reflux disease (GERD), gallstones, non-alcoholic fatty liver disease (NAFLD), erosive esophagitis, and esophageal adenocarcinoma.
- Musculoskeletal System: osteoarthritis of the hip and knee joints, degenerative changes in the spinal joints in all sections, degenerative changes in the carpometacarpal joints, flat feet.
- Reproductive System: infertility in women, polycystic ovary syndrome (PCOS), erectile dysfunction in men.

Respiratory System: asthma, chronic obstructive pulmonary disease (COPD), sleep apnea. Excess body weight has adverse effects on the function of the respiratory system (Boussuges, et.al., 2021) (Nobre e Souz, et.al., 2013). Functional lung changes are caused by the pressure of additional adipose tissue on the chest wall, abdominal cavity, diaphragm, and lungs, particularly worsening parameters such as:

- FRC (Functional Residual Capacity): the volume of air remaining in the lungs after normal expiration.
- FVC (Forced Vital Capacity): the total amount of air that can be forcibly exhaled after full inhalation.

- ERV (Expiratory Reserve Volume): the additional amount of air that can be forcibly exhaled after the expiration of a normal tidal volume.
- FEV1 (Forced Expiratory Volume in the 1st Second): the volume of air exhaled in the first second of a forced exhalation.

Increased adipose tissue volume in the pharyngeal and neck areas can directly reduce the airway lumen, making breathing difficult, and even leading to apnea, resulting in hypoxemia (low oxygen levels in the blood). Hypoxemia stimulates the sympathetic nervous system, potentially leading to complications such as hypertension, arrhythmia, myocardial infarction, or stroke. People with sleep apnea experience shallow breathing and disrupted deep sleep and REM phases, causing them to wake up feeling tired.

Additionally, there is a strong correlation between obesity and type 2 diabetes, dyslipidemia, and the occurrence of cancers (colon, breast, esophagus, gallbladder, pancreas, liver, thyroid, ovaries, kidneys).

Severe obesity is a disabling disease that severely negatively impacts lung function, respiratory muscle work, and quality of life. Ali & Duruturk (2022) consider diaphragm mobilization techniques to be a safe physiotherapy method for obese individuals. These techniques improve respiratory parameters, chest mobility, and diaphragm movement. They emphasize the need for increased research in the future regarding the effects of diaphragm mobilization techniques.

When examining obesity from a cross-cultural perspective, the situation is not as straightforward in considering it a disease. Research indicates that in poor regions where access to food is challenging, overweight is seen as a sign of prosperity, wealth, health, and fertility. There are also areas where food is currently abundant, such as in China, where obesity is historically rooted in prosperity, and individuals with excess weight exhibit better mental well-being and are better perceived socially.

A different pattern prevails in Europe and North America, where obesity is perceived as a health problem, and preference is often given to individuals with a slender physique. Patients with obesity face stigmatization not only from society but also from healthcare workers due to their weight (Groven, & Heggen, 2018). Negative attitudes towards obesity have been documented among medical and physiotherapy students, active physiotherapists (Elboim-Gabyzon , et.al., 2020), and doctors (Huizinga, et.al., 2009).

Patients emphasize the negative attitude of physiotherapists towards them, as therapists often emphasize body weight, especially when applying techniques to exposed body parts. As a result, individuals with obesity typically avoid healthcare systems, receive less preventive care, and obtain less health education. It is important not to use stigmatizing language such as

"obese," "fat," "chubby," and many other stigmatizing words used in various parts of the world when discussing with patients with excess body weight.

Current research results suggest using terminology like "weight," "increased weight," or "unhealthy weight" in conversations. However, it should be noted that there is no single terminology that would be the best, and physiotherapists must consider the patient's background, gender, social status, financial status, and many other factors. It seems reasonable to inquire about the language preferences of patients, especially younger individuals - teenagers.

Therefore, clinical physiotherapists must develop their own ways of communicating with obese patients to help them understand that obesity is a health issue to be addressed, not a failure. Building trust and good relationships between physiotherapists and patients with excess body weight will allow for a discussion about weight without discouraging the patient from therapy. Based on their experience, the therapist must assess the appropriate moment to initiate a conversation about increased body weight, and it is often not during the first visit but in subsequent sessions.

It is essential to pay special attention to the above aspects and maintain sensitivity in both health communication and therapy. The application of therapeutic techniques requires direct and close physical contact with the abdomen and chest area, for which the patient's consent is necessary. Therefore, it is crucial to explain to the patient beforehand why palpation and the use of such techniques in the torso area are necessary to avoid unnecessary stress, frustration, reluctance to therapy, and ultimately its discontinuation.

5.4 Communication with the patient

Here is a summary of some practical suggestions for the physiotherapist to overcome communication barriers and ensure respectful physical contact during the assessment:

Before the examination:

- Clearly explain the purpose of the breathing assessment and the areas that will require physical contact.
- Offer the option to have a chaperone present during the examination, especially if the patient feels more comfortable.
- Provide appropriate draping to ensure the patient feels covered and respected throughout the assessment.

If you are a male physiotherapist dealing with a female patient or client, consider offering a female colleague to perform the assessment if the patient expresses discomfort.

During the Examination:

- Use respectful language and address the patient by their preferred title (e.g., Ms., Mrs.).
- Always obtain verbal consent before any physical touch. Explain exactly where and how you will be making contact.
- Use a gentle, non-invasive touch when assessing the chest and abdomen. Focus on essential areas only.
- Offer the patient options for positioning that maintains comfort and privacy. For example, they might sit upright or lie down with a strategically placed sheet.
- If explaining breathing techniques, utilize visual aids like diagrams or demonstrations instead of solely relying on hand placement.
- Frame the discussion around positive outcomes and the potential benefits of physiotherapy for managing obesity.
- Avoid using weight-stigmatizing language. Focus on neutral terms like "body composition" or "weight management goals."
- Encourage the patient to ask questions and actively participate in their treatment plan.

Cultural Considerations (Polish Context):

- Polish culture generally values direct communication. Explain information clearly but remain sensitive to potential anxieties about weight.
- Maintain a comfortable distance while still being close enough for effective communication. Be mindful of individual preferences.
- Privacy and respect are valued in Polish culture Ensure the examination area is private and minimize distractions.

By following these suggestions, the physiotherapist can create a safe and respectful environment for the patient. Remember, clear communication, informed consent, and sensitive touch are crucial for building trust and promoting successful therapeutic interactions (Auckburally, et.al., 2021), (Huizinga, et.al., 2009), (Sato, 2020), (Puhl, 2020).

1. What similarities have you noticed in your culture?

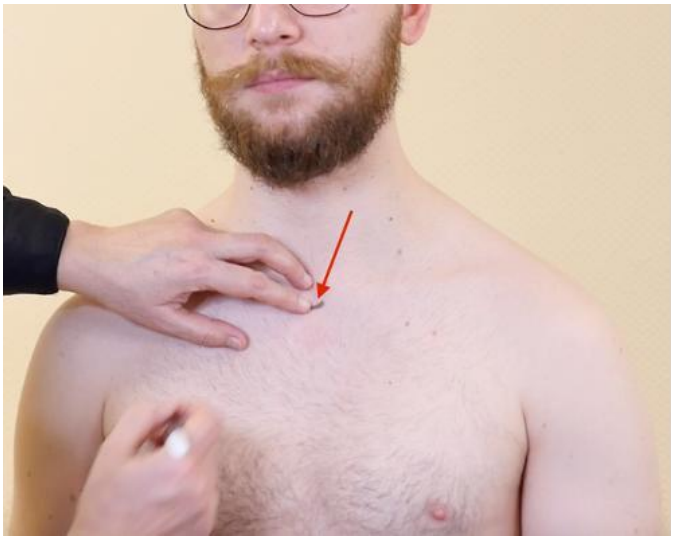
2. What differences have you noticed in your culture?

3. What should you pay attention to when caring for a patient with different cultural values?

5.5 Palpation of the diaphragm and associated structures, assessment of breathing patterns and diaphragm mobilisation techniques in normal weight subjects

5.5.1 Palpation of anatomical bone points needed to locate the lung and diaphragm area

To determine the bony points by which we will locate the lung and diaphragm area, gently but firmly place the pad of your index finger on the sternal notch (Picture 1.). Point downwards where the handle joins the sternum shaft to form the sternal angle. Then move your fingers laterally and locate the second rib, which is attached to the transition between the handle and the sternum shaft. Palpating downwards along the sternum, locate the 5th rib on the right side and the 6th rib on the left side (Picture 2.). The diaphragm should be at this height under normal conditions.



Picture1. Location of the second rib at the height of the sternal angle

Picture 2. Location of the diaphragm at the level of the fifth rib on the right and the left rib on the left side of the sternum

5.5.2 Determination of the thoracic-abdominal boundary in the supine position

Lay your hands flat on the patient's chest with your thumbs joined at the midline of the sternum at the level of the space between the 5th and 6th ribs. (Picture 3.). The left hand is above the diaphragm, where there is a negative pressure of minus 5 cm of water column, and the right hand is below the diaphragm, where there is a positive pressure of 15 cm of water column (1 metre of water column produces a hydrostatic pressure of approximately 0.1 bar). Ask your patient to take an inhalation. If you have positioned your thumbs correctly above and below the thorax, the changing pressure inside the thorax and abdominal cavity will push your thumbs away from each other to a small extent (Picture 4.). If you position your thumbs incorrectly, that is, in an area of equal pressure, inspiration will not change the alignment of your fingers.

Picture 3. Determination of the thoracic-abdominal boundary - placing the hands in the starting position

Picture 4. Delineation of the thoracic-abdominal boundary - visible slight distancing of the thumbs in response to inspiration

5.5.3 Assessment of respiratory movement at the thoracic-abdominal interface in the sitting position

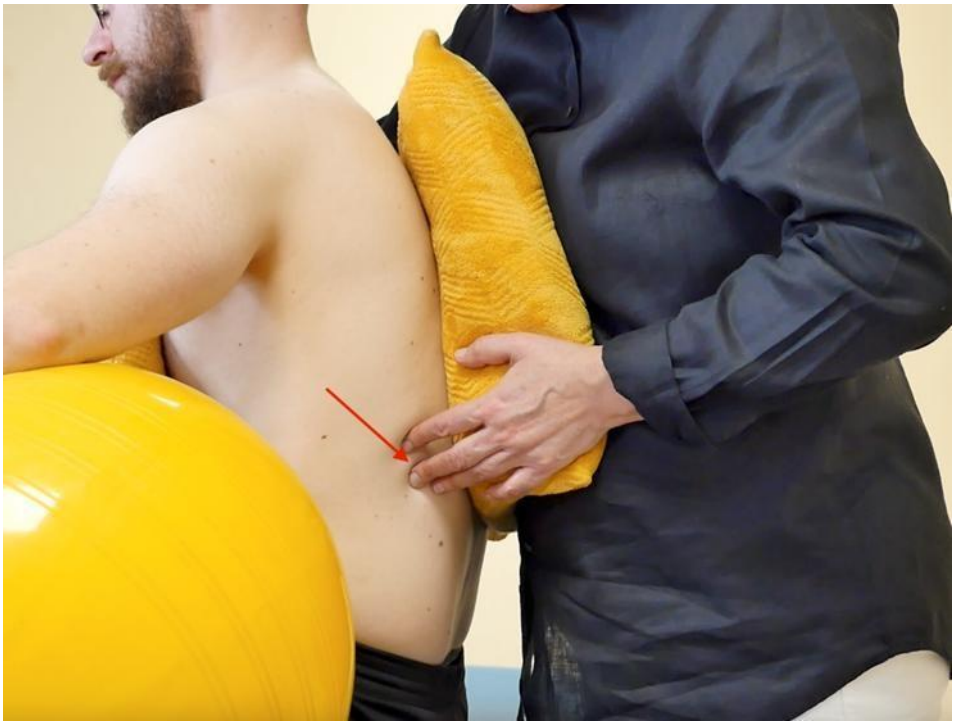
The therapist sits behind the patient, placing the whole hands in the lateral axillary line with the fingers pointing towards the midline of the body. The grip is firm, but does not restrict the respiratory movements of the area under examination (Picture 5.). The index and middle finger cover the last ribs, the fourth and fifth fingers are positioned below the rib arch (Picture 6.). During free breathing, observe whether the movement of the ribs is symmetrical on both sides, whether the curvatures of the liver and stomach move downwards and inwards widening the intercostal spaces (Schwind, 2006).

Picture 5. Assessment of respiratory movement at the thoracic-abdominal border - hand positioning

Picture 6. Assessment of respiratory movement at the thoracic-abdominal border - finger placement

5.5.4 Assessment of respiratory movement of the eleventh and twelfth ribs in the sitting position

An important part of assessing the breathing pattern is to examine the mobility of the lower ribs related to the work of the inferior cervical muscles, which are the muscles that lower the ribs by directing them to the side during inspiration. Palpate the top of the hip plate and move the index and middle fingers to the 11th and 12th ribs at the lateral edge of the dorsal extensor. As you inhale freely, observe that the ribs deviate to the side. Stabilise the patient with your torso without losing contact with the ribs. You can place a pillow between your torso and the patient's torso. Now relieve the pressure on the lower ribs by slightly flexing your torso and rotating at the level of the lower rib joints. Ask the patient to direct the breath towards your fingers giving feedback in the form of pressing your fingertips against the ribs. Repeat this sequence until you feel the posterior inferior serratus muscle has taken up function.

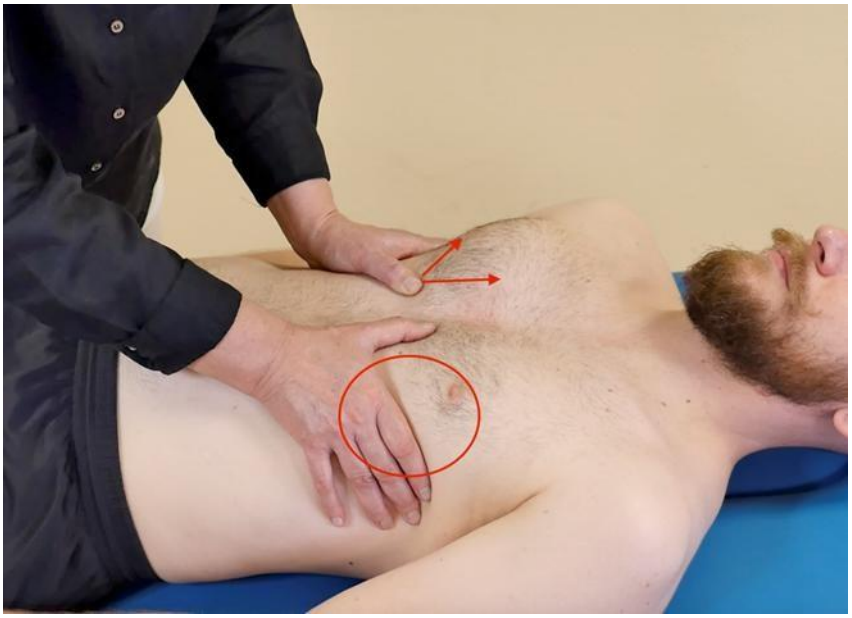


Picture 7. Assessment of respiratory movement of the eleventh and twelfth ribs - finger positioning

5.5.5 Assessment of respiratory movement and diaphragm relaxation in the supine position

This technique is used to assess and improve reduced mobility of the diaphragm domes. The therapist sets the height of the top of the diaphragm dome and places the hands on the lateral side of the lower ribs. The thumbs are positioned at the height of the seventh rib cartilage (Picture 8.). Ask the patient to breathe a little deeper and try to feel which side has less mobility. The patient you see in the Picture has slightly reduced inspiratory mobility on the left side. The therapist's right hand compresses the lower rib quadrant below the diaphragmatic arch, while the left hand allows free movement (Picture 9.). When you notice a reduced resistance of the tissues under your hand when the patient exhales, help to lift and expand the ribs laterally and cephalad. Maintain this position for several inhalations.

Picture 8. Height of the top of the diaphragm dome



Picture 9. Stimulation of respiratory mobility of the chest on the (left) side of restriction

5.5.6 Relaxation of one dome of the diaphragm in the supine position

The technique is performed with reduced diaphragmatic mobility in people with abdominal organ dysfunction. This technique has a significant effect not only on the diaphragm, but also on the structures under the therapist's hands. Thus, in the example below, on the left side, the area around the stomach, spleen, lung capsule and colon are treated. When the therapist works on the opposite side, the area around the lung, liver and colon will be treated. Stand on the side of the patient opposite the dome to be treated (Picture 10.). Arrange the hands so that the thumbs are positioned under the ribcage and the fingers are pointing parallel to the course

of the ribs. During exhalation, press the entire rib arch with the fingers towards the patient's navel. During inhalation, maintain the position obtained. When you notice a greater tenderness of the tissue to relax, you can increase the pressure of the rib arch towards the navel while moving the thumbs slightly in the opposite direction.

Picture 10. Unilateral relaxation of the dome of the diaphragm

5.5.7 Assessment of breathing movements and diaphragm relaxation in supine position

The technique is used to improve the glide of the tissues lying below the lower limit of the diaphragm. The therapist sits on the side of the area to be treated, facing the patient's face. He or she places his or her left hand on the lower ribs, introducing a slight uplift in the thoracolumbar transition (Picture 11.). At the same time, the therapist's right hand is placed in the lateral axillary line and directed towards the anterior surface of the shaft of the twelfth thoracic vertebra introducing pressure (Picture 12.). Maintain compression of the lower ribs until you feel reduced tissue resistance (Schwind, 2006).

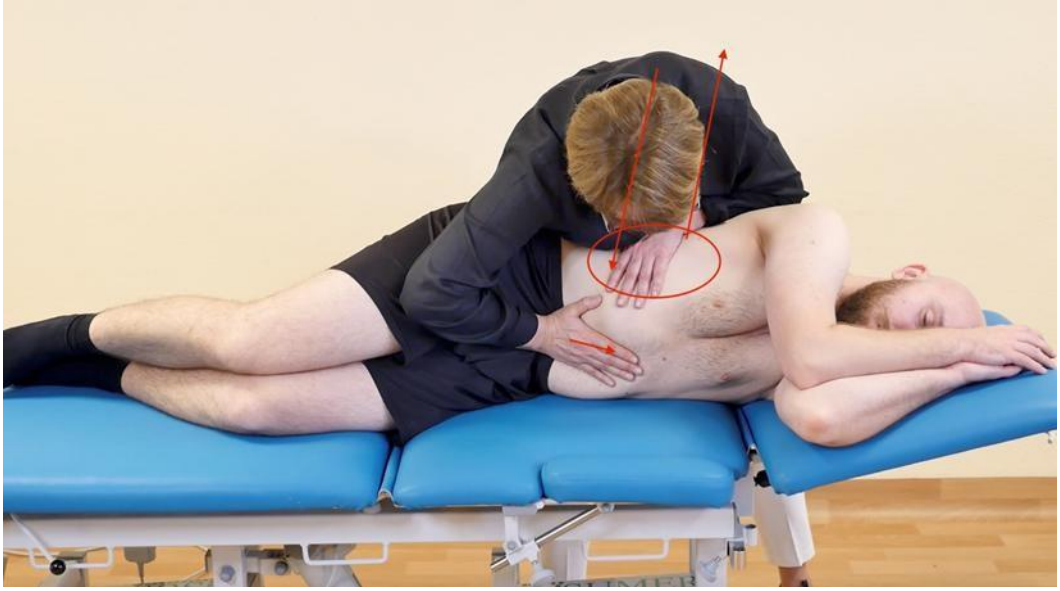
Picture 11. Introduction of a slight extension in the thoracolumbar transition

Picture 12. Relaxing the diaphragm in the supine position

5.5.8 Relaxing one dome of the diaphragm while lying on your side

If your patient presents with a left diaphragmatic dome tension pattern in the inspiratory position, place the patient in the left side lying position with the hip and knee joints slightly flexed. Place your right hand on the patient's abdomen and point cephalad and laterally. Place your left hand in the area of the lower ribs on the right side of the patient's body. Lean in using trunk work during inhalation and exhalation. During exhalation, use your right hand to push the abdominal tissues towards the left shoulder, at the same time compressing the right half of the patient's chest laterally. During inhalation, reduce the pressure on the chest (Picture 13.). The

sequence is repeated until you feel the diaphragm dome relax (Liem, et.al., 2017). Do everything in a natural breathing rhythm without forcing the patient's breathing rate or depth.

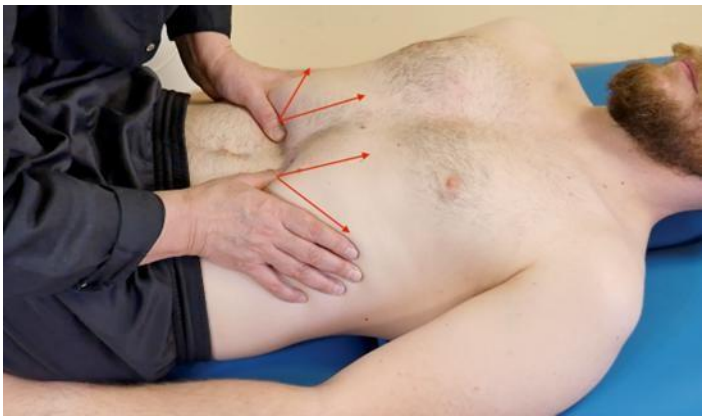


Picture 13. Relaxation of the left dome of the diaphragm while lying on the side

5.5.9 Relaxation of the lower thoracic regions and diaphragm according to Russoe'a

The technique is performed in states of diaphragm tension, abdominal stasis or organ dysfunctions. The therapist stands to the side of the patient, bends his/her lower limbs bringing the heels as close as possible to the buttocks and, leaning with his/her torso, performs traction along the long axis of the spine. The therapist's hands are placed on the lower ribs, with the thumbs at the level of the eighth rib cartilage (Picture 14.). Traction should be maintained throughout the technique. During exhalation, the patient consciously draws in the abdomen and the therapist's hands move to the side and upwards to relax the diaphragm (Picture15.) (Liem, et.al., 2017).

Picture 14. Relaxation of the lower thoracic and diaphragm areas according to Russoe'a - direction of traction



Picture 15. Relaxation of the lower chest and diaphragm areas according to Russoe'a – positioning of the therapist's hands

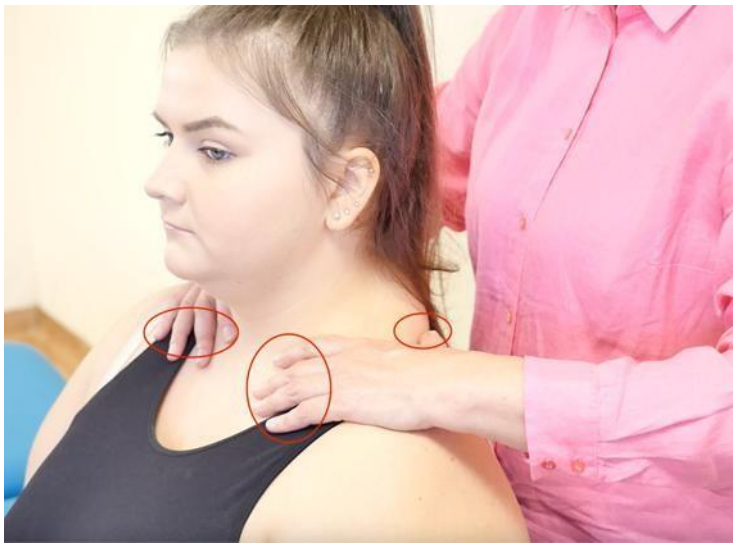
5.6 Palpation of the diaphragm and associated structures, assessment of breathing patterns and diaphragm mobilisation techniques in people with excess body weight

Palpation of bony structures in people with increased body weight is difficult and requires more focus from the therapist. Explain to your patient that some grasps may be uncomfortable because you have to use a little more force to feel bony elements such as the ribs or the clavicle. Also inform your patient how important it is to assess their breathing pattern for their health. Also explain that in order to properly assess the respiratory pattern it is necessary to palpate the neck, chest and abdominal areas. If your patient agrees to this, you can proceed. If, due to the patient's excessive weight, you are unable to palpate the bony elements directly,

do not give up on assessing the respiratory pattern but try to do so indirectly. Feel the way the soft tissue moves under your hands and assess the respiratory movement in that area.

5.6.1 Assessment of respiratory movement at the neck/chest transition in the sagittal plane in an overweight patient in the sitting position

If you are assessing respiratory movements of the upper thoracic aperture region and your patient's weight does not allow your fingers to reliably touch the first rib and the clavicle, you need to assess the behaviour of the soft tissue lying above these points. This requires the therapist to be more focused and the patient to be fully relaxed. Arrange your hands according to the diagram shown in the Picture (Picture 16.). and ask the patient to breathe freely. The thumbs are stationary and serve as reference points for the other fingers, which assess the tissues lying above and below the clavicle and the 1st rib (we try to catch asymmetry in muscle tone between the right and left sides of the body, over-activation of the muscles, and assess the mobility/lack of movement of the 1st rib and the clavicle).



Picture 16. Assessment of respiratory movements in the upper thoracic orifice region - therapist hand positioning

5.6.2 Assess respiratory movement of the eleventh and twelfth ribs in an overweight person in a sitting position

If you do not sense respiratory movement at the eleventh and twelfth ribs, try to cover a larger area of tissue in the lateral line of the body with your hands and assess the movement of the soft tissues over the ribs. Evaluate the symmetry of tissue movement on both sides of the lower ribs (Pictures 17 and 18.). If possible, we assess the activation of the posterior inferior serratus muscle connecting the thoracolumbar fascia to the ribs. Under normal conditions, the XI and XII ribs should lift slightly upwards and laterally during inspiration

Picture 17. Assessment of respiratory movements at eleventh and twelfth rib height - finger placement

Picture 18. Assessment of respiratory movements at eleventh and twelfth rib height - finger placement, side view

5.6.3 Assessment of respiratory movement and diaphragm relaxation in the supine position in an overweight person

The technique presented here affects the diaphragm and the structures underlying the therapist's hands - stomach, spleen, recessus pleurales, colon. During exhalation, press the entire rib arch towards the patient's navel; during inhalation, maintain the achieved position (Picture 19.). If you feel that your pressure is too weak, perform the technique standing on the opposite side and push the entire ribcage towards the navel with your hands (Picture 20.). Ask the patient to relax completely and explain that this pressure may cause internal distension in the bowels, but not pain. Occasionally, gas expulsion may occur, but this should not be a source of stress as it is a ‘normal’ reaction.

Picture 19. Assessment of respiratory movement and diaphragm relaxation - therapist hand positioning

Picture 20. Assessment of respiratory movement and diaphragm relaxation - alternative therapist position

5.6.4 Relaxing one dome of the diaphragm in the supine position in a person with excessive body weight (Schwind, 2006)

The technique presented here requires the therapist to place your hand and forearm on the lower ribs and introduce a gentle upright in the thoracolumbar transition in the patient throughout the technique (Pictures 21 and 22.). Assure the patient that their pressure on your hand and forearm is not painful for you. Such information can help to allay the patient's unspoken fear that they are pressing too hard on your hand. For a full description of the technique, see above, section 5.9.8 Assess respiratory movement and diaphragm relaxation in the supine position.

Picture 21.Position of the therapist's hand in the thoracolumbar transition

Picture 22. Unilateral relaxation of one diaphragm dome while lying backwards

5.6.5 Relaxing one dome of the diaphragm while lying on your side in an overweight patient

If your overweight patient presents with a left diaphragmatic dome tension pattern in the inspiratory position, place him in the left side lying position with the hip and knee joints slightly flexed. Ask him or her to assist you by completely relaxing the abdominal muscles. Explain that the essential part of the diaphragm relaxation technique is done by compressing the abdominal fascia, which must be completely relaxed so that the therapist can vary the direction and strength of this compression to relax the diaphragm lying in the chest (Picture 23.). A full description of the technique can be found above in section 5.5.8. Relaxing one dome of the diaphragm while lying on your side (Liem, et.al., 2017).

Picture 23. Unilateral relaxation of one diaphragm dome while lying on your side

5.6.6 Relaxation of the lower thoracic regions and diaphragm according to Rousse'a in a person with excessive body weight

If your patient is a person with a high body mass, you can ask them to actively participate in performing the procedure so that they feel more comfortable. Share the areas of action - ask the patient to place his hands on his ribs and teach him to draw in his abdomen and direct his hands to the side and upwards as he exhales (Picture 24.). During this time, you will perform spinal traction through the patient's lower limbs (Picture 25.) This joint action will allow the patient to relax the diaphragm. For detailed instructions on how to perform the technique, see section 5.5.9. Relaxing the lower chest and diaphragm according to Russoe'a (Liem, et.al., 2017).

Picture 24. Patient's hand position and direction during expiration

Picture 25. Direction of spinal traction performed by the therapist

5.6.7 Diaphragm relaxation in supine position - Recoil in an overweight patient

Diaphragm relaxation using the recoil technique requires the therapist's hands to be placed on the patient's chest. If it is difficult to avoid contact with, for example, the patient's breasts when performing this technique, for her comfort, let her know what movements you will perform and indicate that you will stop immediately if it is uncomfortable, or she feels pain due to chest compression. Place your hands over the sternocostal joints below the clavicles. You need to experiment with the positioning of your hands so that this is comfortable for the patient and does not cause pain to the tissues being compressed (Picture26 and 27.). During exhalation, compress the sternum in a dorso-caudal direction. During inhalation, maintain the achieved position without allowing the chest to expand. On the next exhalation, repeat the action - compress the sternum in a dorso-caudal direction until you reach the final limit that will not allow you to perform any more compressions (Picture 28.). As the patient begins to take another inhalation, pull your hands away from the chest at a high rate of speed, causing the chest expansion rapidly (Picture 29.).

Picture 26. Example of position of therapist's hands - contact of both hands with the chest

Picture 27. Example of therapist hand positioning - one hand in contact with the chest

Picture 28. Direction of chest compression during patient expiration

Picture29. Detachment of the therapist's hands

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6 RESPECTING THE BOUNDARIES OF PHYSICAL CONTACT IN THE CLIENT/PATIENT - PHYSIOTHERAPIST RELATIONSHIP IN THE FUNCTIONAL DIAGNOSTICS AND THERAPY OF CENTRAL STABILIZATION DISORDERS

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6.1 Core stability

WHAT IS CORE?

Core stability encompasses the lumbo-pelvic complex and refers to the ability to maintain the balance of the spine within its physiological limits while preserving structural integrity. Several authors have proposed a more functional perspective to describe the core as the foundation of the kinetic chain responsible for facilitating the transfer of torque and momentum between the lower and upper extremities for gross motor tasks of daily living, exercise, and sport. Core stability necessitates instantaneous changes by the central nervous system to elicit appropriate combinations and intensities of muscle recruitment for stiffness (i.e., stability) as well as mobility demands of the system. Core stability requires the activity of the central nervous system (CNS) to trigger the right combination and intensity of muscle recruitment for stability and mobility. (Kibler et al., 2006)

FUNCTIONAL CORE ANATOMY

Core stability involves a muscular cylinder consisting of the transversus abdominis (TVA or TrA) and internal abdominal muscles at the front, the multifidus muscle and the rear fibres of the psoas major muscle at the back, the diaphragm on top, and pelvic floor muscles at the bottom. These muscles are anchored to the thoraco-lumbar fascia and the spine area, creating what's known as the kinematic chain. These muscles help to stabilize the spine, pelvis, and kinetic chain during functional movements. Without these muscles, the spine would become mechanically unstable. One of the parameters influencing spinal mechanics and stiffness is intra-abdominal pressure (IAP). (Frank et al., 2013; Willson et al., 2005).

Intra-abdominal pressure is increased through the tension of the thoracolumbar fascia and the contraction of muscles like the transversus abdominis and multifidus.

The heightened tension of the thoracolumbar fascia and the resulting intra-abdominal pressure, which stem from muscle contraction, also play a role in supporting each spinal vertebra within the region. (Novak et al., 2021; Nelson, 2012).

The lumbopelvic-hip complex, often referred to as the "core," consists of the lumbar vertebrae, the pelvis, the hip joints, and both active and passive structures that either enable or restrict movement in these segments. The stability of any system refers to its capacity to limit displacement and preserve structural integrity. Core stability can be defined as the ability of the lumbo-pelvic-hip complex to prevent the vertebral column from buckling and restore it to equilibrium following perturbations. (Willson et al., 2005)

The core stability kinematic chain, which includes the iliac crest, the trunk, and the pelvic girdle, is responsible for postural control, overall movement control, as well as the distribution and transfer of forces in the lower limb area. The Panjabi model elucidates the mechanisms of central stabilization, consisting of three interconnected subsystems: passive (bony and joint structures), active (muscles), and the neural component (muscle control). The primary function of these static tissues is to maintain stabilization at the end range of motion in the joint. As tensile forces increase, mechanical resistance to movement is also produced to transmit information about position and load to the neural subsystem via mechanoreceptors. The active subsystem consists of the core musculature, and its task is to provide dynamic stabilization of the spine and proximal appendicular skeleton, as well as movement information to the neural control subsystem.

The central element is the neural control subsystem for incoming and outgoing signals, which ultimately create and maintain core stability. Importantly, continuous interaction between the three subsystems is necessary to maintain stability. (Huxel & Anderson 2013; Wirth et al., 2017)

Any dysfunction within the lumbo-pelvic-hip complex can lead to disruptions in the stabilization mechanism. This results in the generation of abnormal movement patterns, followed by the occurrence of structural damage to the musculoskeletal system.

Hodges and Richardson (1997) have described a "feedforward" mechanism, which means that deep muscles are activated before movements of the upper or lower limbs. This early activation ensures the stability of the trunk during these movements.

The "feedforward" process involves recruiting deep muscles to support overall movement, allowing for smooth, uncompensated movements. In healthy individuals, the transversus abdominis and multifidi contract before the shoulders or legs move, stabilizing the lumbar spine. (Vasselin et al., 2012)

The transverse abdominis muscle plays a key role in stabilizing the lumbar spine. Its contraction increases intra-abdominal pressure and tensions the thoracolumbar fascia, which contributes to lumbar stabilization. In this way, the spine is stabilized before peripheral movements are generated, providing the limbs with a stable base for movement, muscle activation, and the production of functional movement in accordance with physiological movement patterns.

Functional motion is defined as the ability to maintain balance, mobility, and stability along the kinematic chain. Integral functional movement is a model of precision and efficiency. Deficits in postural control, impaired balance, altered proprioception, and inefficient motor control contribute to pain, dysfunction, and incorrect movement patterns. (Uddin & Ahmed 2013).

Research results indicate that weak central stabilization can increase the risk of limb injuries in physically active individuals. Many authors describe various classifications of core stability in dynamic stabilization. These include local stabilizers (single-joint deep muscles) and global mobilizers (multi-joint superficial muscles).

Local muscles are located deeply and attach to or near the spine, consisting of Type I (slow-twitch) muscle fibres. These muscles primarily work eccentrically to control movement and maintain static stabilization. They include, for example, the multifidus, transversus abdominis, internal obliques, medial fibres of the external obliques, quadratus lumborum, diaphragm, and lumbar segments of the iliocostalis and longissimus.

Global muscles are located more superficially, with a greater proportion of Type II (fast-twitch) muscle fibres. They connect the trunk to the limbs, working concentrically to generate large torque and power during movement. These include, for example, the rectus abdominis, lateral fibres of the external obliques, erector spinae, thoracic segments of the iliocostalis, and gluteals. Their main function is to generate torque and movement in the joints. (Teixeira et al., 2019; Behm et al., 2022; Zielonka-Pycka et al., 2017)

Gibbons and Camerford (2001) proposed a functional model that further divided global muscles into stabilizers and mobilizers. The functional model maintained the local stabilizers and separated the global muscles into stabilizers (internal and external obliques, spinalis) and mobilizers (rectus abdominus, iliocostalis).

Stabilizers generate force eccentrically to control movement throughout range of motion, while mobilizers concentrically accelerate through range of motion and act as shock absorbers, especially in the sagittal plane. Behm et al. (2010) also maintained the local stabilizer category and divided the global muscles into mobilizers and transfer load categories. The transfer muscles are separate yet integral to core stability because they have fascial attachments that stiffen the core and transfer force through the kinetic chain.

On the other hand, Behm et al. (2010) categorized global muscles into mobilizers and load-bearing muscles. (Gibbons & Comerford 2001; Behm et al., 2010)

6.2 Core stability in the prevention of Low Back Pain and traumatic injuries

Core stability encompasses the passive structures of the thoracolumbar spine and pelvis, as well as the active involvement of the torso muscles. Stability relies on neuromuscular control of the torso in response to both internal and external forces, including those generated by distant body parts and expected or unexpected disruptions. According to the general definition in sports medicine literature, stability forms the foundation for dynamic trunk control, enabling the generation, transfer, and control of force and movement to further segments of the kinetic chain. Core stability is a fundamental element in regular activities, involving integrated activation of multiple segments to provide force generation, proximal stability for distal mobility, and the creation of interactive moments. (McGill et al., 1999; Kibler et al., 2006; Zemková & Zapletalová 2022, Dendas, 2010).

As mentioned by the authors, even slight disruptions in proprioception and core neuromuscular control can influence the risk of the occurrence of Low Back Pain (LBP) and lower limb injuries in active populations. (Butowicz et al., 2016; Huxel & Anderson 2013; Abdelraouf & Abdel-Aziem 2016).

Low Back Pain (LBP) remains a significant health and financial issue for large populations. Spinal misalignments, biomechanical disorders, and overuse injuries influence the incidence of chronic LBP. One case for the development of LBP is a loss of motor control (dysfunction of the abdominal and back muscles). An important risk factor for LBP is weakness and low activity of the muscle system which contains the lumbar multifidus, transversus abdominis, pelvic floor muscles and diaphragm. In the case of this low activity of deep muscles, the global muscles system – rectus abdominis, erector spinae and abdominal oblique muscles compensate to maintain the stabilization of the lumbar region. This compensation is one of the causes of LBP. The transversus abdominis and lumbar multifidus play a very important role in spinal stabilization. Many authors believe that the application of core stabilization exercises yields better treatment outcomes than conventional physiotherapy. These exercises can positively affect the level of functional limitations, improve the function of spinal stabilizers, which correct posture control, and deep muscles, thereby increasing joint mobility and balance. Ali et al. (2022) Based on a conducted meta-analysis, the authors concluded that core stabilization exercises are widely used and increasingly popular among physiotherapists for treating non-specific LBP. The review results indicate the effectiveness of deep muscle exercises in alleviating symptoms and improving patient functioning in patients with acute non- specific LBP. Although the clinical benefits of these exercises have been demonstrated in the short term, the long-term effects remain unclear. (Smrcina et al., 2022)

According to Hlaing et al. (2021) core stabilization exercise is superior to strengthening exercise. It is effective in improving balance, proprioception and reducing functional disability in patients with subacute NSLBP. However, this position is not supported by other authors such as Shamsi et al. (2016), who claim that core stabilization exercises do not have a better

therapeutic effect than traditional physiotherapy in alleviating pain in individuals with non-specific LBP.

Comparable results after conventional physiotherapy and McGill stabilization exercises have been observed by other authors. (Ghorbanpour et al., 2018)

The results Puntumetakul et al. (2021) of the two-group studies showed significant differences in the 5-Sit-Stand Test (FTSST) scores and pain intensity between the trunk stabilization exercise (CSE) and trunk strengthening exercise (STE) programs after ten weeks of exercise training and after 3 months of follow-up. The proportion of abdominal muscles improved significantly in the CSE group after ten weeks of exercise compared to the STE group. The study results suggest that both exercises can improve balance and reduce pain intensity in patients with chronic low back pain and clinical lumbar instability. The CSE group observed greater improvement in deep abdominal muscle activation than the STE group. (Lengkana et al., 2019).

Deficit of core stability may lead to increased risk of traumatic injuries including ACL damage. (Kibler et al., 2006) Core stability is described in the literature as dynamic control of the lumbopelvic complex, facilitating the transfer of rotational force and momentum between the upper and lower limbs during large motor tasks associated with sports, exercise, and daily life. During functional tasks, trunk muscles activate prior to upper and lower limb muscles (feedforward mechanism), creating a stable base for limb mobility. Furthermore, trunk muscle strength effectively reduces joint loads and controls the direction of movement of the lower limbs, especially the knees. Poor coordination of trunk muscles may result in compensatory patterns and increase the risk of anterior cruciate ligament (ACL) injury. Systematic review studies (Larwa et al., 2021) have shown that weak trunk stability, weak hip abduction strength, increased knee valgus, and landing on heels may contribute to increased ACL injury risk in young athletes. A three-year prospective study demonstrated that athletes with poor central stability during loaded exercises exhibited excessive internal hip rotation and consequently increased knee valgus. This may potentially contribute to ACL injury. (Larwa et al., 2021; Zazulak et al., 2007)

Attar et al. (2022), in a systematic review and meta-analysis, examined the impact of injury prevention programs incorporating trunk stability exercises on knee injuries and ACL injuries. They found that exercise programs including trunk stability exercises reduce the incidence of knee injuries by 46% in males and 65% in females.

The authors suggest that coordination of trunk muscles is essential for proper generation, transfer, and control of forces and movements within the body. However, weakening or decreased coordination, disrupted timing of trunk muscle activation, may lead to abnormal movement patterns and various types of sports injuries. (De Blaiser et al., 2019; De Blaiser et al., 2021)

It has been demonstrated that trunk stability exercises can correct muscular imbalance and improve trunk muscle coordination, positively impacting knee kinematics, hip strength, and trunk endurance in male athletes following ACL reconstruction (ACLR). Based on the study

findings, incorporating simple trunk stability training before routine team training may reduce the risk of secondary injuries. The authors advocate for the benefits of integrating stability training into exercise programming, preventive protocols, and regular rehabilitation programs. According to Lee & McGill (2015), isometric exercises of the trunk in athletes can develop trunk stiffness, while minimizing spine overload. Due to the low load on the spine during these exercises, athletes can perform them almost every day during the training period. Researchers say a 15- to 45-minute isometric training program combined with a strength and conditioning program provides core stability.

For individuals involved in physical activities, such as athletes, having a strong and stable core is essential. Core stability is vital for injury prevention, and there are several reasons why it is so important:

1. Spinal Alignment and Posture

Core stability helps maintain proper spinal alignment and posture, reducing the risk of overuse injuries and strain on the spine.

2. Transfer of Power

A stable core enhances the transfer of power between the upper and lower body during athletic movements, such as throwing, kicking, and jumping, which can improve performance and prevent compensatory movements that lead to injuries.

3. Injury Resilience

By improving core stability, individuals are less likely to experience common injuries such as lower back pain, muscle strains, and joint sprains, particularly during dynamic movements and sudden changes in direction. (McGill, 2010)

Core stability enhances injury prevention through:

1. Muscular Support

Strong core muscles provide support to the spine and pelvis, reducing excessive loading on other structures.

2. Improve Balance and Coordination

A stable core improves balance and coordination, reducing the risks of falls and traumatic injuries.

3. Enhanced Proprioception

Core stability enhances proprioceptive awareness, allowing athletes to respond effectively to external forces and maintain control during movements. (Willson et al., 2005; Behm et al., 2022; Kibler et al., 2006; McGill, 2010).

However, it's worth noting that the concept of core stability has both proponents and critics, and scientists have expressed varying viewpoints on the topic in the existing literature.

According to some authors:

Weak trunk muscles, weak abdominals and imbalances between trunk muscles groups are not pathological and weak or dysfunctional abdominal muscles are not case of back pain.

Damage to abdominal musculature does not seem to be detrimental to spinal stability.

The core stability exercises are no more effective than, and will not prevent injury more than, any other forms of exercise.

There may be potential danger of damaging the spine with continuous tensing of the trunk muscles during daily and sports activities. (Lederman, 2010; Lederman, 2011)

Classification into 'local' and 'global' muscle groups is inappropriate. (Wirth et al., 2017)

6.3 Functional diagnosis of the core

Functional diagnostics is an area of physiotherapy that deals with assessing the musculoskeletal system, including the evaluation of recruitment, strength, and endurance of the core muscles. (Kibler et al., 2006).

It allows for identifying dysfunctions, neuromuscular control disorders, and, based on these findings, planning and implementing a physiotherapy program to improve overall function. Implementing proper diagnostics is key to creating an optimal therapeutic plan. The simplest way to assess core muscle function is to evaluate the voluntary contraction of the transversus abdominis muscle. This involves palpating the transversus abdominis muscle in a medial direction and just below the anterior superior iliac spines, right next to the rectus abdominis muscle. This assessment is performed while the individual taking an abdominal drawing-in manoeuvre (ADIM) technique. (Vasseljen et al., 2012; Willson et al., 2005).

This initial examination helps identify improper recruitment and/or muscle function. In addition to palpation, objective methods like ultrasound (USG) are also used to assess muscle contraction. To evaluate core muscle strength and endurance, diagnostic tests such as the McGill Muscular Endurance Test protocol can be employed.

The test consists of 3 tests, and the results are recorded in a prepared protocol sheet.

1. The Trunk Flexor Endurance Test evaluates the endurance of the deep abdominal muscles, including the transversus abdominis, quadratus lumborum, and erector spinae. It is also a timed, isometric test that focuses on the static contraction of these

muscles, which help stabilize the spine, and continues until fatigue or significant compensatory movements of the torso occur **(Picture 1)**

2. The Trunk Lateral Endurance Test measures the endurance of the lateral muscles, including the transversus abdominis, obliques, quadratus lumborum, and erector spinae. This timed test involves static, isometric contractions of the lateral muscles on both sides of the torso to stabilize the spine. The test is performed with the participant lying on their side, raising their hips, and supporting their body weight on the elbow and feet. This test is conducted for both sides of the body. **(Picture 2)**

3. The Trunk Extensor Endurance Test assesses the endurance of the back muscles, including the erector spinae, latissimus dorsi, iliocostalis, and multifidus muscles. It is a timed, isometric test that involves a static contraction of these extensor muscles, which stabilize the spine. The test is conducted with the participant lying face down, hips and upper torso extending over the edge of a table, while the lower limbs are stabilized. **(Picture 3)**

When performing diagnostic tests, the patient's posture, positioning of the head, pelvis and spine curvatures as well as the correct breathing pattern are important.

Picture 1 The Trunk Flexor Endurance Test

Picture 2 The Trunk Lateral Endurance Test

Picture 3 The Trunk Extensor Endurance Test

The results obtained from the tests, which are measured in seconds, are entered into a prepared study protocol sheet and then subjected to analysis.

Table 1 McGill's torso muscular endurance test battery—record sheet

Trunk flexor endurance test Time to completion: _____
Trunk lateral endurance test Right side time to completion: _____Left side time to completion:_____
Trunk extensor endurance test

Time to completion: _____	
Ratio of Comparison	**Criteria for Good Relationship Between Muscles**
Flexion:extension	Ratio less than 1.0
Right-side bridge:left-side bridge	Scores should be no greater than 0.05 from a balanced score of 1.0
Side bridge (each side):extension	Ratio less than 0.75
Flexion:extension ratio: _____Rating: q Good q Poor	
Right-side bridge:left-side bridge ratio: _____Rating: q Good q Poor	
Side-bridge (each side):extension ratio: _____Rating: q Good q Poor	

Source: https://www.acefitness.org/cmes-resources/pdfs/02-10-CMES-McGillsTorsoEnduracneTest.pdf

6.3.1 The method of recording results and Interpretation

Procedure for assessing results according to the McGill Muscular Endurance Test protocol.

To perform accurate calculations and interpret results, it is essential to use a diagnostic card. This minimizes the possibility of errors and enables a precise assessment of outcomes for functional diagnostics before, during, and/or after therapy, as well as intervention programming. (McGill, 2010)

Table 2 Results recording procedure according to the McGill Muscle Endurance Test protocol

Trunk flexor endurance test
Time to completion: _____1

Trunk lateral endurance test
Right side time to completion: _____2 Left side time to completion: _____3

Trunk extensor endurance test
Time to completion: _____4

Ratio of Comparison	Criteria for Good Relationship Between Muscles
Flexion:extension	Ratio less than 1.0
Right-side bridge:left-side bridge	Scores should be no greater than 0.05 from a balanced score of 1.0
Side bridge (each side):extension	Ratio less than 0.75

Flexion:extension ratio: _____5 Rating: ❑ Good ❑ Poor

Right-side bridge:left-side bridge ratio: _____6 Rating: ❑ Good ❑ Poor

Side-bridge (each side):extension ratio: _____7 Rating: ❑ Good ❑ Poor

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Step number 1: method of recording obtained data

1). For the "Trunk flexor endurance test" row (1), record the result measured in seconds.

2). For the "Trunk lateral endurance test," record the result measured in seconds for the right side (2) and for the left side (3).

3). For the "Trunk extensor endurance test" row, record the result measured in seconds (4).

Step number 2: calculations/relationships

In the "Flexion: extension ratio" row (5), enter the result - the quotient (ratio) of the score achieved in the trunk flexor endurance test (1) to the score achieved in the trunk extensor endurance test (4).

In the "Right side bridge: left side bridge" row (6), enter the result - the quotient (ratio) of the score achieved in the lateral endurance test for the right side (2) to the score achieved in the same test for the left side (3).

In the "Side bridge (each side): extension ratio row (7), perform two calculations:

- The ratio of the score achieved in the lateral endurance test for the right side (2) to the score achieved in the trunk extensor endurance test (4).
- The ratio of the score achieved in the lateral endurance test for the left side (3) to the score achieved in the trunk extensor endurance test (4).

Table 3 Results recording procedure according to the McGill Muscle Endurance Test protocol.

Trunk flexor endurance test
Time to completion: 75

Trunk lateral endurance test
Right side time to completion: 52 Left side time to completion: 50

Trunk extensor endurance test
Time to completion: 70

Ratio of Comparison	Criteria for Good Relationship Between Muscles
Flexion:extension	Ratio less than 1.0
Right-side bridge:left-side bridge	Scores should be no greater than 0.05 from a balanced score of 1.0
Side bridge (each side):extension	Ratio less than 0.75

Flexion:extension ratio: 75:70= 1.07 Rating: ❑ Good ❑ Poor

Right-side bridge:left-side bridge ratio: 52:50=1.04 Rating: ❑ Good ❑ Poor

Side-bridge (each side):extension ratio: 52:70=0.74 50:70= 0.71 Rating: ❑ Good ❑ Poor

Example calculations:

1. Trunk Flexor Endurance Test: 75s
2. Trunk Lateral Endurance Test:
   - Right side: 52s
   - Left side: 50s
3. Trunk Extensor Endurance Test: 70s

Calculations:

1. Flexion: extension ratio = 75 / 70 ≈ 1.07
2. Right side bridge: left side bridge = 52 / 50 = 1.04

3. Side bridge (each side): extension ratio:
   - Right side = 52 / 70 ≈ 0.74
   - Left side = 50 / 70 ≈ 0.71

Step number 3: interpretation of results

For interpreting the results, utilize the data from the table marked in green color and markers indicated by red squares.

Table 4 Results assessment procedure according to the McGill muscular endurance test protocol.

Trunk flexor endurance test
Time to completion: 75

Trunk lateral endurance test
Right side time to completion: 52 Left side time to completion: 50

Trunk extensor endurance test
Time to completion: 70

Ratio of Comparison	Criteria for Good Relationship Between Muscles
Flexion:extension	Ratio less than 1.0
Right-side bridge:left-side bridge	Scores should be no greater than 0.05 from a balanced score of 1.0
Side bridge (each side):extension	Ratio less than 0.75

Flexion:extension ratio: 75:70= 1.07	Rating: ❑ Good	☒ Poor
Right-side bridge:left-side bridge ratio: 52:50=1.04	Rating: ☒ Good	❑ Poor
Side-bridge (each side):extension ratio: 52:70=0.74 50:70= 0.71	Rating: ☒ Good	❑ Poor

Interpretation of results

The Flexion: extension ratio of 1.07 is outside the norm. Therefore, at the marker corresponding to this row, mark the relationship as "poor."

The remaining criteria are met, so mark the relationships as "good."

Recommendations: Focus training on balancing muscular strength between trunk flexors and extensors, with emphasis on trunk extensors. (McGill, 2010)

6.4 Training

After conducting the functional diagnostic tests, such as the McGill protocol, and analyzing the results, a training or physiotherapy program can be planned. The intervention should be individually tailored to the exerciser's fitness level. To increase the intensity of the exercises, progressive training should be applied. This includes upper body movements, diaphragmatic breathing exercises, unstable surfaces, and sport-specific functional training. Progressive exercises improve muscle recruitment and have a positive impact on sports performance and injury prevention. (Kibler et al., 2006)

Training the core muscles is an integral part of physiotherapy and forms the basis for healthy body movement. Dysfunctions in core stability can lead to increased forces on the spine and the development of compensations in the distal parts of the body. This, in turn, can result in spinal overloads and biomechanically inefficient movements, leading to reduced overall function. (McGill, 2010; Lee & McGill, 2015).

Core stability training involves exercises for the muscular corset surrounding the torso and the lumbo-pelvic complex. Its primary purpose is to provide stability and protection for the spine during various movements, ranging from everyday activities to complex motions in sports.

This is linked to their function, which includes:

1. Reducing forces acting on the spine.
2. Facilitating the proper and most efficient transfer of forces from the lower part of the body to the upper part, and vice versa.

Endurance core stability is a vital element in preventing traumatic injuries and Low Back Pain (LBP), as well as enhancing athletic performance. Injury prevention is linked to better spine stability during movement and the ability to perform physiological movement patterns without pathological compensations. To achieve mobility in peripheral joints, it is necessary to establish proximal stability beforehand. An essential aspect of training is proper controlled diaphragmatic breathing, which determines the correct tension of deep muscles.

Core muscle training, like any other muscle training, should be progressive, meaning that the training load should be gradually increased. It's important to remember that too rapid progress can lead to incorrect exercise patterns or compensatory movements. (Willson et al., 2005; Behm et al., 2022; McGill, 2010; Lee & McGill, 2015; McGill & Karpowicz 2009; Mullane et al., 2021).

Core exercises may include: Bird dog, Side plank, McGill sit-ups, Glute Bridge Hold, and Pallof press with a resistance band.

6.5 Ethics and cultural differences

Understanding the rules how to conduct an interview while respecting ethics and cultural differences. The principles of relationship and how to conduct functional diagnostics, including palpation and training/physiotherapy. It's crucial to clarify actions, such as observing how the patient moves and performs tasks or performing abdominal palpation.

An essential aspect to pay attention to is communication between the client/patient and the therapist. Communication can be particularly challenging in therapy where touch, in addition to verbal communication, is a primary means of interaction. This can pose challenges for both the client/patient and the physiotherapist. In the physiotherapist-client/patient relationship, one of the elements of effective communication is the ability to interpret nonverbal signals, including those stemming from the patient's reaction to the type and pressure of the touch applied by the physiotherapist.

Should be aware that the profession of a physiotherapist lacks clearly defined norms that specify the protocol for appropriate behaviour in various therapeutic situations and the principles regulating the use of touch as a diagnostic and therapeutic tool. Most behaviours are determined by the cultural context and the therapist's own sensitivity and experience.

According to the principles of a physiotherapist's professional ethics, it is their duty to provide services with the utmost care, adhering to professional and ethical standards of conduct. The Code of Ethics for Physiotherapists adopted by the Polish Chamber of Physiotherapists (KIF) distinguishes fundamental moral values, including care, professionalism, responsibility, fairness, professional integrity, and respect for the dignity and autonomy of the patient/client.

(Bystrzycka et al., 2023)

6.5.1 Therapeutic / non-therapeutic touch

In physiotherapy practice, four distinct types of touch are recognized:

- Diagnostic touch: Used to examine the patient's body and gather crucial medical information to facilitate diagnosis.
- Interventional touch: Treatment (therapeutic intervention classified as task-oriented touch, applied to provide direct, manual therapy such as massage or joint mobilization).
- Assistive touch: Assisting specific movements (touch is used to physically aid the patient. Examples include managing specific movements, such as active range-of-motion assistance or helping a patient transfer).
- Informative touch: Used for obtaining information, supporting diagnostic actions, or informing about symptoms occurring during therapy

Non-therapeutic touch includes:

- Care touch: Contact aimed at comforting, encouraging, showing empathy, or providing support for the patient.
- Building relationships: Handshake for greeting and farewell, aimed at building or maintaining rapport.
- Safety assurance: Touch used to reassure or provide a sense of safety to the patient.
- Preparatory touch: Non-therapeutic touch used to prepare the patient for therapy, such as assisting with dressing or putting on shoes.

A physiotherapist's work with a patient/client's body is based on interventional touch used in therapy. Through touch, a physiotherapist can detect changes as a response to treatment, but touch can also be perceived as support, protection, care, acceptance, and respect. Professional touch is perceived as intended only when the physiotherapist fully focuses on the patient/client during interactions. Maintaining eye contact most of the time is a good sign of concentration. (Przyłuska-Fiszer & Wójcik, 2020).

6.5.2 Use of physical contact in physiotherapy

- Palpation

Palpation is a crucial skill in physiotherapy that involves using touch to evaluate soft tissues, joints, and musculoskeletal structures. Physiotherapists may use palpation techniques to identify areas of tenderness, muscle tension, or restricted mobility, which helps in diagnosing and treating musculoskeletal conditions. While palpation is a valuable clinical tool, physiotherapists must ensure that they obtain informed consent and respect patient comfort and privacy during palpation procedures.

- Examination

Physical examination is a crucial part of the physiotherapy assessment process, allowing therapists to evaluate a patient’s range of motion, strength, flexibility, and functional abilities. During the examination, physiotherapists may employ hands-on techniques to assess joint mobility, muscle length, and tissue texture. Therapists need to communicate openly with patients, explain the purpose of the examination, and obtain consent.

- Treatment

Physiotherapy treatment comprises various interventions that aim to promote recovery, reduce pain, and restore function. Commonly used techniques include manual therapy, massage, and mobilization to alleviate musculoskeletal symptoms and improve tissue mobility. During treatment, physiotherapists must respect patient autonomy and preferences, ensuring that they are comfortable with the level of physical contact involved in the therapeutic process.

- Manual Therapy

Manual therapy involves the skilled manipulation of soft tissues and joints to alleviate musculoskeletal dysfunction and pain. These techniques may include joint mobilization, manipulation, soft tissue mobilization, and myofascial release. Physiotherapists are trained to perform these techniques safely and effectively, considering individual patient needs and preferences. Before administering manual therapy, therapists should obtain informed consent and explain the intended benefits and potential risks of the treatment.

It seems imperative, therefore, that patients are able to give informed consent to touch and have the need and methods of work explained to them in the specified areas. Conversely, for patients/clients of physiotherapy clinics, awareness of continuous attention, observation, and, if necessary, reactions to overly intense stimuli and their modification are essential. (Chochowska & Marcinkowski, 2013a; Chochowska & Marcinkowski, 2013b).

The physiotherapist must obtain permission to use various forms of touch and body work during therapy. Patients expect cues, whether it's a smile or brief eye contact, which, combined with
a handshake or a touch on the arm, can form the foundation of a relationship, enhance the patient/client's well-being, and build trust. As a result, better therapy outcomes can be expected. (Roger et al., 2002; Przyłuska-Fiszer & Wójcik, 2020)

6.5.3 Cross-culture aspect, respect for socio-cultural norms

Professional organizations play a vital role in establishing guidelines and codes of ethics to guide physiotherapy practice. These standards highlight the importance of patient autonomy, dignity, and consent in all aspects of care, including physical contact. The American Physical Therapy Association (APTA) in the United States and the Chartered Society of Physiotherapy (CSP) in the United Kingdom provide clear guidance on professional conduct, emphasizing the need for informed consent, clear communication, and respect for patient preferences.

Similarly, the World Confederation for Physical Therapy (WCPT) has established international standards for physiotherapy education and practice, promoting principles of professionalism, cultural competence, and ethical conduct. The guidelines emphasize the importance of tailoring treatment approaches to individual patient needs while acknowledging and respecting cultural diversity and ethical conduct. The guidelines emphasize the importance of tailoring

treatment approaches to individual patient needs while acknowledging and respecting cultural diversity.

Preparation is an important for collaboration with individuals from different cultures and different socio-cultural norms. It's important to be culturally sensitive and open to understanding and accommodating diverse perspectives and needs.

World Confederation for Physical Therapy (WCPT). (n.d.). Policy statement: Ethical principles. Retrieved from https://www.wcpt.org/policy/ps-ethical-principles

The physiotherapist should ensure the protection of privacy, respect the intimacy and boundaries of the client/patient, maintain an appropriate distance, and uphold the confidentiality of information. This involves employing suitable verbal and nonverbal communication, the ability to read emotions and signals conveyed, and providing a sense of safety and respect for the patient. It's crucial to prepare for the athlete/patient's reactions to pain, injury, movement execution, or obtaining weak results in functional tests. Understanding how individuals may respond emotionally and physically to these situations is an important part of being an effective physiotherapist. This empathy and understanding can help you provide the necessary support and guidance to help them through their physical challenges and rehabilitation process.

The client/patient, regardless of age or gender, has the right to medical care that respects their principles, values, and customs. During the interview, important is to establish a diagnostic-therapeutic action plan with them. If the client/patient does not fully accept the proposal for cultural reasons, it is good practice to emphasize that physiotherapist respect worldview and are open to making changes with mutual consent. Physiotherapist should present alternative possibilities, which may include adjusting the examination room, providing additional explanations about the rationale for introducing touch as a diagnostic-therapeutic tool, specifying the area of touch, or suggesting alternative forms of treatment. It is important for the client/patient to consciously accept the planned treatment. Touch is an integral and essential part of the physiotherapist's profession, playing a crucial role, and the ability to apply appropriate touch is linked to the practical experience of the physiotherapist. Not only may the client/patient have difficulty with this, but also an inexperienced physiotherapist. Touch should not be too aggressive, but intense enough to achieve the intended diagnostic or therapeutic goal. It is recommended that obtain consent for the application of touch and indicate the specific area to be touched and the goal you intend to achieve. Starting the diagnosis with an observation of the patient's silhouette, abdominal position, spine, ribcage, and pelvic alignment is a common practice. However, it's essential to acknowledge that in some cultures, this approach may pose challenges or discomfort.

Therefore, it's important to have an initial conversation with the client/patient about the diagnostic process, explaining its significance.

Important is how to observe the body and movements during exercises while considering cultural norms and customs in different countries. This is vital for ensuring that your approach is culturally sensitive and respectful.

In certain scientific studies, issues related to physical boundaries have been raised. Questions have been asked about whether a patient's gender and their associated sexual sphere might present a barrier for a physiotherapist during manual work. These are important topics to consider and discuss, especially when respecting personal boundaries and cultural sensitivities.

It is even emphasized that touch is one of the fundamental ways of social and sexual communication, so contact with a physiotherapist can sometimes evoke sexual connotations. During physiotherapeutic procedures, physical contact occurs, which, on one hand, helps build a deep, trust-based relationship and, on the other hand, implies the emergence of challenging situations for both parties. Jokes and flirting can be interpreted ambiguously and may encourage the establishment of inappropriate relationships. This applies to both the physiotherapist and the client/patient. Boundaries should be clearly defined, with no possibility of crossing them by either party. It is essential not to respond to ambiguous proposals and to refrain from making inappropriate jokes. The physiotherapist should inform and clarify the form of intervention with respect to ethical norms and cross-cultural differences.

The therapeutic relationship generates a certain type of intimacy because during treatment, there is physical, psychological, and social contact between the physiotherapist and the patient. This kind of situation can lead to boundary violations by either party, sometimes entirely unintentional. Physical contact with the patient on a therapeutic level through touch brings many benefits and should not be a burden for both the physiotherapist and the client/patient, taking into account the norms and cultural customs of different countries.

During collaboration with the client/patient, must be established positive relationships and gain their trust. Important is by beginning with positive comments, highlighting errors with constructive criticism, and concluding with positive feedback. Emphasize what they are doing correctly, for example, "You are holding your head correctly, but pay attention to maintaining your breath; your pelvis is positioned correctly," "You breathe diaphragmatically excellently; adjust your pelvis to a neutral position, you engage your abdomen" "You corrected your posture well; work on endurance, you've already improved your position." With positive support and an appropriate, but non-judgmental, attitude, you can achieve the desired results faster. The interaction must be consistent with cultural norms.

The client/patient should be dressed in appropriate sportswear (a snug-fitting shirt, shorts, socks, and athletic shoes) for performing tasks. If this poses a cultural issue, they should have attire that allows task execution. This should be mutually agreed upon, respecting cultural differences. You should also obtain approval for the location where diagnostic tests and exercises will be conducted. If the client/patient requires a separate room, physiotherapist should respect that.

Touch in physiotherapy ensures privacy protection, respects the patient's intimacy and boundaries, maintains distance, and keeps information confidential. It constitutes an appropriate form of verbal and non-verbal communication. Through touch, the physiotherapist perceives emotions and signals conveyed by the patient. They are also aware of the non-

therapeutic significance of touch, respecting the emotional, psychological, and physical boundaries of the patient/client in relation to cultural differences. (Przyłuska-Fiszer & Wójcik, 2020; Dadura & Wójcik, 2014).

Obtaining informed consent, explaining the purpose and necessity of working with the patient's/client's body, and adapting to expectations with mutual acceptance seem to be obvious and essential actions. Physiotherapists should pay particular attention to their primary tool used in functional diagnostics or manual therapy—hands. Taking care of the hands and their temperature is crucial during manual therapy. Physiotherapists should observe the patient's reaction to touch to ensure their comfort and safety. Different reactions from the patient to the exact same action can be expected, often depending on individual characteristics, previous touch experiences, and other life experiences.

The touch of a physiotherapist serves not only a therapeutic but also a psychosocial purpose. Touch is also a form of non-verbal communication with the patient. In the physiotherapist-patient/client relationship, care is a significant value expressed through professional action for the patient/client, respecting their autonomy, sensitivity to their needs and experiences, building trust based on respect for standards and competencies, and moral integrity understood as fidelity to professional ethics. (American Physical Therapy Association, 2021; Przyłuska-Fiszer & Wójcik, 2000). The professionalism of a physiotherapist, similar to that in medicine, entails acting in accordance with professional and ethical standards (World Confederation for Physical Therapy 2021; Długołęcka et al., 2024; Przyłuska-Fiszer & Wójcik, 2020).

6.5.4 Practices in different countries

United States

In the United States, physiotherapists follow ethical guidelines set forth by the American Physical Therapy Association (APTA). APTA is the source for standards of ethics and professionalism in the physical therapy profession. These guidelines prioritize patient-centered care and respect for autonomy. This Code of Ethics describes the profesional behavior of physical therapists in their multiple roles (eg, management of patients/clients, consultation, research, education, and administration), addresses multiple aspects of ethical action and reflects the values of the physical therapist. Physical therapists shall act in a respectful manner toward each person regardless of age, nationality, gender, race, religion, ethnicity, social or economic status, sexual orientation, health condition, or disability. They receive training in effective communication to ensure patient comfort and safety during treatment sessions. Physiotherapy education programs emphasize the importance of obtaining informed consent and setting clear boundaries around physical contact.

American Physical Therapy Association (APTA). (n.d.). APTA Code of Ethics for the Physical Therapist and Standards of Ethical Conduct for the Physical Therapist Assistant. Retrieved from https://www.apta.org/your-practice/ethics/code-of-ethics

American Physical Therapy Association (APTA). (n.d.). Guide to Physical Therapist Practice. Retrieved from https://www.apta.org/patient-care/practice-resources/guide-to-physical-therapist-practice

United Kingdom

The Chartered Society of Physiotherapy (CSP) is the professional, educational and trade union body for the chartered physiotherapists, physiotherapy students and support workers.

Physiotherapists in UK adhere to the standards set by the CSP, which highlights the importance of professionalism, respect for diversity, and evidence-based practice. Physiotherapy practice in the UK is focused on providing patient-centered care, with therapists valuing patient input and preferences regarding treatment approaches and physical contact.

Chartered Society of Physiotherapy (CSP). (n.d.). Professionalism and Values for Physiotherapy Practice. Retrieved from https://www.csp.org.uk/professional-clinical/professionalism/professionalism-values-physiotherapy-practice

This is an international standard also valid in the Maltese “Code of Ethical Conduct for Physi-otherapists” (MAP 2017) and French “Code de déontologiedes masseurs-kinésithérapeutes” (ORDREMK 2022).

MAP. 2017. Code of ethical conduct for physiotherapists. Malta Association of Physiotherapists. Retrieved from

https://physiomalta.com/wp-content/uploads/2018/04/Code-of-Ethics-FINAL.pdf

Codes of professional conduct, therefore, provide support for people for whom ethical professional practice is important but who are not always able to make the judgement by themselves.

The interaction between the physical therapist and the patient/client is based on protecting privacy, respecting the intimacy and boundaries of the patient's privacy, maintaining distance, preserving the confidentiality of information, and appropriate verbal and non-verbal communication. The physical therapist possesses the ability to interpret the patient's feelings and signals, ensuring a sense of security and respect for the patient. The physical therapist is aware of the non-therapeutic significance of touch and respects the emotional, psychological, and physical boundaries of the patient/client.

Department of Health and Social Care. (2019). Professional standards for physiotherapy practice. Retrieved from https://www.gov.uk/government/publications/physiotherapy-and-podiatry-standards-for-education-and-training/physiotherapy-and-podiatry-standards-for-education-and-training#history

Respecting the boundaries of physical contact in the client/patient-physiotherapist relationship is essential for maintaining promoting therapeutic effectiveness, trust, and upholding ethical standards of practice. By understanding and acknowledging cultural and social influences on

perceptions of physical touch, physiotherapists can provide care that is respectful, client/patient-centered, and culturally sensitive, regardless of geographical location or cultural background.

6.5.5 Cultural Considerations (Polish Context):

- Older persons typically adhere to modest dress codes. Be mindful of this during the assessment and offer modifications to the testing procedures.
- Polish culture can be more indirect in communication. Be patient and allow the patient to express herself comfortably.
- Physiotherapists are considered healthcare professionals and deserve respect. However, avoid overly assertive communication, especially with a religious Picture.

1. What similarities have you noticed in your culture?
2. What differences have you noticed in your culture?
3. What should you pay attention to when caring for a patient with different cultural values?

6.6 Example of a Training Plan

Core muscle training should be progressive, meaning that the training load is gradually increased. Increasing the number of repetitions or making appropriate changes to the pace of work (such as maintaining an isometric contraction in the exercises below), altering the rest time between sets, or the training volume over the week should not result in a loss of quality in movement patterns. The table below presents a basic 4-week Core Stability training cycle built on the principle of a reverse ramp. Each weekly training is repeated three times, with at least one day of rest between sessions. The training plan can be applied to individuals with weakened spinal stability, but the results depend on the patient's age, level of fitness, body awareness, and the type of dysfunction.

(McGill & Karpowicz (2009); Mullane et al., 2021)

Table 5 **Training Plan**

Week 1

Exercise	Repetitions	Sets	Rest between sets (s)	Work tempo (s) *
Bird dog ##	5-3-2	3	30	4-0-4-5
Side plank #	5-3-2	3	30	2-0-2-10
McGill Sit up	5-3-2	3	30	1-0-1-5
Glute bridge Hold	5-3-2	3	30	4-0-4-10
Pallof press #	5-3	2	30	4-0-4-5

Week 2

Exercise	Repetitions	Sets	Rest between sets (s)	Work tempo (s) *
Bird dog ##	6-4-2	3	30	4-0-4-5
Side plank #	6-4-2	3	30	2-0-2-10
Mcgill Sit up	6-4-2	3	30	1-0-1-5
Glute bridge Hold	6-4-2	3	30	4-0-4-10
Pallof press #	6-4	2	30	4-0-4-5

Week 3

Exercise	Repetitions	Sets	Rest between sets (s)	Work tempo (s) *
Bird dog ##	7-5-3	3	30	4-0-4-5
Side plank #	7-5-3	3	30	2-0-2-10
Mcgill Sit up	7-5-3	3	30	1-0-1-5
Glute bridge Hold	7-5-3	3	30	4-0-4-10
Pallof press #	7-5	2	30	4-0-4-5

Week 4

Exercise	Repetitions	Sets	Rest between sets (s)	Work tempo (s) *
Bird dog ##	7-5-3	3	30	4-0-4-6
Side plank #	7-5-3	3	30	2-0-2-15
Mcgill Sit up	7-5-3	3	30	1-0-1-6
Glute bridge Hold	7-5-3	3	30	4-0-4-15
Pallof press #	7-5	2	30	4-0-4-5

* Work tempo refers to the duration of each phase of the exercise expressed in seconds (s), i.e.,

- The first position refers to the duration of the eccentric phase of muscle work.

- The second position refers to the duration of the phase of maximum muscle stretch.

- The third position refers to the duration of the concentric phase of muscle work.

- The fourth position refers to the duration of the phase of maximum muscle tension.

In the Pallof Press and Side Plank exercises, it is recommended to repeat the set on each side.
In the Bird Dog exercise, the number of repetitions pertains to each side individually.

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7 COMMUNICATION METHODS OF DEALING WITH INTROVERTED ADOLESCENTS WITH POSTURAL DEFECTS IN GENERAL

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7.1 Posture

According to the Posture Committee of the American Academy of Orthopaedic Surgeons, posture is defined as the balanced and proper alignment of skeletal elements to protect the body from deformations and prevent injury. Posture is an active process that includes perception, emotions and the environment in addition to the coordinated movement of the joint and muscular structures (Dunk & Callaghan, 2010) In other words, posture generally refers to the relationship between the parts of the human body in an upright position. The arrangement of body parts such as the head, neck, trunk, upper and lower extremities constitute posture, and for a good body posture, it should be ergonomically advantageous when standing, mechanically effective when moving and supportive for the normal function of internal organs.

In an anatomical position, a standing person has three main planes:

- Sagittal plane,
- Frontal plane and
- Horizontal plane.

Flexion-extension, dorsiflexion-plantar flexion, forward and backward bending movements are performed in the sagittal plane. In the frontal plane, abduction-adduction, lateral flexion, ulnar-radial deviation, inversion and eversion movements take place. In the horizontal plane, internal-external rotation and axial rotation movements are performed. Understanding these planes and movements is important for the understanding of spinal mobility. The cervical, thoracic and lumbar parts of the spine perform flexion-extension in the sagittal plane, lateral flexion in the frontal plane and axial rotation in the horizontal plane.

When analysing joint movements in our body, we encounter three basic arthrokinetic movements: rolling, sliding and rotation. In addition to these movements, forces or loads can cause stretching, compression, bending, shearing, torsion and combined loading in the

musculoskeletal system. It should not be forgotten that the spine also has parallel osteokinetic movements.

When we look at the muscle groups and their interactions that govern the basic movements of the spine and our posture, the trunk-back muscles, core and stabiliser muscles come to the fore. Muscle activations occur in three types: isometric, concentric and eccentric and ensure correct joint movements. Correct muscle functions and interactions allow for proper movement and correct postural alignment. Body posture is defined in three reference planes, sagittal, coronal and transversal, and is divided into inactive and active posture. Processes that minimize muscle activity such as rest and sleep are defined as inactive posture, while processes that require integrated and coordinated movement of many muscles are defined as active posture. Active posture is also classified as static posture and dynamic posture. Static posture is defined as the posture in which the muscles contract to stabilize the joints, no movement occurs, and the existing position is maintained, and it can be exemplified as the posture in situations such as standing and sitting. Dynamic posture is defined as a posture that requires the function of muscles and joints to form the basis of any movement and consists of non-stationary positions such as walking, running, throwing (O'Sullivan et al., 2002; Claus et al., 2009).

According to a proposed definition of good or correct posture; "Good posture is a state of musculoskeletal balance that protects the supporting structures of the body against injury or progressive deformity, regardless of whether these structures are working or resting. Under these conditions, the muscles work most efficiently, and the internal organs are in optimal positions." (Kendall et al., 2005).

Maintaining correct posture involves minimal stress to the body through the maintenance of musculoskeletal balance. Body posture is a psychomotor habit related to factors such as somatic development, body composition and structure, and its importance for health is often emphasized by its influence on the organization and function of systems and internal organs (Wilczyński & Baran, 2019). Correct posture, characterized by the proper alignment of the cervical, thoracic and lumbar parts of the spine, allows these regions to maintain their anatomically normal curvature (Jorgić et al., 2024). In order to shape the posture, the appropriate mechanisms to resist gravity must work in coordination. Correct posture is an integrated system of osteoarticular, and fascial-ligamentous-muscular structures controlled by the central nervous system to provide optimal conditions for development and puberty (Calloni et al., 2017). Any deviation is defined as bad posture, causing a departure from the ideal posture and triggering stress on the spine (Bullock-Saxton, 1993). Bad posture is associated with reduced gait and functional performance in addition to balance problems. Research in older adults emphasizes that bad posture is associated with increased mortality rates (Page, 2005). When the concept of "bad posture" is examined in the literature, it is concluded that the concept is specific and subjective to the individual and is related to certain postural habits and pain. It is stated that posture may vary from person to person and a posture that may be considered good posture for one person may not be functional or comfortable for another (Barrett et al., 2016; Slater et al., 2019). In this context, when evaluating the concept of posture,

it should be taken into consideration that posture is individualized, and the definition of ideal posture may vary from person to person.

7.2 Relation of Fascia-Muscle-Posture

Fascia is a 3-dimensional connective tissue that extends uninterruptedly throughout the body and surrounds, supports, and separates each tissue (Findley & Shalwala, 2013; Bordoni & Zanier, 2015). Fascia, which wraps the entire body like a taut web, is a dull, colorless anatomical tissue that covers all fibrous collagenous connective tissues (Schleip & Müller, 2013). In the human body, it is known that this structure is in communication with other structures, forms various layers at different depths, and continues uninterruptedly. Therefore, it is an organ that can affect the general health of the individual (Tozzi, 2012). The fascial system, which is closely related to posture, surrounds and intertwines organs, muscle, bone, and nerve fibers, giving the body a functional structure. It ensures the integrated functioning of all body systems (Van Der Wal, 2009).

A review found that although there is strong experimental support for the existence of a superficial posterior line, a posterior functional line and an anterior functional line, the evidence for a spiral line, anterior line and lateral line is weak (Wilke et al., 2016). Although the desired level of evidence for the existence of fascial systems has not been reached in the literature, fascial connections often guide treatments in the clinic and are associated with muscle function and postural problems.

7.2.1 Superficial Back Line

The “Superficial Back Line (SBL)” consists of two sections from the fingers to the knees and from the knees to the forehead. The SBL protects the entire back surface of the body by unifying it like a shield. The overall postural function of the SBL is to support the body in full extension and prevent the tendency to go into flexion. The Achilles tendon, sacrotuberous ligament, thoracolumbar fascia, erector spinae and occipital process are part of the SBL. Unlike other joints, the knees flex under the influence of the SBL muscles. In standing, the tendons of the SBL support the line of stance between the tibia and femur (Figure 1).

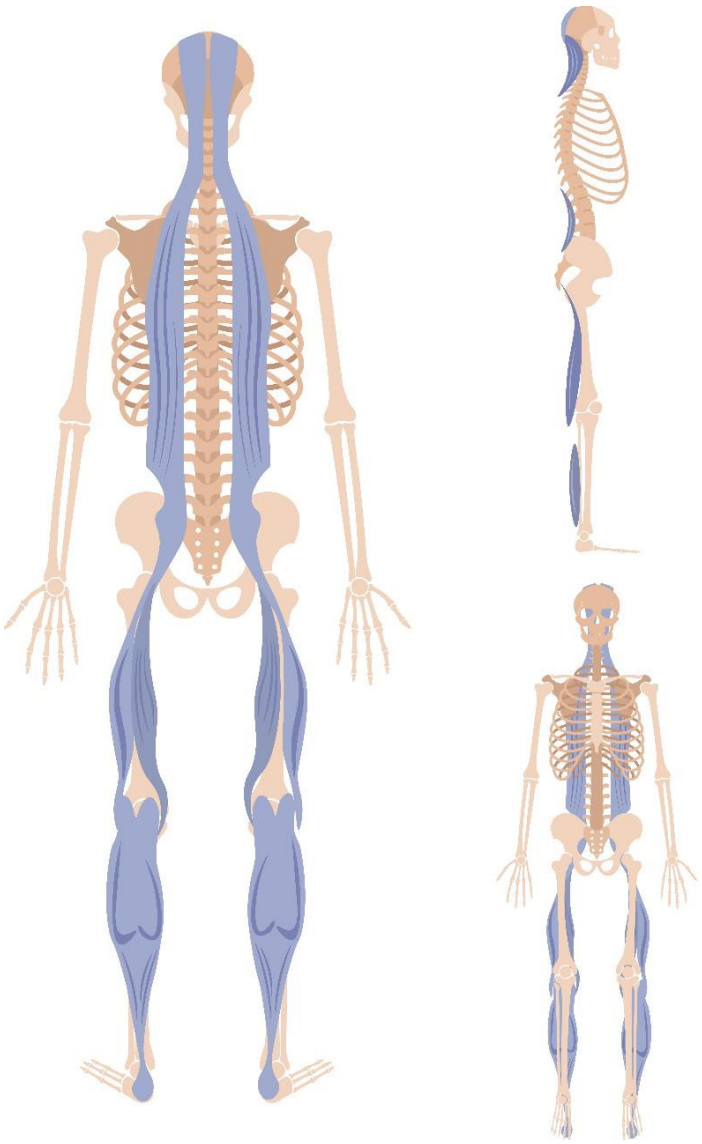


Figure 1 Myers, T. W. (2001). Anatomy trains: myofascial meridians for manual and movement therapists.

To stretch the SBL, the trunk can be tilted forwards without bending the knees or, sitting on your knees, the trunk can be tilted forwards until the head touches the floor (Figure 2):

Figure 2 SBL stretch

7.2.2 Superficial Front Line

The Superficial Front Line (SFL) "connects the entire front surface of the body from the top of the feet to the side of the skull in two parts. The overall postural function of the SFL is to provide the support needed to stabilize and lift parts of the skeleton (pubis, rib cage and face) in front of the gravity line. The SFL muscles protect the internal organs by supporting the anterior surface of the human body (soft and sensitive areas). The SFL fuses with the SBL through the periosteum around the phalanx tips. In terms of posture, the dorsiflexors limit excessive backward movement of the tibia-fibula complex, while the plantar flexors prevent excessive forward movement. The sagittal postural balance in the body (A-P balance) is maintained by the free or tight relationship between these two lines. When considered as parts of fascial planes rather than muscle chains, it is known that in most cases the SFL tends to shift downward and, in response, the SBL tends to shift upward (Figure 3).

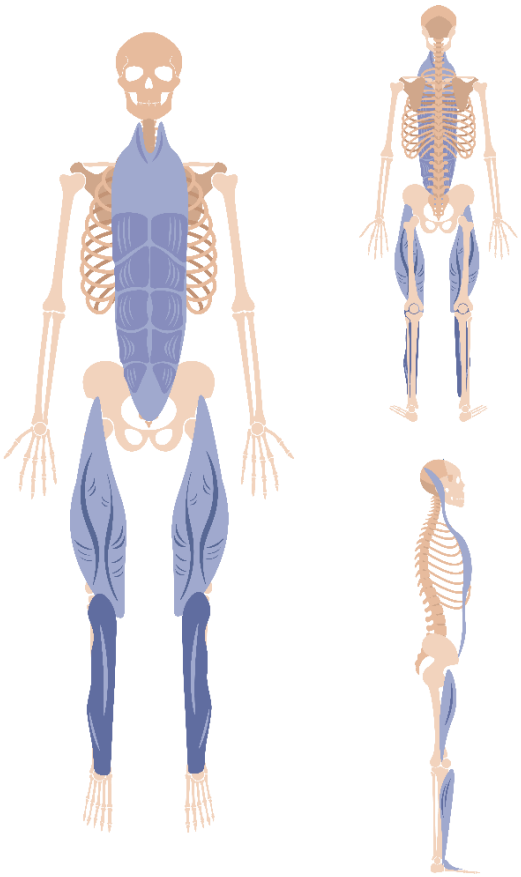


Figure 3 Myers, T. W. (2001). Anatomy trains: myofascial meridians for manual and movement therapists.

To stretch the SFL, the knight position can be taken with one knee in front and the trunk can be extended backwards with the arms or the trunk can be lifted upwards in the prone position with support from the hands (Figure 4):

Figure 4 SFL stretch

7.2.3 Lateral Line

The Lateral Line (LL) covers both sides of the body, starting at the midpoints of the feet and lateral midpoints, following the lateral surface of the leg and thigh from the outside of the ankle, and extending to the skull. The general postural function of the LL is to balance the front and back as well as the left and right sides. The LL also regulates the forces between the other superficial lines. The LL stabilizes the trunk and legs during any activity involving the arms (Figure 5).

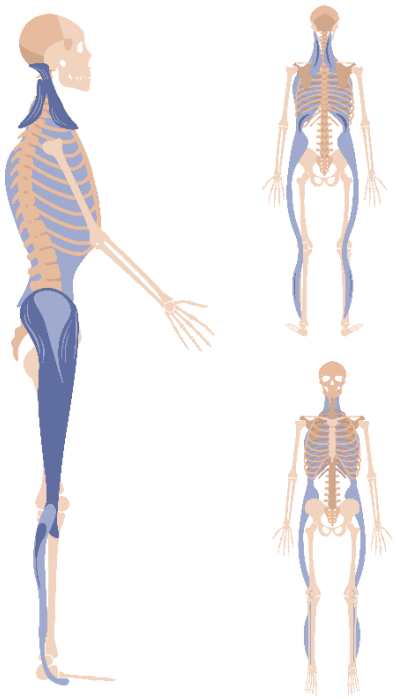


Figure 5 Myers, T. W. (2001). Anatomy trains: myofascial meridians for manual and movement therapists.

To stretch the LL, one can sit with one knee bent and the other leg extended to the side, with one hand on the extended leg and the other hand on the head, the trunk can be extended sideways and upwards. Alternatively, stretching is performed by reaching upwards with the arm in a side-lying position with support from one hand and the side edge of the feet (Figure 6):

Figure 6 LL stretch

7.2.4 Spiral Line

The Spiral Line (SPL) forms a spiral structure around the body, starting from the upper back, through the shoulder and around the ribs to the buttocks. The Spiral Line passes under the anterolateral part of the thigh and under the arch of the foot and runs along the back of the leg towards the ischium and erector fascia, ending very close to where it started. The postural function of the SPL is to provide postural balance in all planes by spiralling the body. The SPL helps the knee to move in a controlled manner during walking by connecting the arch of the foot with the pelvic tilt. The SPL plays a role in creating, coordinating and maintaining rotational movements in the body in balance disorders. Many myofascial components in the SPL are connected to other fascial lines and can affect their proper functioning and functionality (Picture 7).

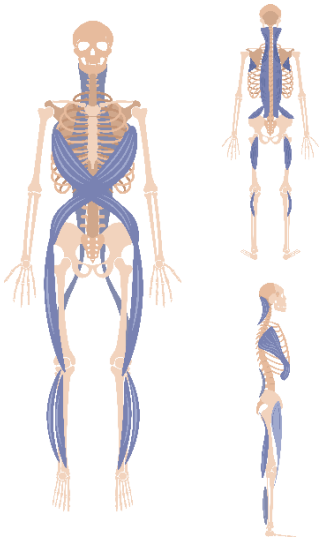


Figure 7 Myers, T. W. (2001). Anatomy trains: myofascial meridians for manual and movement therapists.

To stretch the SPL, you can sit with one knee bent and the other leg extended, support from the floor with one arm and apply resistance with the other arm with the elbow bent. Alternatively, in a kneeling position with one knee bent and the other leg extended backwards, stretching can be done forward with the help of body weight with the hands (Figure 8):

Figure 8 SPL stretch

7.2.5 Arm Lines

The four different myofascial lines associated with the axial skeleton and extending to the arm are defined as the Arm Lines. It is a myofascial line with multiple cross connections within itself in order to control and stabilize the variability due to the high mobility of the shoulder and arm.

The postural function of the arm lines is to create a tension line extending from the elbow to the back. It can influence the position of the shoulders, neck, rib cage and ribs, creating resistance to respiratory function. It is activated in activities such as weight transfer and push-ups on the arms (Figure 9).

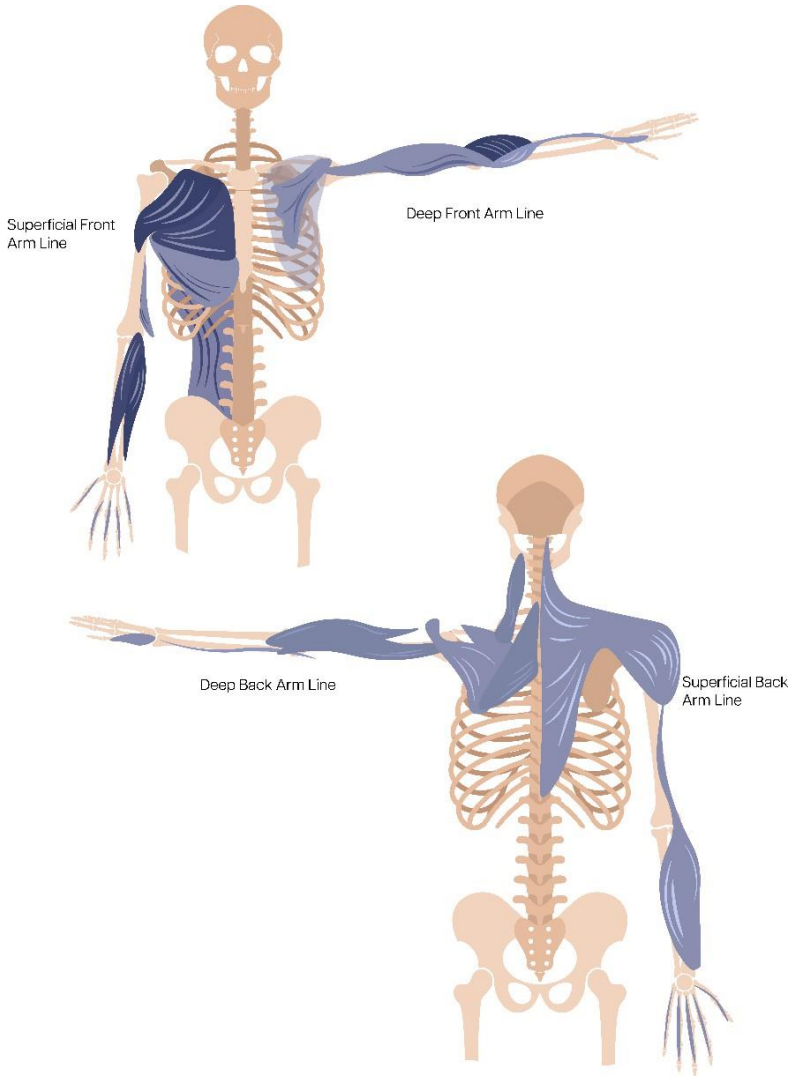


Figure 9 Myers, T. W. (2001). Anatomy trains: myofascial meridians for manual and movement therapists.

To stretch the Arm Lines, you can try sitting with one hand extended behind the torso from above, trying to connect the fingers with the other hand extending from the waist. Alternatively, while standing on one leg, the arms can be crossed over each other for a stretching effect (Figure 10):

Figure 10 Arm Lines stretch

7.2.6 Functional Lines

“Functional Lines”, which extend from the arm lines to the opposite pelvis and leg, are rarely used to change postural position. They are mainly involved in activities that require stabilization and balance. For example, during javelin or baseball throwing, they provide force dissipation by stabilizing the opposite side of the throwing limb (Figure 11).

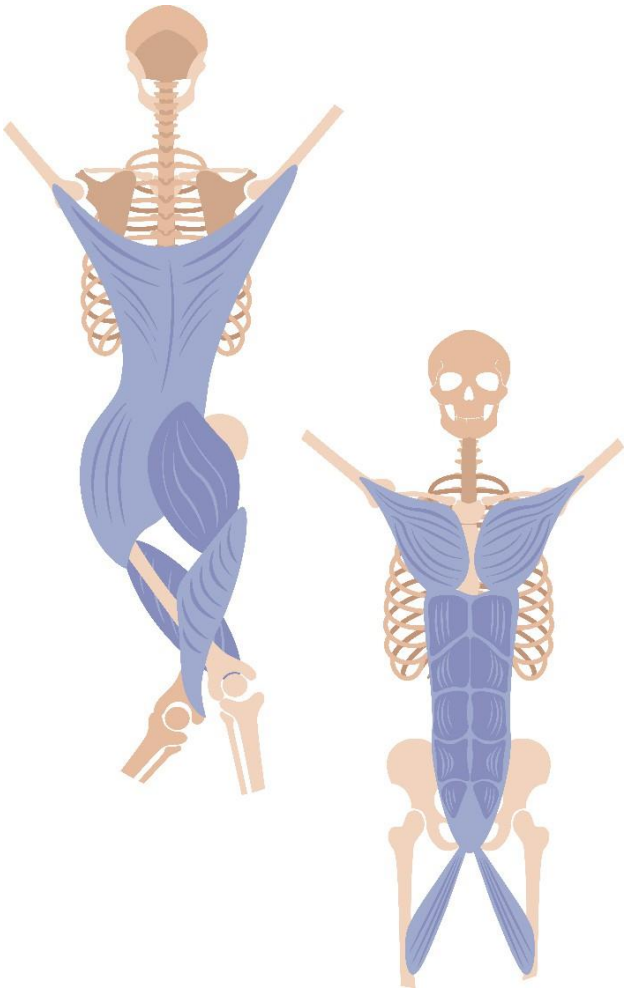


Figure 11 Myers, T. W. (2001). Anatomy trains: myofascial meridians for manual and movement therapists.

7.2.7 Deep Front Line

The “Deep Front Line (DFL)”, which forms the myofascial core of the body, is located between the left and right Lateral Lines in the coronal plane and between the Superficial Front Line and the Superficial Posterior Line in the sagittal plane and is surrounded by the Spiral and Functional Lines. It starts deep in the sole of the foot and extends along the back of the knee to the inner thigh. From this point it continues upwards through the hip joint, pelvis and lumbar spine to the skull. Compared to the previous outlines, the DFL is considered three-dimensional. The DFL includes the supporting muscles, regulates the respiratory period and gait rhythm, provides balance between the internal organs and acts as a stabilizer between the other lines. The postural functions of the DFL support the body by elevating the medial arch, stabilizing the lower extremities, supporting the lumbar spine from the front, providing rib cage mobility during inspiration and expiration, and balancing the head and neck. In summary, DFL reduces the work done by the muscles to maintain a balanced posture and keep the body in an upright position (Figure 12) (Myers, 2009).

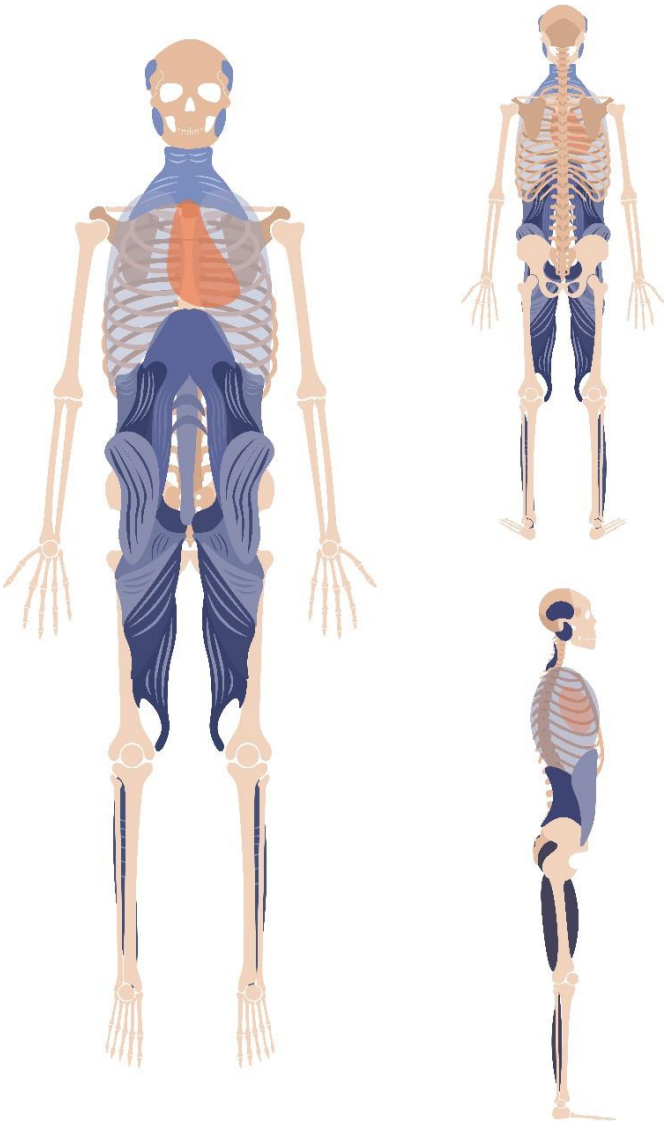


Figure 12 Myers, T. W. (2001). Anatomy trains: myofascial meridians for manual and movement therapists

To stretch the DFL, with one knee in front and the other leg extended backwards, the body weight can be transferred forwards by inversion or eversion of the foot (Figure 13):

Figure 13 DFL stretch

Coordinated activation of muscles is required to maintain and sustain posture. When general muscle activations are examined using electromyography:

- The intrinsic muscles of the foot are immobilized due to the support provided by the ligaments.
- Soleus is constantly active against gravity, while gastrocnemius, tibialis posterior and tibialis anterior muscles are relatively less active.
- The quadriceps and hamstring muscles are minimally active.
- Iliopsoas is constantly active.
- Gluteus maximus is not active.

- Gluteus medius and tensor fascia lata muscles are active to prevent lateral postural oscillation.
- The erector spinae muscles are active to counteract gravity.
- The lower fibers of the deep obliques are active to protect the abdomen while the superficial abdominal muscles are inactive (Tikkanen et al., 2013; Chiba et al., 2016).

7.3 Posture in Adolescence

Adolescence is the transition period from childhood to adulthood during which physical growth, sexual development and psychosocial maturation take place and is one of the most important stages of human development. Adolescents may face some psychosocial problems specific to this period, such as being in the process of identity formation, accelerated cognitive development, increased emotional intensity, career choice, establishing a relationship with the opposite sex, separation from parents and individualization. In this period when psychosocial problems and risk-taking behaviours are more common than in other periods of life, protecting and improving the health of adolescents, preventing risky behaviours that may negatively affect their lives and well-being, strengthening their abilities, and increasing their skills and capacity in combating these behaviours are of great importance in protecting and improving both the physical and psychosocial health of adolescents (Sharma & Rawat, 2023).

In addition to developing self-image and self-esteem, gaining the ability to manage emotions and relationships, and increasing qualities and abilities, body posture is also physiologically formed during adolescence. Body posture can be influenced by a wide range of physiological, occupational and biomechanical factors. In order to prevent the emergence of postural problems and their negative effects in daily life, it is of great importance to be able to predict the factors affecting posture and their consequences. Postural defects affect not only the adolescent himself/herself but also his/her environment and play an important role in defining the social personality of the individual. Since postural problems are frequently seen in childhood and adolescence, it is necessary to emphasize the importance of protective and preventive programs in this period. Therefore, from the earliest possible childhood period, in addition to increasing the level of physical activity and adopting a healthy lifestyle, the habit of developing and maintaining the correct posture should be tried to be gained. (Sharma & Rawat, 2023), In this context, cooperation between health institutions, pre-school and school institutions, sports clubs and families is of great importance in the education system. Raising awareness of the family on issues such as healthy living habits and the importance of regular physical activity is of great importance in terms of preventing all kinds of diseases. It is emphasized that physical activity can benefit from the contributions of physical activity such as supporting the development process positively, correcting posture disorders and deformities and developing positive motor skills by training parents to direct and motivate their children to participate in different types of physical activity (Protić-Gava, 2014).

Especially in spinal disorders that progress to the point of treatment, cooperation between family, teachers and health professionals becomes much more important and requires joint decision-making to achieve treatment goals. Considering that living with postural defects is a critical psychosocial factor for body image and identity development in adolescents, psychological and social aspects should be examined in addition to the physical condition during the evaluation process. Conducting all these evaluations by a multidisciplinary team in cooperation with the adolescent and the family facilitates obtaining more useful and faster results. If the primary goal is to establish healthy and effective communication with the adolescent throughout the whole process, to include them in the decision-making process and to ensure their active participation in the treatment, General health can be improved.

(Sebastian et al., 2008; Van Leijenhorst et al., 2010).

7.4 Postural Defects

Posture is defined as the optimal positioning of each part of the body in relation to the neighbouring part and the whole body. When we look from the sagittal plane, the vertebral column shows anatomical curvatures along the segments and these curvatures allow us to determine the neutral position for each segment. There are normal curvatures called lordosis in the cervical and lumbar segments of the spine and kyphosis in the thoracic and sacral segments, and abnormalities in these curvatures cause problems in postural alignment (Figure 14) (Czaprowski et al., 2018).

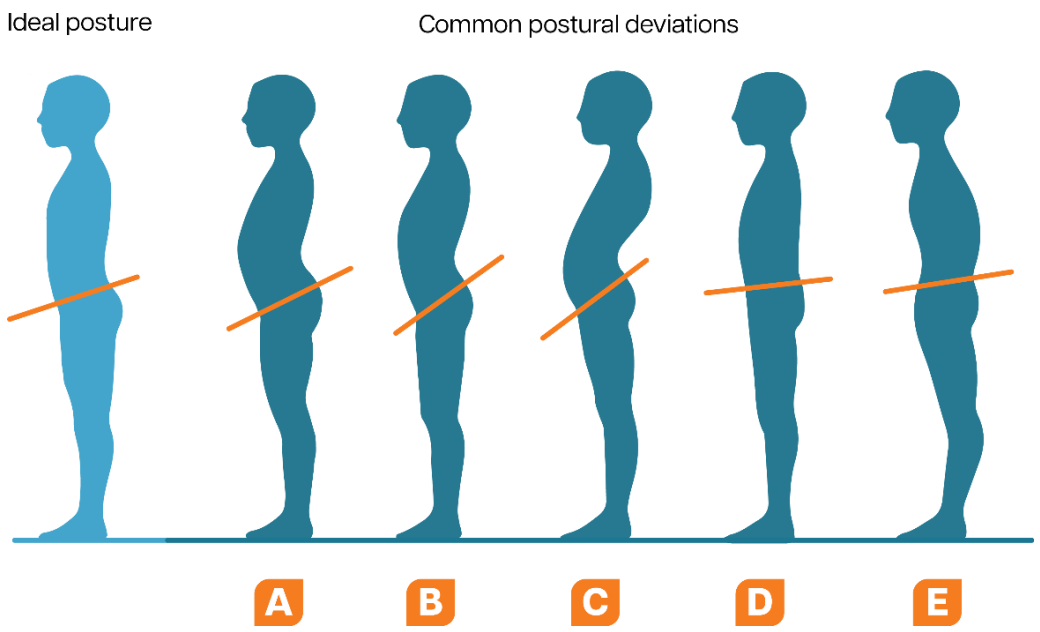


Figure 14 Myers, T. W. (2001). Anatomy trains: myofascial meridians for manual and movement therapists (90).

In children and adolescents, morphological changes related to skeletal growth and maturation of the postural control centre alter spinal alignment to improve spinal balance. The alignment of the spine can be disturbed due to deformities, musculoskeletal problems and neurodegenerative lesions. Spinal misalignment requires a precise analysis that distinguishes between structural disorders, transient changes and compensatory mechanisms. Precise knowledge of normal alignment is needed to guide therapeutic decision-making to restore a balanced alignment (Abelin-Genevois, 2021).

Since posture is provided by the interaction of multiple factors, the formation of postural problems can develop due to many reasons including physical, environmental, sociocultural and psychological.

Age, gender, genetic factors, inactive lifestyle can be counted among the physical causes of postural problems. In addition to genetic determinants, interactions between the nervous and endocrine systems can also cause developmental problems and deformations by affecting posture (Dayer et al., 2013).

The body structure, body composition and physical activity level of the person also affect posture indirectly. Today, obesity, which is frequently encountered especially in childhood, is emphasised as an important factor. Obesity and low level of physical activity trigger each other and cause overloading of the musculoskeletal system and development of inappropriate posture patterns in the process of posture development. In this context, these factors can be changed positively by modifications such as providing the necessary conditions and environmental arrangement to encourage physical activity, reducing screen time by ensuring that people spend their free time in quality, gaining healthy eating habits, organising school bags and working environment (Vincent & McKernan, 2013).

In a study examining the relationship between body composition and postural defects in school-age children, correct spinal alignment was found in only 41% of the children evaluated, while different problems such as decreased and/or increased lordosis, decreased and/or increased kyphosis and scoliosis were observed in the rest. In the study in which significant correlations were found between body composition and posture, it was reported that the curvatures in the spine were smooth in children with mesomorph type strong body structure, whereas alignment problems were more likely to be seen in children with ectomorph type weak body structure. No correlation was found with body composition in children with scoliosis or scoliotic posture. In the light of these findings, it is stated that unilateral and single-system therapeutic approaches should be avoided in the prevention and correction of postural problems and approaches that take into account both somatic and neurophysiological factors are appropriate. In addition, it is emphasised that it is much easier to shape the correct posture habit with the correct body composition/structure (Wilczyński et al., 2020).

In a recent study conducted to investigate the occurrence of back and side view posture defects in school-age children and to determine the risk factors associated with the occurrence of posture abnormalities, it was observed that the body posture of the children examined was closed, head pushed forward and drooping, shoulders rounded, hyperlordosis and pelvic

anteversion. In most of the children, various abnormalities related to the feet were detected and this was considered as a bad sign for the future as it may cause further asymmetry. Only some of the postural abnormalities identified were significantly associated with the risk factors studied, such as age (older children), gender (more common in boys), BMI (overweight/obesity), desk sitting (no adjustable chair), time spent on the computer (two hours or more) and dietary habits (snacks between meals) (Baranowska et al., 2023).

As a result of the sociocultural changes brought about by the Internet age, postural defects are encountered more frequently. With the increase in the use of online courses and technological devices brought about by the Covid-19 pandemic, adolescents have become more isolated from their families and social life. In addition to long-term screen use, factors such as the family's wrong attitude towards this situation and the inability to provide adequate physical and mental support increase and facilitate the development of postural problems in adolescents. For adolescents who are at a sensitive stage in every sense, conditions such as loss of self-confidence, aesthetic and cosmetic problems, negative body image, loneliness and depressive mood brought by postural problems have a great impact on adolescents by reducing psychological resilience and social commitment (Endo et al., 2012; Parrish et al., 2018; In et al., 2021).

Postural problems that develop due to multiple causes include changes in existing kyphotic and lordotic curvatures or decreases and/or increases. Postural defects mainly affect the musculoskeletal system and may cause functional impairment and tension in supporting structures. As a result of muscle weakness and shortness due to impairment in the stabilisation function of the muscles, decrease or increase in muscle activation, imbalance and functional loss occur between mobilizing and stabilizing muscles. Posture can be evaluated from anterior, posterior and lateral directions and defects occurring in the sagittal plane are more prominent. Common postural defects include forward-head posture, kyphotic posture, kypholordotic posture, sway-back posture, flat-back posture and scoliosis (Griegel-Morris et al., 1992).

7.4.1 Forward Head Posture

Forward Head posture is a posture in which the head is shifted forwards with the chin protruding. It is caused by increased flexion of the lower cervical spine and upper thoracic spine and increased extension of the upper cervical spine and occiput. FHP is considered one of the most common musculoskeletal abnormalities, characterised by incorrect posture of the head in the sagittal plane and a tilt of the body's centre of gravity more forward than a vertical line relative to the head position. This causes increased load and biomechanical stress on the cervical joints and ligamentous system (Lee et al., 2022). Numerous studies have identified several causes and risk factors for FHP, including repetitive and cumulative traumas to the neck, prolonged sitting, improper head position during work, and smartphone use (Kim & Koo, 2023). Several conditions related to FHP, including thoracic kyphosis and cervical range of motion, postural control, muscle weakness, pain and injury, can lead to neck pain, headaches, migraines and postural abnormalities (Mahmoud et al., 2019).

7.4.2 Kyphotic Posture

Kyphosis is defined as a physiological curvature of the spine in the sagittal plane with posterior convexity. According to the Scoliosis Research Society, the thoracic curvature in the sagittal plane should be between 20° and 45° Cobb degrees in growing adolescents and young adults. Hyperkyphosis is an angle of kyphosis that exceeds the normal range and may present as a structural or postural disorder. Hyperkyphosis can occur at any level of the thoracic or lumbar spine but is most likely in the main thoracic region or at the thoracolumbar junction (Tribus, 1998; Miladi 2013).

Scheuermann's kyphosis is referred to as idiopathic kyphosis, representing a rigid deformity that occurs due to compression of the thoracic vertebrae and endplate irregularities during spinal growth. Increased kyphosis in the thoracic region can cause pain, breathing difficulties and cosmetic problems. In addition, kyphotic posture is associated with back pain and poor cosmetic appearance. In addition, health-related quality of life (HRQoL) is lower in patients with kyphosis compared to healthy controls (Kamali et al., 2016; Zapata et al., 2021).

7.4.3 Kypholordotic Posture

In this posture, the head is in anterior tilt, cervical vertebrae are in hyperextension position, scapula is in abduction, dorsal and lumbar lordosis is increased, pelvis is in anterior pelvic tilt, hip is in flexion, knee is slightly hyperextended, ankle is slightly plantar flexed. Muscle groups are also affected due to this posture. Neck extensors, hip flexors, lumbar extensors are shortened and strengthened. Neck flexors and upper thoracic extensor oblique muscles are weak and extended. Hamstrings are extended but may not be weak (Kendall et al., 2005).

7.4.4 Lordotic Posture

Lordosis refers to the forward curvature of the spine. Exaggeration of this curve is usually referred to as hyper-lordosis. The head, neck and thoracic spine are in neutral position. The lumbar spine is hyperextended, causing an anterior tilt of the pelvis. The hips are flexed, the knees are hyperextended, and the ankles are in plantar flexion. In lordotic posture, the headline descends behind the lumbar vertebral bodies, passing close to the intervertebral facet joints, which causes extensor overload of the facets. The head line also lies in front of the axis of the knee joint, leading to overload of the anterior knee compartment. The headline may overlap the baseline or cross in front of it in anterior head tilt. The abdominal muscles are extended and weak. The lower back muscles and hip flexors are short and strong (Kendall et al., 2005; Czaprowski et al., 2018).

7.4.5 Sway-back Posture

In this type of posture, there is an anteriror tilt of the head, straightening of the cervical and lumbar spine, flexion of the thoracic spine, posterior tilt of the pelvis, hyperextension of the hip and knee, and slight plantar flexion of the ankle. In the sway back posture, the anterior pelvic tilt and thoracic kyphosis are flattened to the upper part of the lumbar spine.

The pelvis is in front of the headline, while the upper part of the trunk is usually orientated behind this axis. The headline and the base line usually overlap each other, which ensures the normal position of the head. However, the head is protruded due to the inclination of the chest in relation to the base and the headline. The headline passes posteriorly to the lumbar vertebral bodies (causing extension overload) and posteriorly to the axis of the hip joints (causing hip joint overload). The neck flexors, middle/lower trapezius, thoracic paraspinals, external obliques and iliopsoas are extended and weak. Hip extensors are short and strong (Kendall et al., 2005).

7.4.6 Flat-back Posture

In this type of posture, the head is in anterior tilt with the cervical spine. There is a slight flexion of the upper thoracic spine and extension of the lower thoracic and lumbar spine. The pelvis is in posterior tilt, knees in extension and ankles in plantar flexion. In the flat back posture, the headline and baseline usually overlap and pass in front of the lumbar vertebral bodies (leading to flexion overload) and behind the hip joint axis. The hip flexors are extended and weak. The hip extensors are short and strong (Kendall et al., 2005).

7.4.7 Upper Cross Syndrome

Upper cross syndrome (UCS) is also called proximal or shoulder girdle cross syndrome. UCS is defined as ‘tightness of the upper trapezius, pectoralis major and levator scapula muscles and weakness of the serratus anterior, middle and lower trapezius and deep neck flexors, especially the scalene muscles. UCS can cause body dysfunctions such as headache, early fatigue and decreased respiratory capacity. UCS is associated with deep neck flexor weakness and muscle imbalances of key antagonists, including strong pectoral muscles and sternocleidomastoid, leading to an increase in thoracic kyphosis, cervical lordosis and FHP. Individuals presenting with upper cross syndrome have a forward head posture as well as altered shoulder girdle function, elliptical shoulders, scapular winging and decreased mobility of the thoracic spine (Ardhadi et al., 2019).

7.4.8 Lower Cross Syndrome

Lower Cross Syndrome (LCS) is a common disorder characterized by muscle tension caused by an imbalance in the strength of muscles in the lower limbs, and it has also been reported that LCS is a musculoskeletal imbalance characterized by specific patterns of muscle

weakness, also known as pelvic. LCS results from an imbalance of muscle strength in the lower limbs, affected by muscle tension on the iliopsoas, rectus femoris, tensor fascia lata, adductor group, gastrocnemius, and soleus. Due to muscle imbalance, the person with LCS may develop low back pain later in life. This muscle imbalance causes joint pain (low back, hip and knee) and specific postural changes such as anterior pelvic tilt, lumbar lordosis, lateral lumbar shift, external rotation of the hip and knee hyperextension. It can also lead to increased thoracic kyphosis and cervical lordosis. There are two known subtypes of lower cross syndrome (A and B). The two types are similar and involve the same main muscle imbalance characteristics. In type A, the imbalance occurs in the hip, while in type B the imbalance occurs in the lower back. The two subgroups can be distinguished according to altered postural alignment and regional patterns of myofascial activation (Ngang Naga et al., 2021).

7.4.9 Scoliosis

Scoliosis is a complex three-dimensional structural deformity accompanied by lateral deviation of the spine over 10°, axial rotation and sagittal plane deviations on coronal spine radiography. Each of these components contributes to the general shape and structure of the spine in individuals with scoliosis. When we consider scoliosis in the sagittal plane, this plane is very important for understanding the overall balance of the spine and its effect on posture and function. Scoliosis is defined using the Cobb angle in the coronal plane of the spine, often accompanied by vertebral rotation in the transverse plane and hypokyphosis in the sagittal plane. These abnormalities in the costovertebral joints, vertebral rotation and thorax produce a ‘convex’ and ‘concave’ haemithorax. When the scoliosis becomes more pronounced, the rotational component begins and leads to torsion-scoliosis, also known as hunchback (Newton et al., 2015, Burkus et al., 2018).

The following symptoms may suggest scoliosis:

- Lateral curvature of the spine
- Trunk lateral flexion
- Change in shoulder heights
- Differences in pelvic height
- Leg length inequalities
- Muscle pain
- Ligament and tendon pain
- Decreased respiratory function

There are several different types affecting children and adolescents. Currently, the most common type is “Adolescent Idiopathic Scoliosis (AIS)”. AIS usually develops between the ages of 10 and 18 years, between the onset of puberty and the closure of the growth plate, and its prevalence is reported to be 2-3% (Diebo et al., 2019; Weinstein et al., 2008; Yılmaz et al., 2020; Burwell et al., 2016).

7.5 Evaluation of Postural Defects

Correction of postural defects, which aims to restore proper sagittal alignment, should start with a detailed clinical examination, and continue with the application of specific exercises aimed at restoring the function of the musculoskeletal system. Although diagnostic evaluations for postural problems include modern imaging techniques such as digital whole-body radiography, computed tomography or nuclear magnetic resonance, basic clinical examination and anamnesis remain valuable (Czaprowski et al., 2018).

The main objective of posture analysis, which is frequently used by physiotherapists in clinical examination, is to determine the postural defects in individuals, to apply the correct treatment programme and to prevent postural problems that may occur in the future. Auxiliary tools such as plurimeters, inclinometers and goniometers can often be used in physiotherapy and rehabilitation assessments for posture analysis. Posture analysis is performed from lateral, anterior and posterior directions and examined in detail in terms of head-neck position, shoulder heights, thoracic cage alignment, symmetry of lumbar hollows, pelvic tilt, hip levels, leg length inequalities, knee and foot alignments. In addition to posture tables (New York Posture Rating Scale, Bragg) and length-distance measurements, methods such as Picturegraphy in sagittal plane, symmetrygraphy and radiography are used in posture analysis. In addition to posture analysis, range of motion, flexibility, muscle strength, balance, respiration, pain and quality of life should be evaluated. Shortened and/or extended muscle groups should be identified and hypoactive or hyperactive structures that have lost their function should be detected. Spinal flexibility and range of motion are greatly affected due to muscular imbalance. Considering that respiratory functions may be affected due to changes in spine and rib cage alignment, pulmonary function tests and respiratory muscle strength should be evaluated. Since the change in spinal alignment will cause changes in gravity and centre of gravity, postural control may be adversely affected, and this may cause balance problems and should be included in the evaluation programme. The evaluation of the concept of posture, which is formed because of the interaction of multiple systems, should be made in a holistic manner to address all systems and the treatment programme should be shaped in the light of these evaluations (Figure 15) (Rahman et al., 2017).

Figure 15 Posture analysis is performed from lateral, anterior and posterior directions

The gold standard for the diagnosis and evaluation of spinal deformities is radiographic imaging of the trunk. As a result of the reflection of X-rays on the spine, the Cobb method is used to measure and categorise curvatures. With the increase in computer-aided approaches to determine the Cobb angle, more consistent and reliable results are obtained. Despite all these advantages, the radiation and long-term adverse effects of radiographic methods are an important point to be considered (Stecher et al., 2024). In addition to radiation, alternative methods are preferred due to disadvantages such as image distortion and low inter-observer reliability. EOS®, a low-dose dual-plane digital radiographic imaging system, is an example of a current alternative method. Spinopelvic parameters such as thoracic kyphosis, lumbar lordosis, sacral kyphosis and pelvic ratio in EOS® are reliable and comparable to conventional C1-S1 radiographs (Shakeri et al., 2024).

Raster-stereography, Spinal Mouse® spinal scanning systems and Picturegrammetry are the three main non-radiographic methods currently preferred. Raster-stereography allows assessment by using infrared cameras and beams projected onto the person to be measured. Raster-stereography, which offers a wide range of postural parameters and can be used quickly, is a high-cost method. Spinal Mouse® is a valid and reliable tool that can be rolled along the spine, allowing measurement of vertebral shape and angulation, and is frequently used for spinal assessment, especially in cases of increased kyphosis. Picturegrammetry is a low-cost and frequently preferred tool that allows kinematic and geometric analysis of

movement and posture in two-dimensional evaluations. It is also actively used in the process of creating 3D models using Picturegraphs, diagnosing and evaluating posture disorders (Belli et al., 2023).

Spinometry, another radiation-free method, is a three-dimensional tool for spinal imaging that provides additional information about functional gait patterns related to the pelvis and lower extremities. This technology, which uses surface topography to mark bone regions and detect asymmetry, supports the long-term treatment process by helping to evaluate spinal deformities (Bode et al., 2024). Another topographic method, the newly developed torsobarography, enables the detection of sagittal imbalance and asymmetric morphology of the trunk by analyzing the pressure distribution along the trunk in the lying position. Torsobarographs, which are thought to be a pioneering system in the early diagnosis of postural deformities, have an important potential in terms of providing reliable posture analysis (Stecher et al., 2024).

Mobile applications, which are frequently used due to the developing technology and the increase in the use of smart phones, stand out as popular methods used in terms of subjective evaluation of posture and as a supportive tool. Light sensor-based software developed as 3-dimensional mobile scanning tools are rapidly progressing towards becoming highly accessible tools that prevent the progression of postural defects, reduce or correct them with effective treatments, provide feedback to the person (Kandasamy et al., 2023). The Scoliosis Tele Screening Test (STS-Test), one of the mobile applications for posture analysis developed for the use of parents, offers the opportunity to assess the risk of scoliosis. This test, which allows parents to observe and monitor the spine at regular intervals and to detect scoliosis without the need to visit a health institution, supports the active participation of the family in early diagnosis. Developed as a cost-effective, result-oriented, protective and up-to-date method, this test is a good alternative method with validity and reliability (Yılmaz et al., 2023).

In Adolescent Idiopathic Scoliosis (AIS), which is the most common spinal deformity in adolescence, it is of great importance to detect the deformity to prevent its progression and to perform appropriate interventions. The diagnosis of AIS is made by both clinical examination and specific radiological examinations. Clinical evaluation includes postural and anthropometric analyses. In Adam's Forward Bending Test, which is one of the most used effective and simple clinical tests, the spine is evaluated for the presence of curvature and asymmetry by asking the person to bend forward while standing. While the person is in a comfortable standing position, the posture of the person is evaluated from the anterior, posterior and lateral directions and the shoulder and hip levels, the presence of midline shifts that may develop compensatory in the trunk and pelvis, head-neck asymmetry and deviations in the whole spine alignment are examined. One of the most important points in the clinical evaluation is the anamnesis, and family history, pain status, growth potential, presence of neurological or other symptoms, participation in activities of daily living and physical activity level are questioned.

Radiological evaluation is routinely used in the diagnosis of AIS and Cobb angle calculations are used to detect curvature and determine the type and severity of scoliosis (Scaramuzzo,

2023). In a recent study conducted to determine the Cobb angle; in addition to the prediction ability of the deep learning algorithm used by comparing the measurement results calculated with routine radiological imaging and the imaging system with 3D depth sensors; It was aimed to examine the result measurements depending on the presence or absence of clothing. As a result of the study, it is stated that the predicted Cobb angle results and the actual results are correlated. It is concluded that the method is a valuable alternative for scoliosis examination with underwear since there is no significant difference in the measurement results with and without underwear in the forward bending posture and the psychological burden of naked evaluation cannot be ignored, especially for adolescents (Ishikawa et al., 2023).

When the questionnaires used to evaluate postural problems are analysed; Scoliosis Research Society Questionnaire (SRS-22r) is an internationally widely used questionnaire developed to evaluate health-related quality of life in people with AIS. Validity and reliability studies of the questionnaire have been conducted and current studies suggest that the questionnaire can be revised to increase its scope and improve the outcome measurements. Other frequently used questionnaires include the Spinal Appearance Questionnaire (SAQ), which evaluates personal perception of cosmetic deformity, physical appearance and image, and the Kyphosis Specific Spinal Appearance Questionnaire (KSAQ), which was developed to evaluate the appearance in hyperkyphosis patients (Yağcı et al., 2023; Sanders et al., 2007; Zapata et al., 2021).

7.6 Treatment of Postural Defects

Correct body posture plays a vital role in human health. It is suggested that ideal upright posture is a sign of musculoskeletal health and is one of the main indicators of movement system health (Griegel-Morris et al., 1992). Therefore, defects in posture may adversely affect the health of the person if left untreated. The management of postural problems requires a multidisciplinary approach and requires the use of different components such as exercise training, ergonomic arrangements, orthosis, taping, surgery, psychosocial support.

Although surgical options are considered in cases where posture problems are very severe, treatments generally consist of conventional methods. Supportive methods such as the use of orthosis, plastering, device use is also preferred according to the condition of the person. Since these methods immobilize an isolated part of the body by applying corrective forces, they may have a dysfunctional effect on the muscle (Hrysomallis & Garrison, 2001).

Physiotherapy and exercise training are frequently recommended and used more frequently in the prevention or correction of postural disorders. By acting on the muscle imbalance caused by posture problems with exercises; shortened muscles with increased activity are extended and muscles with prolonged and decreased activity are strengthened (Romano et al., 2012).

Posture is negatively affected, and postural problems become common as a result of the increase in static postural positions such as prolonged sitting with the effect of modern lifestyle, prolonged screen time due to the use of technological devices such as phones and computers, and negative changes in physical activity level (In Jung et al., 2024).

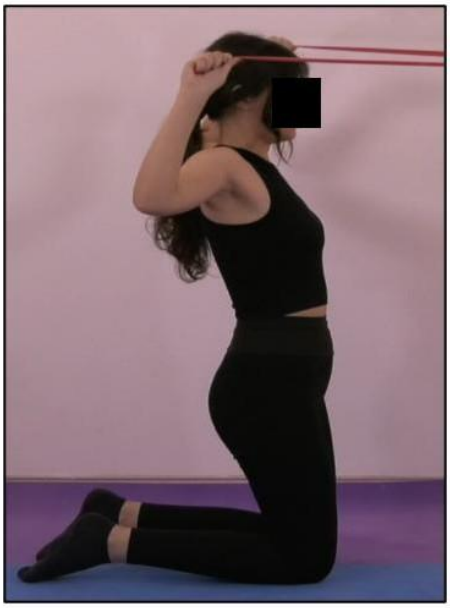
It is recognized that physical activity has important health advantages such as reducing mortality risks, improving psychological well-being and mental health, reducing chronic diseases and maintaining ideal weight. For these reasons, increasing physical activity, which is recognised as a fundamental component of health, is defined as a global health priority. It is thought that posture can be maintained and improved by increasing the level of physical activity (Salsali et al., 2023).

Basically, within the scope of physiotherapy and rehabilitation applications aiming to manage pain, maintain function, maintain and improve alignment; methods such as superficial heat agents, stretching-recovery exercises, aerobic exercises, core stabilization and strengthening exercises, biofeedback, cognitive-behavioral therapy and acupuncture and combinations of these methods with each other are preferred (Haldeman et al., 2018).

The adolescent and family should be included in the decision-making and treatment program planning process. An individualized treatment program suitable for the individual should be created by taking into account the wishes and goals of the adolescent. Family education is very important in terms of the effectiveness and sustainability of the treatment; active participation of the family is necessary in motivating and supporting the adolescent and making ergonomic arrangements suitable for the adolescent.

Posture-correcting exercises are very diverse and include movements for the neck, back, shoulders and pelvic floor. Exercises such as cat-and-mouse, scapular retraction and chin-tuck are frequently used.

Examples of exercises are presented below (Figures 16):



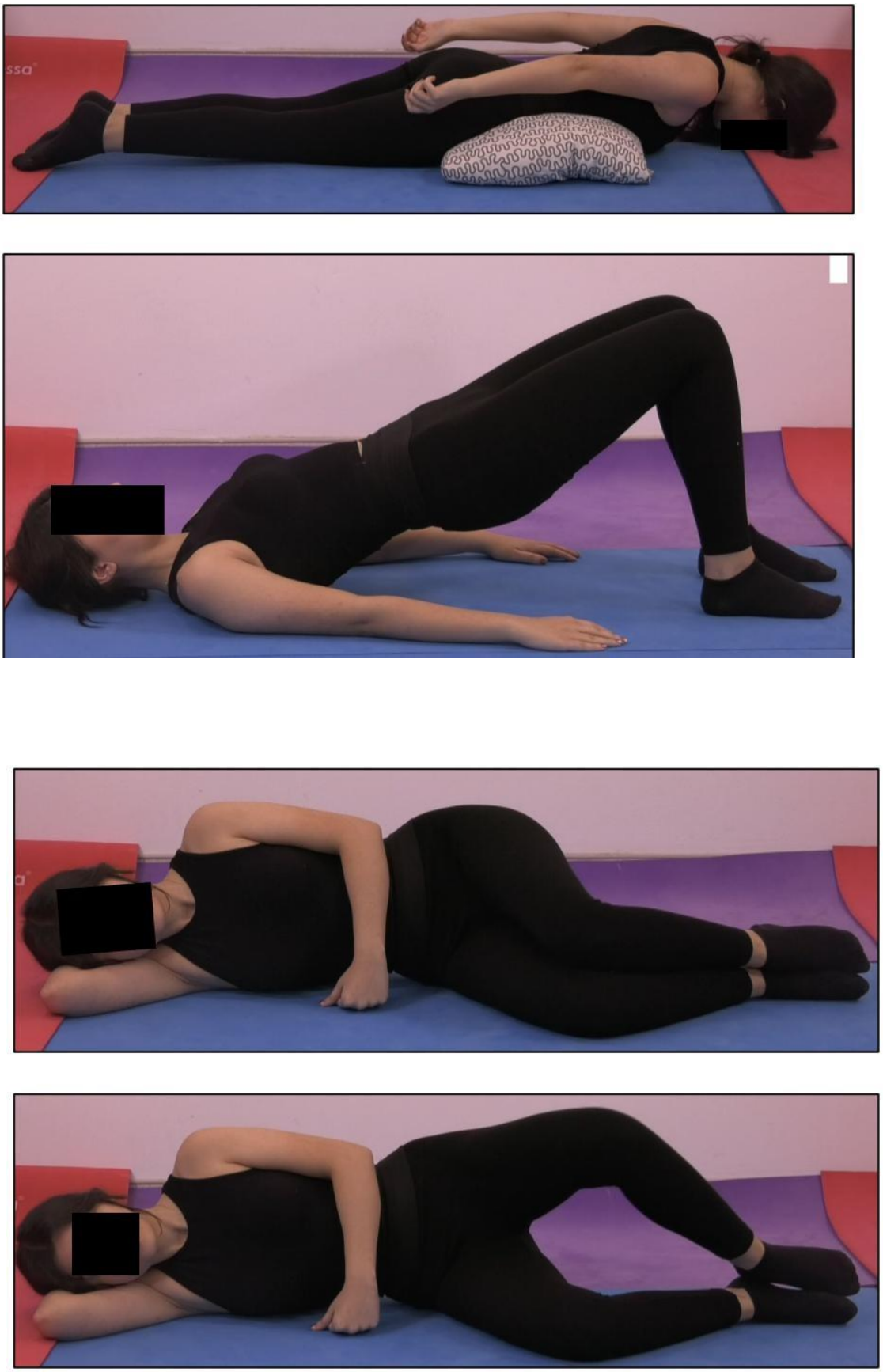


Figure 16 Posture correcting exercise samples

There are a wide variety of exercise methods that can be used, and McKenzie and Williams exercises are the accepted methods preferred especially for back and low back pain. While McKenzie exercises are identified with spinal extension exercises, Williams exercises are identified with lumbar flexion exercises (Faas, 1996).

The Mckenzie method adopts self-healing through posture correction and high-frequency repetitive exercise movements. This method, which was developed for diagnostic purposes as well as treatment, evaluates patients by dividing them into subgroups according to their clinical condition. In this method, which is based on the phenomenon of centralization; pain progressing from the spine to the distal spine returns to the spine with repetitive movements and recovery is aimed with appropriate exercises. Prone and standing lumbar extension exercises are preferred to lengthen the spine (Lam et al., 2018).

The Williams method is used to improve lumbar flexion and strengthen the gluteal and abdominal muscles. Unlike McKenzie exercises, the Williams method, which focuses on lumbar flexion, includes exercises based on posterior pelvic tilt, stretching the hamstrings and hip flexors, squats, single knee and stretching the spine by pulling both knees towards the chest (Fatemi et al., 2015):

1) Pelvic tilt- The posterior pelvic tilt position is performed with the patient lying on their back with their hands at their side and knees bent. The patient is then asked to tighten the abdominal muscles as well as the gluteal muscles and press the back towards the floor.

2) Single knee to chest- The single knee to chest movement is performed with the patient lying on a table or bed. The patient is then asked to release one leg from the table or bed, bend the other leg and wrap the hands around the bent knee and pull the bent leg towards the chest.

3) Double knee to chest- The double knee to chest stretch is also performed with the patient lying on his/her back. The patient is asked to bring both knees to the chest, one at a time. The patient holds his/her hands together, pulls his/her knees towards the chest and tilts his/her head forwards. While performing the movement, the patient is asked to keep the knees together and shoulders flat on the floor. The patient then lowers one leg at a time.

4) Hamstring stretching- The patient lies on his back with his hands at his side. With one knee bent and the other knee straight, he is asked to pull the foot of the straight leg towards him. He is then asked to lift his leg until he feels a stretch in the back of his thigh.

5) Squat- Standing with feet slightly wider than hip width apart, toes pointing slightly outwards, hands are asked to be clasped on the chest for balance. The hips are pushed backwards, and the knees are lowered as low as possible. Arms can be swung backwards for momentum.

6) Hip Flexor Stretch- Kneeling on the affected leg and bending the good leg forwards, with this leg flat on the floor and keeping the back straight, slowly push the hip forwards until you feel a stretch in the upper thigh of the back leg.

When these two methods, which offer different approaches, are compared, McKenzie exercises are preferred in disc problems and in cases where relief is provided with extension, and Williams exercises are preferred in cases worsened by extension. A recent study concluded that McKenzie exercises are more effective in reducing pain and improving functionality (Karez et al., 2023).

Other methods include ergonomic interventions, superficial heat agents, self-myofascial release techniques, soft tissue mobilizations, manual therapy, posture corrective exercises, scapulothoracic stabilization exercises, stretching and strengthening exercises. In the treatment of postural problems; exercises that increase body and mind coordination and improve body awareness should also be included in the program (Chang et al., 2023).

It is stated that Pilates exercises are effective in correcting postural disorders with correct exercise selection and controlled practice. It is emphasized that Pilates, which integrates the use of upper and lower extremities with the trunk instead of training certain muscle groups separately, provides improvement on pain and Cobb angle, strengthens the relevant muscles by correcting postural disorders and alleviates the severity of deformity. There is evidence that Pilates is a popularized method due to its advantages such as being safe, easy to apply and suitable for all ages and can be used to increase spinal mobility, improve quality of life, physical function and health.

(Negrini et al., 2008; Gou et al., 2021; Emery et al., 2010; Alves de Araújo et al., 2012; Li et al., 2024).

In recent years, virtual reality systems have started to be used in evaluation and treatment in the field of rehabilitation. Virtual reality programs offer the opportunity to experience situations that can be encountered in real life in a safe environment by reducing the risks faced by patients (Bryanton et al., 2006; Park et al., 2013).

Therapists need a meaningful and motivational tool to increase the effectiveness of exercises. In this context, game-based virtual reality systems, an innovative technology, are seen as a useful tool in rehabilitation and their use is becoming widespread day by day. In a study investigating the effectiveness of a game-based virtual reality system on Forward-head-posture; it was concluded that it can be used as a facilitating tool for individuals with FHP to perform therapeutic exercises correctly and for physiotherapists to follow up (Asadzadeh, 2024). It was concluded that virtual reality interventions applied in patients with chronic low back pain are effective on physical functions and quality of life. It is expected that the use of these applications in clinical and home environments will increase gradually (Weiss et al., 2004).

The treatment of scoliosis, the most complex deformity of the spine, is multifaceted. The aim of treatment is to prevent progression of the curve, improve aesthetic appearance, reduce asymmetric compression load, eliminate muscle imbalances, prevent asymmetric torsion during walking, increase respiratory function, reduce symptoms that impair quality of life such as pain, and improve balance by providing active and passive correct posture. Skeletal maturation of the patient must be taken into consideration in the treatment of AIS. In patients

with growth potential, follow-up at 6-month intervals for curves less than 25 degrees, conservative treatment for curves between 25-45 degrees and surgical treatment for curves greater than 45 degrees are recommended. In addition to bone maturation, factors such as Cobb angle, age, menarche, gender, type and pattern of curvature are of great importance when deciding on conservative treatment methods (Dimeglio & Canavese, 2013; McLaughlin, 2016).

The treatment recommendations for scoliosis given by the International Society for Scoliosis Orthopedics and Rehabilitation Treatment (SOSORT) are as follows:

-In the first stage of idiopathic scoliosis treatment, scoliosis-specific exercises should be performed to prevent progression of the deformity.

The exercise program should be in accordance with the principles of three-dimensional treatment, training in activities of daily living, maintenance of corrected posture and patient education.

- The exercise program should be planned according to the effectiveness shown in scientific publications.
- The application should be designed by physiotherapists trained in this field.
- Communication within the treatment team is essential.
- Exercises should be individually planned and personalized for each patient.
- For successful results, it is recommended to perform the exercises regularly.

The main exercises used in the treatment of scoliosis are posture exercises, flexibility exercises, respiratory exercises, stretching exercises and strengthening exercises. The exercises are aimed at preventing or reversing the progression of curvature, stopping spinal and thoracic deformities in the long term, preventing respiratory dysfunctions, treating spinal pain syndromes and providing aesthetic and posture correction (Figure 17, 18, 19, 20, 21):

Figure 17 Cat cow exercises

Figure 18 Cat cow exercises

Figure 19 Breathing exercises

Figure 20 Cross arm leg extension exercise

Figure 21 Cross arm leg extension exercise

The most used conservative treatment method for low to moderate curvatures in AIS is the use of orthoses and braces. Orthosis and bracing are disadvantageous methods in terms of muscle atrophy, rigidity and flat-back posture development and require long-term use. Orthosis and bracing are combined with scoliosis-specific exercises (SSE) to reduce the side effects of prolonged immobilization and improve final outcomes. Numerous studies have demonstrated the effectiveness of orthosis and bracing in altering the natural progression of AIS and reducing the likelihood of surgical intervention. The most important factor in the success of orthosis and brace use is the individual's compliance and adherence. In this context, since long-term use of orthosis/corset is required to obtain effective results, it is necessary to accurately monitor how many hours the patient wears the orthosis/corset and to evaluate the actual compliance. Technological developments in recent years have led to the use of electronic devices such as thermal or pressure sensors in braces/orthotics, which overcome the limitations of traditional questionnaires or verbal reports and enable more precise monitoring of treatment compliance (Fregne et al., 2024).

While physical activity and exercise therapy are recommended to patients regardless of orthosis and surgery in AIS, curvature-specific exercise methods have been developed in many different methodologies in the conservative treatment of AIS. Although these methods differ in principle, they have common goals such as preventing the progression of deformity, delaying the use of bracing and improving the functionality of the individual (In Jung et al., 2024).

SSE consists of asymmetric movement groups different from normal exercise groups. In the clinic, SSE is used alone for low-grade curves and in combination with orthotics for moderate curves. For curvatures above a certain degree in adulthood, SSE is the primary treatment. The

mechanical changes it produces on the muscles and soft tissues around the spine and the idea that the neuromotor control of the spine can be reorganized accordingly make SSE an important treatment tool. In addition, it is known to be effective in reducing pain, stabilizing curvature, reducing functional distress, improving cardiopulmonary function and thoracic expansion. When used in combination with a brace/orthotic, SSE contributes to reducing the side effects of the brace/orthotic, increasing mobility and achieving better corection (Berdishevsky et al., 2016).

Three-dimensional exercise approaches developed within the scope of SSE are known as Schroth Approach, Scientific Exercise Approach for Scoliosis (SEAS), Lyon Approach, Barcelona Scoliosis Physical Therapy School (BSPTS), Dobomed Method, Side Shift Method and Functional Individual Treatment of Scoliosis (FITS).

The Schroth method is the most preferred method that offers an evidence-based exercise approach and has been used for many years. In Schroth, in addition to exercise training, posture training is provided, and the person is helped to maintain the correct posture during daily life activities. Schroth exercises basically include asymmetric trunk exercises with rotational breathing. Thus, it provides reorganization of the muscle imbalance that develops due to rotational forces associated with scoliosis. This regulation is realized by the coordination of sensorimotor system and kinesthetic stimuli. It is known that rotational breathing combined with asymmetric exercises is superior to other standard treatments in providing benefits such as reduction in trunk rotation, postural balance, improvement in body image perception, increase in vital capacity and muscle Endurance (Bayraktar et al., 2018; Weiss et al., 2016; Moramarco et al., 2018).

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8 LOW BACK PAIN DURING PREGNANCY

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Pregnancy is a process that profoundly affects the human body, particularly the musculoskeletal system. Hormonal changes lead to the relaxation of ligaments that stabilize the joints, weight gain, and a shift in the body's center of gravity, resulting in an increase in lumbar lordosis and the occurrence of anterior pelvic tilt. Additionally, changes in the vascular system can impact the metabolic support to the lumbar region. Among the most common musculoskeletal issues during pregnancy is low back pain (Casagrande et al., 2015). Low back pain during pregnancy is a significant problem that restricts the quality of life for many women worldwide and can arise due to various factors, primarily mechanical and hormonal changes occurring during pregnancy. Low back pain typically begins in the second trimester, around the 22nd week of gestation. It is estimated that approximately 56% of pregnant individuals experience low back pain at some stage of their pregnancy. As the uterus expands during pregnancy, it causes tension in the abdominal muscles, leading to their weakening. This weakened abdominal support places additional strain on the back muscles (Sneag & Bendo, 2007). Consequently, this shift causes the center of gravity to move forward due to the enlarging uterus, leading to an exaggerated curvature of the lower spine. This shift increases the bending forces on the lumbar spine and places greater strain on the supporting muscles.

Low back pain during pregnancy is associated with morbidity during the pregnancy and postpartum period. In one out of ten women who experience low back pain during pregnancy, persistent pain continues into the postnatal period and can last up to two years (Sehmbi et al., 2017). Postnatal low back pain is defined as low back pain that begins within three months after childbirth and lasts for at least six weeks. Several factors are associated with postnatal low back pain, including a history of low back pain during pregnancy, young age, and excessive body weight. Additionally, it can be attributed to hormonal changes during pregnancy that increase connective tissue elasticity, weakness in muscle tissue, and spinal osteoporosis observed during the breastfeeding period.

The changes during pregnancy have physical, cultural and biopsychosocial dimensions. Changes in body image, emotional fluctuations experienced by the pregnant woman, environmental factors, and isolation from work and social life deeply affect the individual. Physical problems experienced during pregnancy should be addressed with a biopsychosocial approach, and a multidisciplinary team, including physiotherapists, physicians, dietitians, psychologists, family, and social circles, should work together to improve the health of the pregnant woman. The changes in body systems during pregnancy are as follows:

8.1 Changes that occur during pregnancy

1. Musculoskeletal System Changes

- The increased level of relaxin during pregnancy reaches its peak, particularly in the third trimester. The hormone relaxin causes joint laxity, making the pelvic joints more flexible, thereby facilitating the passage of the fetus. Progesterone hormone also contributes to this process. The laxity in the joints continues until the sixth month postpartum (Ireland & Ott, 2000).

- Significant hormonal changes, along with the increase in body mass and the weight of the uterus, cause the center of gravity to shift forward. The growing abdomen due to the baby's growth also reveals postural adaptations. With the forward shift in the center of gravity, an increase in lumbar lordosis is observed, and to compensate for this increase, curvatures in the cervical and lumbar spine may also occur (Picture 1) (Demaio & Magann, 2009).

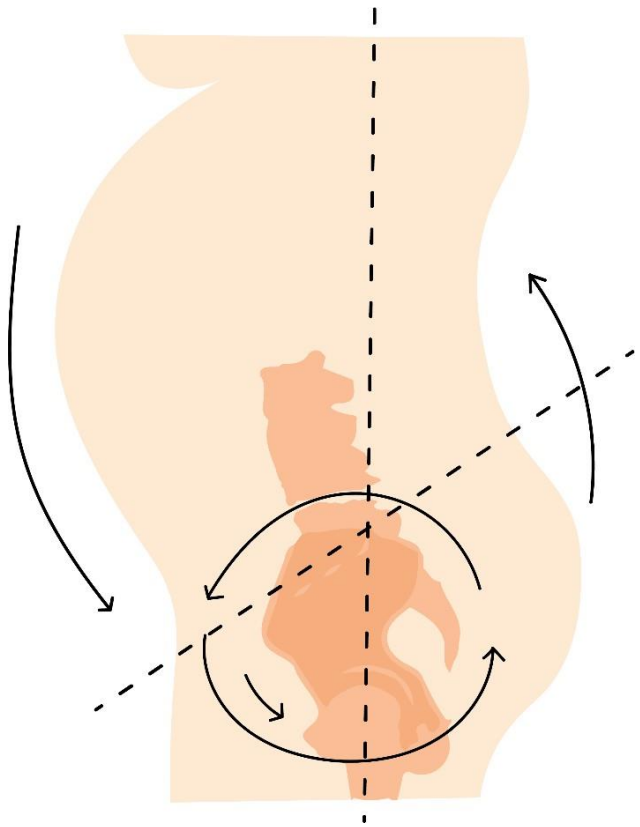

Figure 1 : Illustration demonstrating anterior pelvic tilt and compensatory hyperlordosis.

- Anterior tilt of the neck and hyperextension of the head may also increase (Picture 2) (Sarıyıldız et al., 2022).

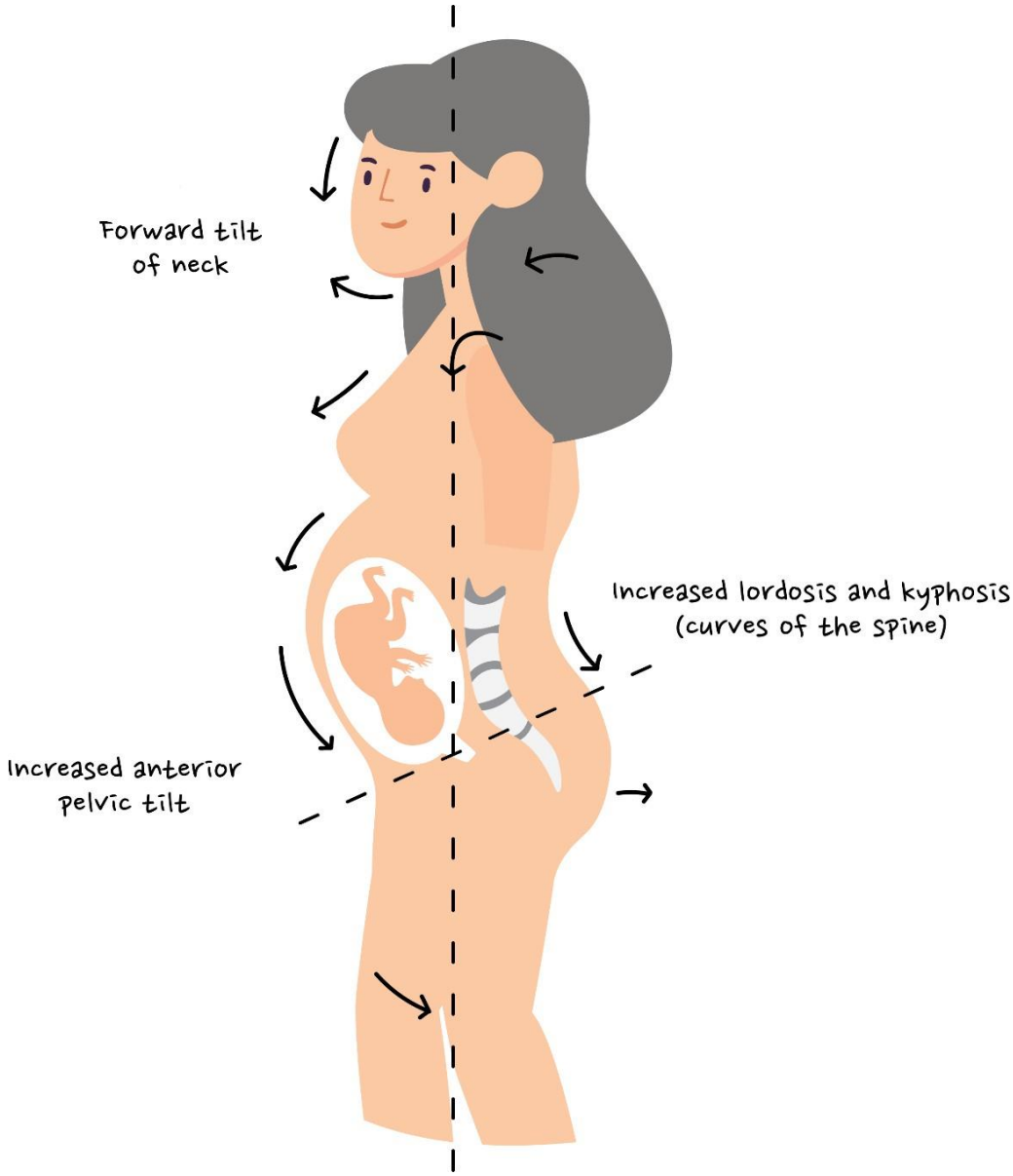

Figure 2 Postural changes in pregnancy.

- As the mammary glands develop, the growing breasts may cause shoulder protraction to compensate for the load on the musculoskeletal system (Barbosa et al., 2012). Changes in the levels of relaxin, estrogen, and progesterone result in increased elasticity of connective tissue (Uzelpasaci Esra & Kaya Serap, 2016).

- The abdominal muscles, which support spinal and pelvic stability, stretch to their elastic limits during pregnancy. The distance between the two rectus abdominis muscles increases, a condition known as diastasis recti (Sarıyıldız et al., 2022). Excessive separation can lead to weakened abdominal muscles and functions, impaired pelvic stability, resulting in pelvic pain and gait disturbances (Liaw et al., 2011).
- Mechanical stress on the joints increases with weight gain, especially towards the third trimester (Sarıyıldız et al., 2022).
- There may be a decrease in the height of the medial arch of the foot (Chiou et al., 2015).
- Pregnant women experiencing a shift in their center of gravity and restricted mobility in their new body may have reduced balance and a related fear of falling (Conder et al., 2019).
- Adaptations to improve stability, such as a slower walking speed with reduced step length, increased step width, shorter swing phase, longer stance phase, and longer double support phase, may be observed as the trimesters progress (Conder et al., 2019).
- Fluid retention becomes more pronounced in the third trimester, leading to soft tissue edema in the lower extremities. Edema can also cause joint effusion and peripheral nerve compression (Sarıyıldız et al., 2022).

2. Changes on the Cardiopulmonary System

- During pregnancy, blood volume increases, which leads to an increase in the amount of blood returning to the heart. The stroke volume increases by an average of 20-30%. To meet the fetus's needs, the heart rate increases by approximately 15 beats per minute (San-Frutos et al., 2011).
- Changes in respiratory rate led to increased oxygen consumption and ventilatory volume. With the increase in maternal heart rate and stroke volume, cardiac output increases by 30-50%, reaching approximately 8.7 L/min (Shivakumar et al., 2011).
- Additionally, during pregnancy, the heart shifts superiorly and anteriorly, ventricular muscle mass increases, and valve diameter enlarges. The end-diastolic volume increases, contributing to the increased ventricular mass. Although the heart enlarges physiologically, there is no change in ejection fraction (Kametas et al., 2001).
- Blood flow to the kidneys and breasts also increases, and the increase in cardiac output is essential to meet the increased basal oxygen consumption (Uzelpasaci Esra & Kaya Serap, 2016).
- During pregnancy, the neck thickens, and edema in the upper respiratory tract, including the larynx and pharynx, increases (Uzelpasaci Esra & Kaya Serap, 2016).

- As the uterus enlarges and abdominal pressure increases, the diaphragm rises by up to 4 cm. The increase in relaxin and progesterone levels causes the ligaments between the ribs and sternum to relax, leading to an increase in the subcostal angle of the rib cage from 68.5 to 104.5 degrees (Hegewald & Crapo, 2011).

- With the elevation of the diaphragm and decreased compliance of the chest wall, total lung capacity decreases by 5% (Uzelpasaci Esra & Kaya Serap, 2016).

- Oxygen consumption increases by 30%, and metabolic rate increases by 15%. Tidal volume increases from 500-700 mL by 30-50%, and respiratory rate increases by 1-2 breaths per minute. Within 48 hours postpartum, lung volumes, residual volume, and functional residual capacity return to normal (Uzelpasaci Esra & Kaya Serap, 2016).

3. **Hematological changes**

- By the 7th week of gestation, blood volume increases by 10-15%, reaching its maximum value between the 30th and 34th weeks. This 1–2-liter increase in blood volume is crucial for the uterus and kidneys. This increase in blood volume is an adaptation to counteract blood loss during childbirth.

- Although most of the weight gained during pregnancy is due to the combined growth of the uterus, fetus, and breasts, the increase in blood volume, fluid leakage into extracellular tissues, and water retention increase the risk of edema.

- With increased erythropoietin secretion in the liver, red blood cell production also rises. As pregnancy progresses, the need for iron increases. Insufficient iron intake can lead to complications such as preterm birth and miscarriage (Uzelpasaci Esra & Kaya Serap, 2016).

- The risk of venous thromboembolism increases fourfold (Heit et al., 2005).

4. **Changes in the hormonal system**

During pregnancy, changes occur to meet the needs of both the mother and the baby.

- During pregnancy, especially the hormones GnRH (gonadotropin-releasing hormone) and CRH (corticotropin-releasing hormone) increase and affect the placenta. GnRH is important for the development of the placenta, while CRH is crucial for the initiation of labor (Majzoub et al., 1999).

- The secretion of ACTH (adrenocorticotropic hormone) and CRH (corticotropin hormone) during pregnancy raises cortisol levels. By the end of pregnancy, cortisol levels in serum and urine increase threefold (Mastorakos & Ilias, 2003).

- To prepare for breastfeeding after childbirth, prolactin levels increase from the anterior pituitary gland during pregnancy. In non-breastfeeding postpartum women, prolactin levels decrease after birth (Uzelpasaci Esra & Kaya Serap, 2016).

- In pregnant women, the secretion of aldosterone nearly doubles, and by the end of pregnancy, it is twice as high. Aldosterone and estrogen affect renal tubules, causing excessive sodium reabsorption, making individuals prone to hypertension (Stephenson, 2000).

- Changes in carbohydrate and fat metabolism occur, with an increase in insulin secretion. Due to glucose utilization, fasting glucose levels decrease by 10-20%, and insulin resistance may develop (Uzelpasaci Esra & Kaya Serap, 2016).

- Research on relaxin physiology indicates that relaxin is a pregnancy hormone that increases laxity in the symphysis pubis and sacroiliac joints to facilitate childbirth. The relaxin hormone increases the water content of connective tissue and stimulates fibroblasts for collagen production. Particularly peaking between the 38th and 42nd weeks of pregnancy, the relaxin hormone weakens soft tissue by approximately tenfold, leading to increased joint laxity (Ponnapula & Boberg, 2010).

5. **Changes in the gastrointestinal system**

- As pregnancy progresses, the mechanical effect of the growing uterus and the increase in progesterone levels cause a delay in gastric emptying.

- In addition to abdominal bloating and constipation, nausea and vomiting are commonly reported.

- Increased placental production of gastrin leads to an increase in gastric acid.

- The decrease in esophageal sphincter tone due to rising progesterone levels causes symptoms such as reflux and heartburn (Uzelpasaci Esra & Kaya Serap, 2016).

6. **Changes in the urinary system**

- The kidneys move superiorly due to the growing uterus. Interstitial fluid, dead space, and increased vascularization can cause them to enlarge by 1 cm (Lindheimer et al., 2001).

- Bladder tone decreases, leading to symptoms such as polyuria and incontinence. These symptoms increase in the third trimester when the fetus's head settles into the pelvis (Lindheimer et al., 2001).
- As a result of systemic vasodilation, there is an increase in glomerular filtration rate and renal plasma flow (Uzelpasaci Esra & Kaya Serap, 2016).

7. **Changes in the reproductive system**

- During the first half of pregnancy, growth occurs in the uterus due to hypertrophy of the muscle cells. There is an increase in the total amount of elastic tissue in the uterus, along with an increase in the number and size of blood vessels. The myometrial wall thickens.
- In the second half of pregnancy, the myometrial wall thins to allow for the growth of the fetus. Dilation occurs in the cervix due to the expansion of the lower uterine segment, facilitating easier passage of the fetus during birth.
- Sometimes, painless and irregular uterine contractions can be observed in the second trimester.
- There is an increase in vascularization of the cervix.
- Ligaments undergo elongation and hypertrophy to stabilize the uterus.
- The fallopian tubes elongate, swell, and become hyperemic.
- Secretions become more acidic due to an increase in glycogen content in the epithelium, preparing the vagina for childbirth.
- Connective tissue content decreases in the vagina, while the mucosal and muscular walls thicken. Vascularity also increases in the vulva (Uzelpasaci Esra & Kaya Serap, 2016).

8. **Changes in breasts**

One of the earliest signs of pregnancy is the changes that occur in the breast.

- With increased venous flow, breast enlargement occurs.
- The areola darkens in color and becomes smaller.
- After the 10th week, colostrum, a fluid that prepares the baby's intestinal system for breast milk, begins to be produced.

- Estrogen stimulates the milk ducts, while progesterone increases the proliferation of lobular-alveolar tissue. These changes are completed in the middle of pregnancy.
- After birth, the baby's suckling stimulates prolactin secretion, thereby increasing milk production (Elling & Powell, 1997).

9. **Weight gain**

- During pregnancy, there is an average weight gain of around 11 kg due to the growth of the baby, placenta, amniotic fluid, enlargement of the uterus, increased blood volume, breast tissue, fat stores, and other pregnancy-related changes. Most of this weight is gained, particularly in the last two trimesters. Without proper attention, weight gains can reach up to 38 kg (Ireland & Ott, 2000).

10. Dermatological changes

- During pregnancy, dermatological conditions such as increased pigmentation, modification of abdominal wall tissue, skin stretching leading to stretch marks, sweating, hair loss, itching, and changes in nails occur.
- Darkening of the skin around the areola and eyes occurs.
- Bluish irregular lines develop around the breast and abdominal areas due to changes in the collagen elastic fibers in the deep layer of the skin.
- Capillary dilation around the thighs and ankles can lead to the appearance of varicose veins. These varicose veins are usually painless (Elling & Powell, 1997).

11. **Psychological changes during pregnancy**

Pregnancy involves a series of complex changes occurring as part of the period, encompassing psychological dimensions that affect the mother and the newborn. During this process, women experience mood swings, anxiety, stress, and fatigue. (Blount et al., 2021) It is known that women with poor mental health during pregnancy have increased rates of physiological problems such as early delivery, hypertensive disorders, placental anomalies, antepartum hemorrhage, labor complications, increased rates of cesarean delivery, spontaneous abortion, intrauterine growth restriction, low birth weight, and physiological problems in the newborn, such as the APGAR score. Social support is the greatest aid in reducing these negative factors affecting women during pregnancy. Studies have shown that women who receive support from family members and their partners are less affected by the psychological problems associated with pregnancy and experience reduced rates of stress and depression during pregnancy. (Gunaydin & Zengin, 2021)

Risk factors that cause low back pain during pregnancy

Studies examining risk factors for back pain emphasize that pregnancy is a significant risk factor for back pain. There is no consensus on the factors that contribute to the onset of back pain during pregnancy. However, factors such as a history of pelvic trauma, young age, multiparity, a pre-existing history of chronic back pain before pregnancy, and a history of back pain during a previous pregnancy are considered risk factors. Studies suggest an increased risk of pregnancy-related back pain in women who experience back pain during menstruation. While there are studies suggesting that higher body weight increases the risk of back pain during pregnancy, there is no consensus on this matter (Katonis et al., 2011; Manyozo et al., 2019).

Preventing back pain during pregnancy

Preventing back pain, which is influenced by many different factors, can be challenging. However, it is crucial to educate future mothers, especially those in high-risk groups, about the discomforting symptoms associated with back pain and to teach them steps to protect themselves and reduce pain. Firstly, excessive loading on the back and daily activities should not be performed with incorrect posture positions. Unsupported rotational movements and prolonged supine positions should be avoided. They need to learn correct standing, walking, and bending techniques.)

a. **Correct standing posture**

Ensure that the earlobes are aligned with the midpoint of the shoulders. Shoulders should be held back and in front of the chest. The pelvis should not be tilted forward or backward but kept in a neutral position without increased lumbar lordosis, and the transversus abdominis muscle should be activated. Body weight should be evenly balanced on both feet and supported with appropriate footwear (Picture 3). Prolonged standing in the same position should be avoided, and if they need to stand in the same position for a long time, one foot should be placed on a step at a height comfortable for the pregnant woman, while the other foot should be kept on the ground. The foot positions should be changed after a few minutes.

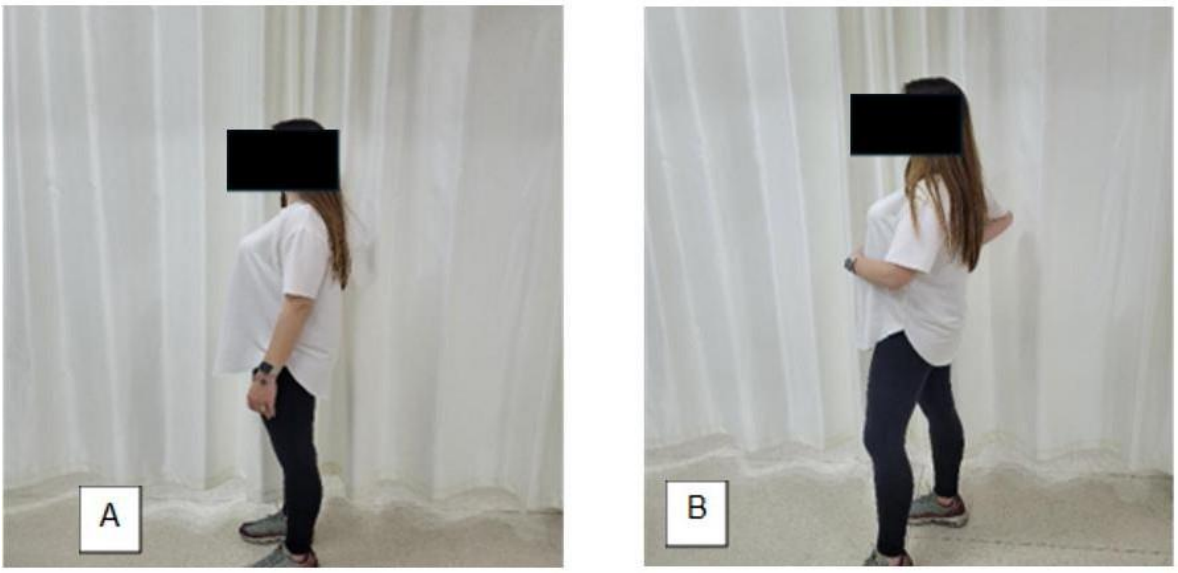

Figure 3 Standing positions for pregnant women A) correct standing posture B) incorrect standing posture

b. **Correct sleeping position**

The optimal sleeping or resting position may vary. Particularly, side lying or elevated sleeping positions can be preferred as relaxation postures. In a side lying position, a pillow of normal height should be placed under the head. Pillows can also be used to support the arms and legs, and a towel or thin support can be placed under the abdomen (Figure 4).

Figure 4: Correct sleeping position for pregnant women

c. **Picking up objects from the ground in the correct position**

As pregnancy progresses and abdominal girth increases, certain functional adaptations may be necessary. Therefore, the strength of the Quadriceps muscle is crucial to continue activities such as sitting down and getting up from the ground. When picking up something from the ground, there are certain factors to be mindful of. Pregnant women should avoid leaning forward by bringing the knees into extension and flexing the back. When lifting an object from the ground, the back should remain straight while the knees and hips are flexed. While bending down to pick up something from the ground, the distance between the feet should be wide, maintaining proximity to the object, and the feet should be firmly grounded. When lifting objects using leg muscles, pelvic floor muscles should be contracted along with the abdominal muscles (Figure 5).

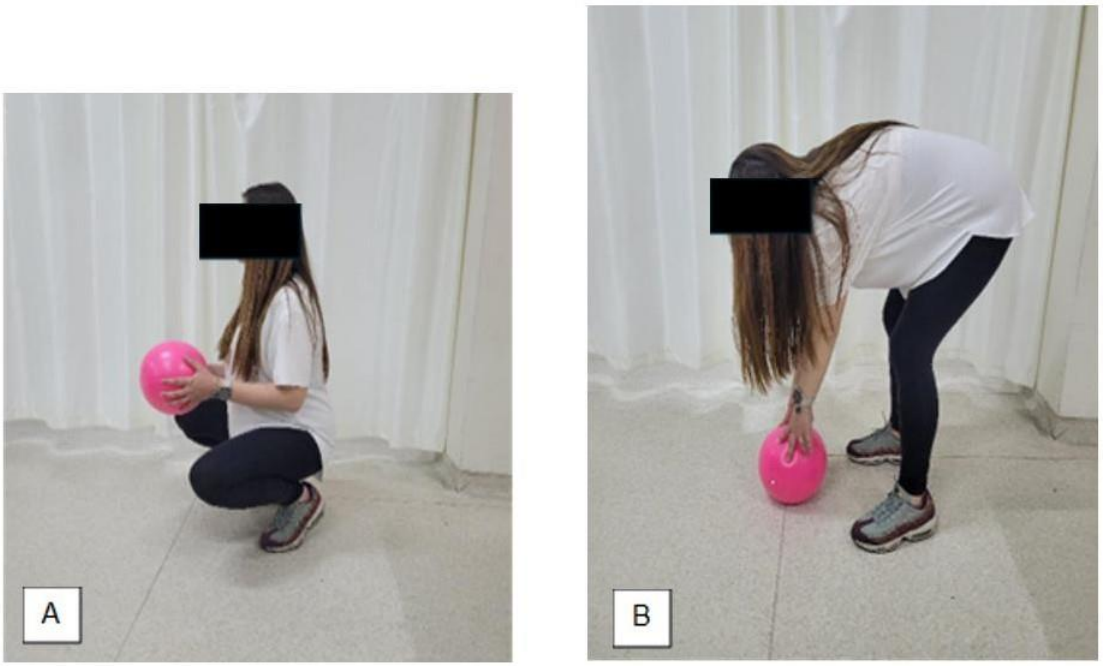

Figure 5: Positions of pregnant women to pick up the object on the floor A) Correct position B) Wrong position

d. **Sitting in the correct position**

In the correct sitting position, the back should be straight, and the shoulders should be pulled back. The hips should contact the chair's backrest. The lumbar region should be supported with a small, rolled towel or lumbar pillows. Knees should be positioned slightly higher than the hips, and if necessary, a support should be placed under the feet. Prolonged sitting in the same position should be avoided (Figure 6).

Figure 6 Sitting positions for pregnant women A) Correct position B) Wrong position

Nutrition during pregnancy

Proper nutrition is crucial for meeting increased nutrient needs during early pregnancy, ensuring healthy fetal development, achieving recommended weight gain during pregnancy, enabling successful breastfeeding postpartum, and facilitating a return to pre-pregnancy weight. It has been noted that having good nutrition before pregnancy reduces the risks of hypertension, gestational diabetes, and preterm birth. Therefore, women should be supported to have a healthy pregnancy period starting at least 3 months before conception. Poor nutrition during pregnancy can lead to problems such as preterm birth, inadequate fetal growth, preeclampsia, and maternal obesity, making it difficult to return to pre-pregnancy conditions. To mitigate these risks and ensure the health of both mother and baby, an appropriate vitamin and mineral supplementation regimen along with a healthy eating plan should be implemented.

For proper and healthy nutrition, pregnant women should consume recommended amounts of all food groups within calorie limits. The essential nutrients that pregnant women need include folic acid, iron, iodine, choline, Omega-3, Vitamin B6, and zinc.

Folic acid: Essential for normal neural tube formation and closure during the early stages of pregnancy (days 21-28 after conception). Inadequate levels can also lead to low birth weight, preterm birth, and fetal growth restriction.

Iron: Iron requirements increase during pregnancy due to the increase in plasma volume and red blood cell mass. Approximately 10% of pregnant women have iron deficiency, which increases to about 25% in the third trimester. Iron deficiency during pregnancy increases the risk of maternal and infant mortality, preterm birth, and low birth weight.

Iodine: Sufficient iodine intake during pregnancy is essential for fetal neurocognitive development. Mothers should also ensure adequate iodine intake during breastfeeding to meet the baby's needs.

Choline: Choline intake needs to increase during pregnancy and breastfeeding to replenish maternal nutrient stores and support normal brain and neuronal growth and development in the baby. Studies have shown that inadequate choline intake during pregnancy increases the risk of neural tube defects.

Omega-3: Pregnant women who consume Omega-3 during pregnancy have children with better neurodevelopmental outcomes, including improved language and communication development. A randomized controlled study has indicated that Omega-3 supplementation reduces the risk of preterm birth before 37 weeks.

Vitamin B6: Vitamin B6 plays a crucial role in fetal nervous system development and supports the baby's development during pregnancy. It also alleviates nausea, a common complaint during early pregnancy. It is an important nutrient in the postpartum period to support the baby's development.

Zinc: Zinc can affect fertilization before pregnancy and fetal development during pregnancy. Additionally, it enhances folic acid absorption and reduces the risk of folate deficiency.

Evaluation of low back pain in the prenatal period

a. **Subjective evaluation**

The assessment of the patient during the prenatal period begins with subjective evaluation. Before commencing the assessment, it is important to position the patient in a comfortable position. During subjective evaluation, a detailed history of the patient should be obtained. The detailed history starts with questioning about physical characteristics. In this context, the patient's age, height, weight, body mass index, pre-pregnancy weight, and factors related to pregnancy (gestational age, gravidity, parity, abortions, estimated delivery time) are queried. Risk factors for back pain during pregnancy should be assessed, and the patient's general health status, occupation, social life, and level of physical activity should be evaluated. Various methods such as physical activity questionnaires, pedometers, accelerometers, and heart rate monitors can be used for evaluating physical activity during pregnancy.

b. **Objective Evaluation**

During objective assessments in pregnant women, the patient's pain intensity, joint range of motion, edema, muscle strength, sensation, and functional status should be evaluated (Baran & Akbayrak, 2016).

Visual Analog Scale (VAS):

The Visual Analog Scale (VAS) is used to assess a patient's pain on a vertical ruler of 100 mm, where 0 at the bottom represents "no pain" and 10 at the top represents "the most intense pain

ever felt." On the VAS scale of 100 mm (10 cm), pain intensity is evaluated as mild pain within the range of 1, 2, 3 cm, moderate pain within the range of 4, 5, 6 cm, and severe pain within the range of 7, 8, 9, 10 cm. Pregnant women should be informed about the visual pain scale applied to them.

Oswestry Disability Index (ODI):

The Oswestry Disability Index (ODI) is used to assess functional impairments in individuals experiencing back pain. Consisting of 10 questions, each graded from 0 to 5, the ODI evaluates parameters such as pain intensity, personal care, lifting, walking, sitting, standing, sleeping, social life, and traveling, among various daily activities. Additionally, it provides a comprehensive assessment of the overall impact of back pain on functionality by measuring the degree of change in pain experienced by the individual.

Environmental measurements

As part of anthropometric measurements, circumferential measurements are used to assess variables such as body fat tissue, edema, and muscle mass increase, particularly related to growth and nutrition. Edema formation, a common condition in pregnant women, occurs due to increased body weight, hormonal, and biomechanical changes. Therefore, circumferential measurements taken in the antenatal period help us understand these changes and take positive steps. Measurements should include chest, waist, abdomen, hip, thigh, leg, hand, and ankle. Chest circumference measurement during maximal inspiration or maximal expiration can provide information about chest cage flexibility.

Lumbopelvic stabilization assessment (Pressure biofeedback)

It is used to measure deep lumbar muscle strength and to teach pregnant women normal postural perception. This device consists of a pressure pad, a manometer, and an air bulb connected to the pad. Pressure changes in the pad are read in millimeters of mercury (mmHg). During assessment, the patient is positioned supine with a tilt, and the pressure cell is placed under the lumbar spine and inflated to a base pressure of 40 mm Hg. The patient is then asked to perform the abdominal hollowing maneuver without moving their spine and pelvis, and to maintain the contraction for 10 seconds. Changes in pressure during abdominal hollowing are measured and recorded (Picture 7).

Figure 7 Evaluation of Lumbopelvic Stabilization

Evaluation of low back pain in the postnatal period

During the postpartum period, the following steps can be followed to evaluate low back pain in women:

1. Palpation of the paravertebral muscles, ligaments, and spinous processes in the lumbar region is performed. Muscle tone, spasm, and the presence of trigger points are examined during palpation.

2. Anterior-posterior and lateral postural analysis are conducted.

3. Range of motion of the lumbar region is assessed, with attention paid to whether movements are painful and restricted during the evaluation (Picture 8).

Figure 8 Range of Motion Assessment

4. Evaluation of muscle strength in the lumbar region is performed (Figure 9-11).

Figure 9 Trunk Rotation Muscle Strength Assessment

Figure 10 Trunk Flexors Muscle Strength Assessment

Figure 11 Trunk Extensors Muscle Strength Assessment

5. Assessment of muscle tightness is conducted (Picture 12).

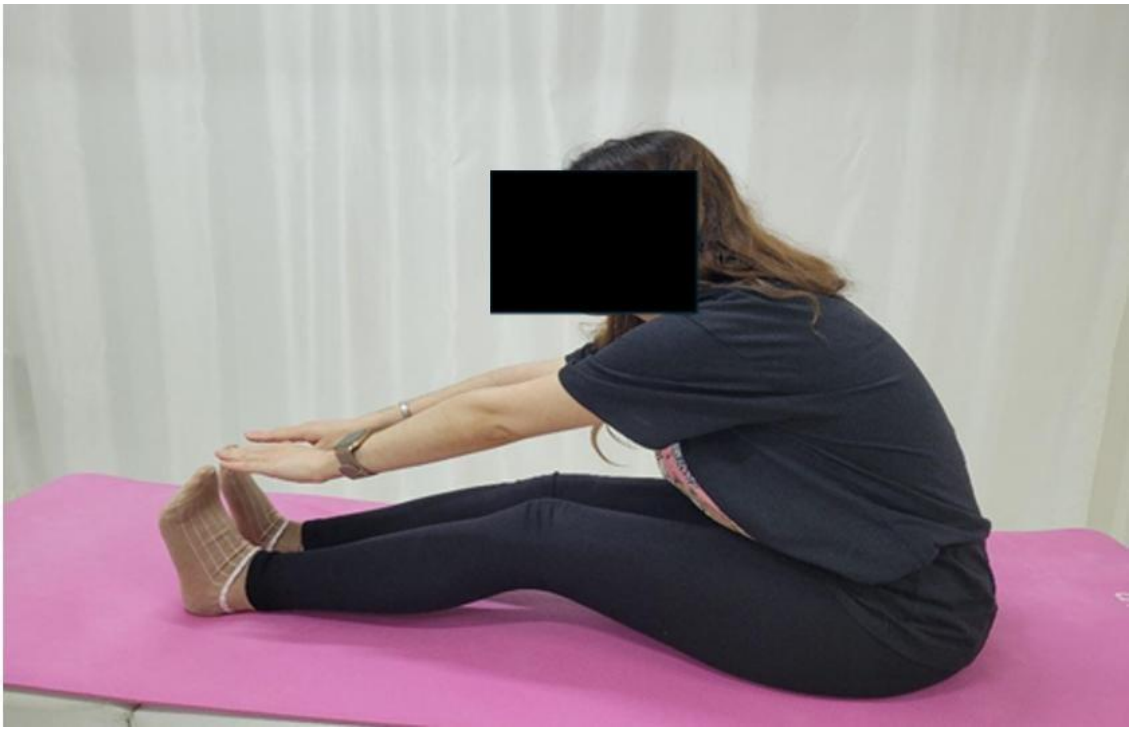

Figure 12 Hamstring muscle shortness assessment

6. Assessment of the patient's pain intensity is conducted (Baran & Akbayrak, 2016).

7. Evaluation of Sacroiliac Joint Examination Tests is performed (Figure 13-16).

Sacroiliac Joint Examination Tests

1. **Faber-Patrick Test**

The pregnant woman is placed in a supine position with hip flexion, abduction, and external rotation. Subsequently, gentle pressure is applied to the ipsilateral knee until maximum range of motion is achieved. Additional minor oscillations may be applied to provoke pain (Figure 13). A positive result is indicated by the recurrence of the patient's pain or limitations in range of motion (Tasso et al., 2023).

Figure 13 Faber-Patrick Test

2. **Gaenslen Test:**

The pregnant woman, lying supine on the examination table, has one lower extremity lowered off the bed towards the therapist, while the hip joint of the other lower extremity is passively brought into maximum flexion of the hip and knee joint (Figure 14). If there is pain in the sacroiliac joint on the hanging side, the test is considered positive (Buchanan et al., 2021).

Figure 14 Gaenslen Test

3. **Straight Leg Raise Test:**

The pregnant woman lies supine. The physiotherapist's distal hand holds the patient's heel while the other hand is on the anterior aspect of the patient's thigh to maintain knee extension. The physiotherapist slowly raises the leg until no tension is felt or until full range of motion is achieved (Figure 15). If there is radiating pain down the leg, our test is positive; if there is no pain even when we increase the angle up to 90 degrees, the test is negative (Baran & Akbayrak, 2016).

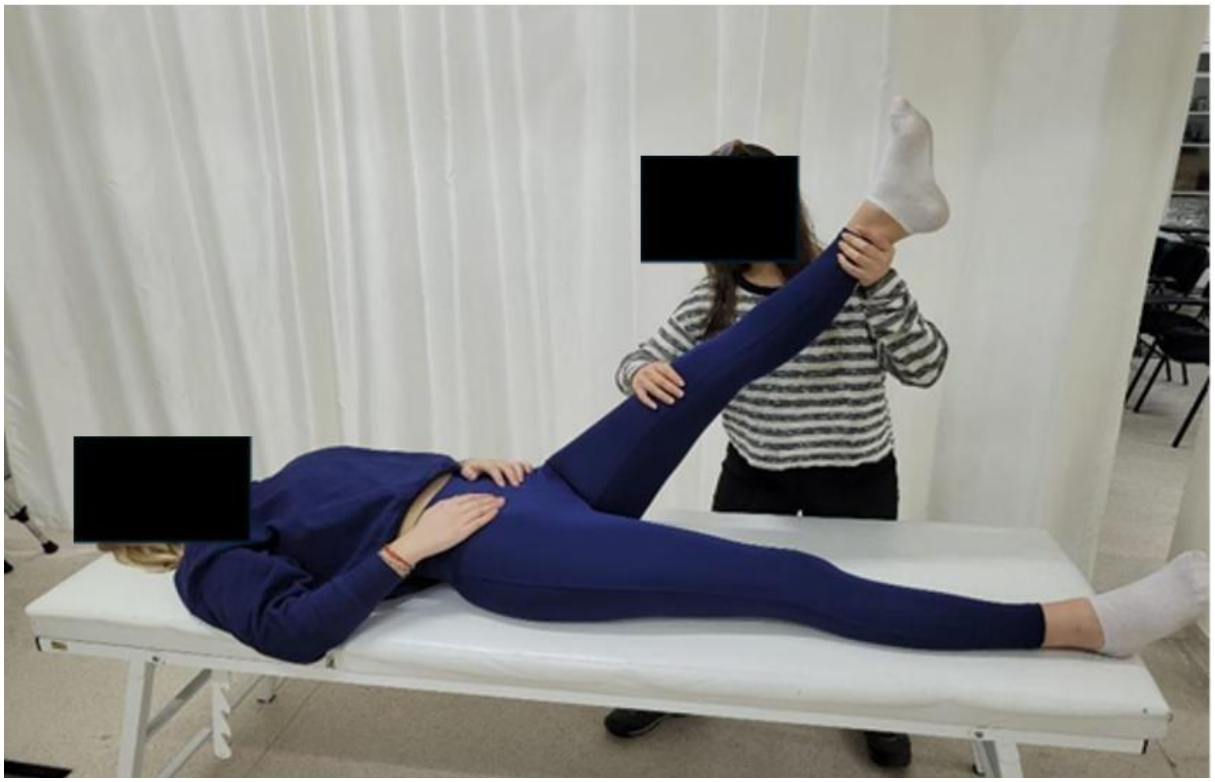

Figure 15 Straight Leg Raise Test

4. **Sacroiliac Compression Test**

The pregnant woman is positioned in a side-lying position with hips flexed at 45° and knees at 90°. The physiotherapist applies a compression force from the upper iliac crest to the lower iliac crest while positioned behind the pregnant woman (Figure 16). If there is pain in the sacroiliac joint, the test is considered positive (Buchanan et al., 2021).

Figure 16 Sacroiliac Compression Test

Treatment

In the treatment of back pain, a multimodal approach is recommended. The multimodal approach encompasses patient education, physiotherapy methods, psychological therapies, and interventional techniques. However, there is no consensus on the treatment of back pain that occurs during pregnancy. Treatment options include physiotherapy, TENS, pharmacological treatment, acupuncture, massage, chiropractic treatment, yoga, pilates, and stabilization belts.

1. **Patient Education**

The first stage of patient education should involve informing the pregnant woman about basic anatomy, appropriate ergonomic approaches during daily life activities, correct posture, relaxation techniques, and pain management strategies. The patient should be encouraged to remain active during pregnancy. Bio-psychosocial approaches can help prevent the catastrophization of pain and should therefore be considered when planning rehabilitation programs.

2. **Physiotherapy and Exercise**

During pregnancy, exercise is the most commonly used method for managing back pain. Studies in the literature have evaluated the effectiveness of individually tailored exercise programs, group therapy, yoga, water aerobics, and fitness activities for pregnant individuals.

Before starting an exercise program, pregnant individuals should be informed about several points. Avoiding tight clothing and selecting appropriate footwear are important for proper positioning and maintaining body balance during exercise. Individuals should be advised to breathe regularly and ensure adequate fluid intake during exercise, and care should be taken not to exceed a heart rate of 140 beats per minute during exercise. Due to the increased risk of injury, individuals should be made aware of the potential risks of participating in contact sports such as boxing, skiing, and water skiing. Abdominal exercises should be modified, especially to prevent excessive strain on the rectus abdominis muscle due to pressure from the uterus, and flexion exercises performed while sitting should be preferred to reduce this risk. Additionally, regardless of the individual's level of physical fitness, vigilance should be maintained for the following conditions during physical exertion, and exercise should be stopped and consultation with an obstetrician sought:

- Vaginal bleeding
- Dizziness or presyncope
- Shortness of breath before physical activity
- Chest discomfort
- Leakage of amniotic fluid
- Muscle weakness affecting balance
- Cephalalgia
- Discomfort, tenderness, or swelling in the calf muscles
- Persistent and painful contractions in the uterus

a. **Strengthening Exercises**

Preconception and early pregnancy abdominal and back strengthening exercises aimed at core stabilization and exercises targeting pelvic floor muscles are effective in improving posture, functional level, and reducing back pain (Sabino & Grauer, 2008). Pelvic tilt exercises, in particular, contribute to reducing pain in the lumbar region. Strength training during the prenatal period can be applied once or twice a week. Each exercise session should include 8-10 exercises unless contraindicated. Yoga and clinical pilates exercises enhance core stabilization while increasing overall body endurance.

b. **Aerobic Exercise**

Maintaining overall body health, increasing fitness, and preventing excessive weight gain during pregnancy are crucial, and aerobic exercises play a significant role in achieving these

goals. The American College of Obstetricians and Gynecologists recommends moderate-intensity aerobic exercise on most days of the week for individuals without any medical or obstetric contraindications ("Physical Activity and Exercise during Pregnancy and the Postpartum Period: ACOG Committee Opinion, Number 804," 2020). The aerobic exercise program can include exercises targeting major muscle groups such as walking, swimming, cycling, and aquatic exercises, chosen to enable the pregnant individual to continue for the long term.

Walking is one of the most preferred exercises during pregnancy due to its accessibility. Moderate intensity walking programs are recommended in early pregnancy (three to five times a week at 55% of maximum aerobic capacity for 20 minutes) (Connolly et al., 2019). Stationary cycling is a reliable exercise that allows controlled workload without putting stress on the joints and is used in planning aerobic exercise programs. Swimming during pregnancy provides many benefits for both the mother and the baby. The buoyancy of the water reduces stress on joints and muscles, making the pregnant individual feel lighter. Swimming exercises engage different muscle groups, support cardiovascular health, improve circulation, and increase endurance. Additionally, the cooling effect of water helps balance the increased body temperature due to pregnancy (Clapp, 2000). Water aerobics during pregnancy reduces the load on anatomical structures by eliminating gravity and reducing resistance to movement. Granath et al. demonstrated in their study that water aerobics reduced sick leave and could be recommended for pregnant women. Planned aquatic exercises for pregnant women can focus on strength, flexibility, warming up, relaxation, and fitness (Granath et al., 2006).

Contraindications for aerobic exercise during pregnancy ("Physical Activity and Exercise during Pregnancy and the Postpartum Period: ACOG Committee Opinion, Number 804," 2020)

1. Complications Related to Pregnancy:

- Preeclampsia or severe hypertension
- Risk of preterm birth or history of previous preterm birth
- Cervical insufficiency
- Placenta previa (placenta covering the cervix)
- Vaginal bleeding or abnormal discharge
- Early membrane rupture (premature rupture of membranes)
- Significant risk of preterm birth in multiple pregnancies

2. Maternal Health Conditions:

- Heart diseases or serious cardiovascular disorders
- Lung diseases or severe respiratory problems
- Neurological disorders (e.g., seizure disorders)
- Severe anemia or bleeding disorders

3. Other Medical Conditions:

- Musculoskeletal problems (e.g., severe back or pelvic pain)
- Chronic diseases such as uncontrolled diabetes mellitus
- Hormonal imbalances such as hyperthyroidism

c. **Stretching and Flexibility exercises**

Stretching and flexibility exercises are exercises used to increase normal joint range of motion. Considering the effect of the relaxing hormone on ligaments that provide joint stability during pregnancy, it is important to avoid stretching exercises in pregnant individuals that simultaneously involve multiple muscles. The stretching routine should be planned in a way that does not excessively strain the joint and should be applied gently at the end of the movement.

d. **Yoga**

Yoga is a method that, besides its physical effects, reduces stress and anxiety, improves mood, enhances well-being, and aids in weight control. During pregnancy, disturbances in the physical, mental, or psychosocial dimensions of a woman can lead to problems in the health of both the mother and the baby. The anxiety and stress experienced by the mother can result in issues such as intrauterine growth restriction, gestational diabetes, pregnancy-induced hypertension, preterm birth, and preeclampsia. Additionally, back and pelvic pain, leg swelling and cramps, respiratory problems due to the pressure from the growing abdomen in the later weeks of pregnancy, and sleep disturbances negatively affect the quality of life for pregnant individuals. By balancing all these dimensions, yoga has become a popular method among pregnant women in recent times because it offers a normal pregnancy, childbirth, and postpartum period without any side effects (Karadağ et al., 2019). Reviewing the literature, it has been reported that a four-week yoga program combined with conventional exercises consisting of stretching, strengthening, and stabilization techniques is effective in reducing postpartum back pain resulting from pregnancy (Vishnu Bhoir MPT et al., 2022). To alleviate back pain in pregnant women, yoga poses such as janu sirsana, child pose, ardha uttanasana,

virabhadrasana, and happy baby pose are recommended. These yoga exercises are effective and much easier for pregnant women to perform (Budi Rahayu, 2023).

e. **Pilates**

Pilates is one of the most reliable exercise methods for both mother and baby, preparing the woman for the childbirth process and strengthening her physiologically and psychologically from the first trimester of pregnancy to the last, as well as accelerating her return to her pre-pregnancy shape in the postpartum period.

Pilates exercises regulate blood flow to the baby, aiding in the mother's relaxation and calming. It helps the mother adapt more easily to the physiological changes that occur during pregnancy, reducing anxiety and stress during this period, consequently leading to a more comfortable pregnancy. Its positive effect on anxiety also reduces the risk of low birth weight baby delivery. (Lawton, 2003) Particularly during the second and third trimesters of pregnancy, breathing difficulties are experienced. Working with correct breathing techniques reduces the sensation of breathlessness and provides a sense of comfort to the mother. Through the learned correct breathing techniques, it helps to alleviate discomfort caused by fetal movements, muscle spasms and cramps, contractions, and facilitates relaxation during childbirth (Özçoban et al., 2017).

It is known that back pain occurs in pregnant women due to factors such as weight gain associated with fetal growth, change in the body's center of gravity, increased laxity due to hormones, and destabilization. Pilates exercises, due to their effects on the core area and pelvic stabilization, are one of the methods that can be used in the treatment of back pain during pregnancy. (Investigation et al., n.d.) It also has effects such as regaining balance, increasing range of motion, flexibility, and strength. (Yıldırım et al., 2023)

With the goal of harmoniously working the body, this method is important for increasing activity performance and control over the woman's body, making both pregnancy and postpartum recovery more comfortable.

f. **TENS**

Transcutaneous Electrical Nerve Stimulation (TENS) is a non-pharmacological, non-invasive method employed for pain management. It aims to alleviate pain by transmitting electrical currents through electrodes adhered to the skin. TENS devices are typically easily portable and can be used at home. As a non-pharmacological approach to pain control, it presents an appealing option during pregnancy; however, caution should be exercised to avoid its use in the abdominal and pelvic regions (Manyozo et al., 2019).

3) Acupuncture

Some studies have indicated that acupuncture administered during pregnancy alleviates back pain and pelvic pain, facilitating physical activity and reducing the need for medication. However, there are studies in the literature suggesting that the effect may not be persistent in

some women. Therefore, while ear acupuncture for back pain may be an alternative method, its long-term efficacy remains uncertain (Katonis et al., 2011).

4) Pharmacological treatment

For individuals experiencing back pain during pregnancy, pharmacological treatment requires attention. The potential effects of medications used during pregnancy on both the mother and the baby should be considered. The general principles to be followed in pharmacological treatment and commonly used medications are as follows (Manyozo et al., 2019):

1. Acetaminophen (Paracetamol):

Acetaminophen is the most used medication for pain relief during pregnancy and is considered safe. For back pain, acetaminophen is typically recommended as the first choice.

2. Nonsteroidal Anti-Inflammatory Drugs (NSAIDs):

NSAIDs like ibuprofen and aspirin are generally not recommended during pregnancy. Especially in the third trimester, their use is known to potentially cause serious complications in the fetus. Therefore, they should not be used without doctor's advice.

3. Muscle Relaxants:

Muscle relaxants are generally considered safe during pregnancy, but due to the potential risks and side effects of specific drugs, they should be used with caution. Muscle relaxants prescribed by a doctor can be used to alleviate back pain.

4. Opioid Drugs:

Opioids are rarely prescribed for severe pain and should be used with caution. In pregnancy, the use of opioids can lead to serious complications in the newborn, such as dependency and withdrawal. These drugs should only be used under doctor supervision and with dosage limitations.

5. Topical Analgesics:

Topical analgesics can be a safe alternative for relieving back pain during pregnancy. These medications, available in cream, gel, or patch forms, can minimize systemic side effects.

Exercises Suitable for Pregnant Women (Baran & Akbayrak, 2016; Yıldırım et al., 2023)

Figure 17 Cat-cow Exercise

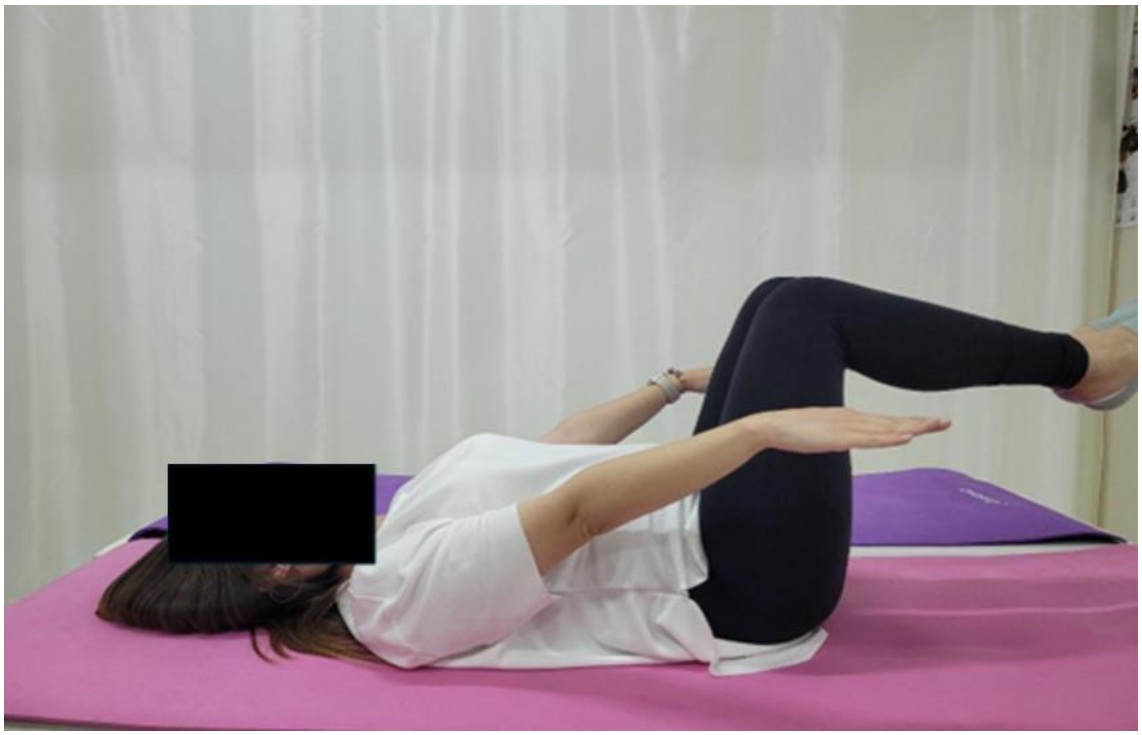

Figure 18 Hundred Exercise

Figure 19 Single leg stretch Exercise

Figure 20 Corkscrew Exercise

Figure 21 Side-kick Exercise

Figure 22 Bridge Exercise

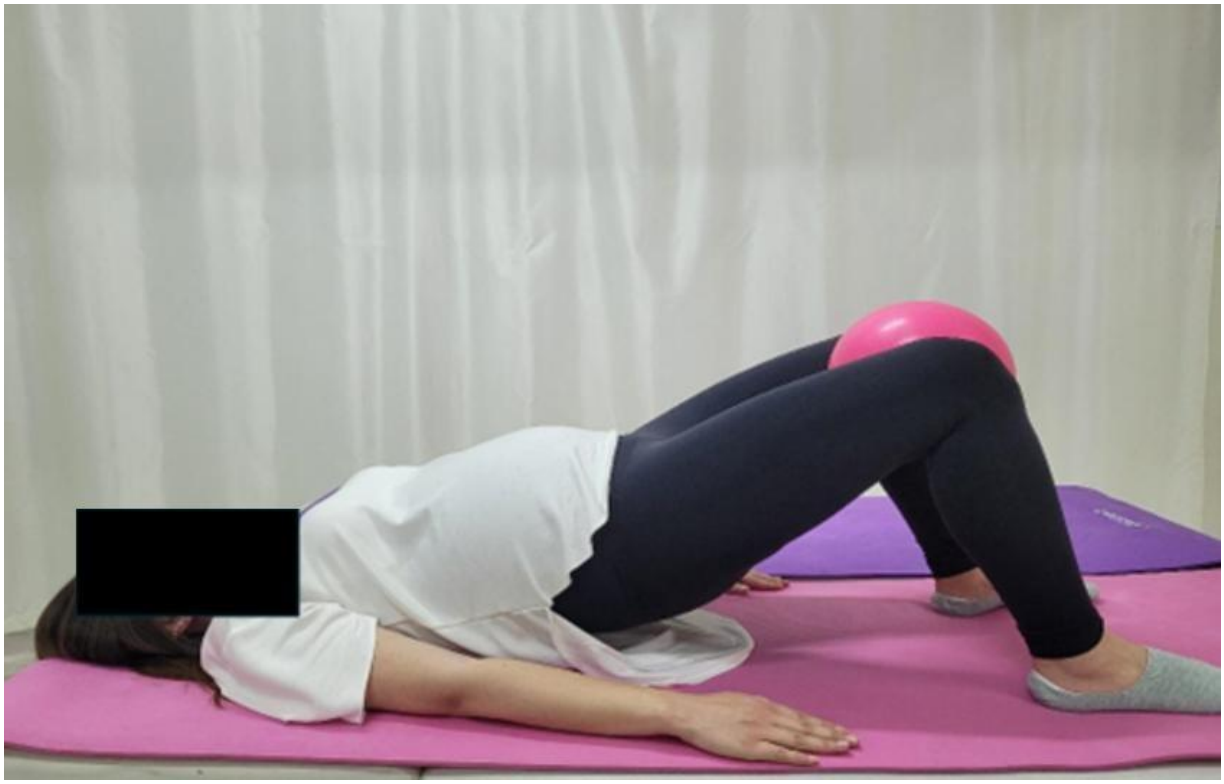

Figure 23 Bridge Building with a ball between the knees Exercise

Figure 24 Child Pose Exercise

Figure 25 Hip Flexor Stretching Exercise

Figure 26 Shoulder Rolling Exercise

Figure 27 Straight Leg Raise Exercise

Figure 28 Rolling like a ball Exercise

Figure 22 Kegel Exercise

Exercises Examples Applicable to Pregnant Women in the Postnatal Period (Adnan et al., 2021)

Figure 23 Stability Ball-Hamstring Curl Exercise

Figure 24 Side-Lying Crunch Exercise

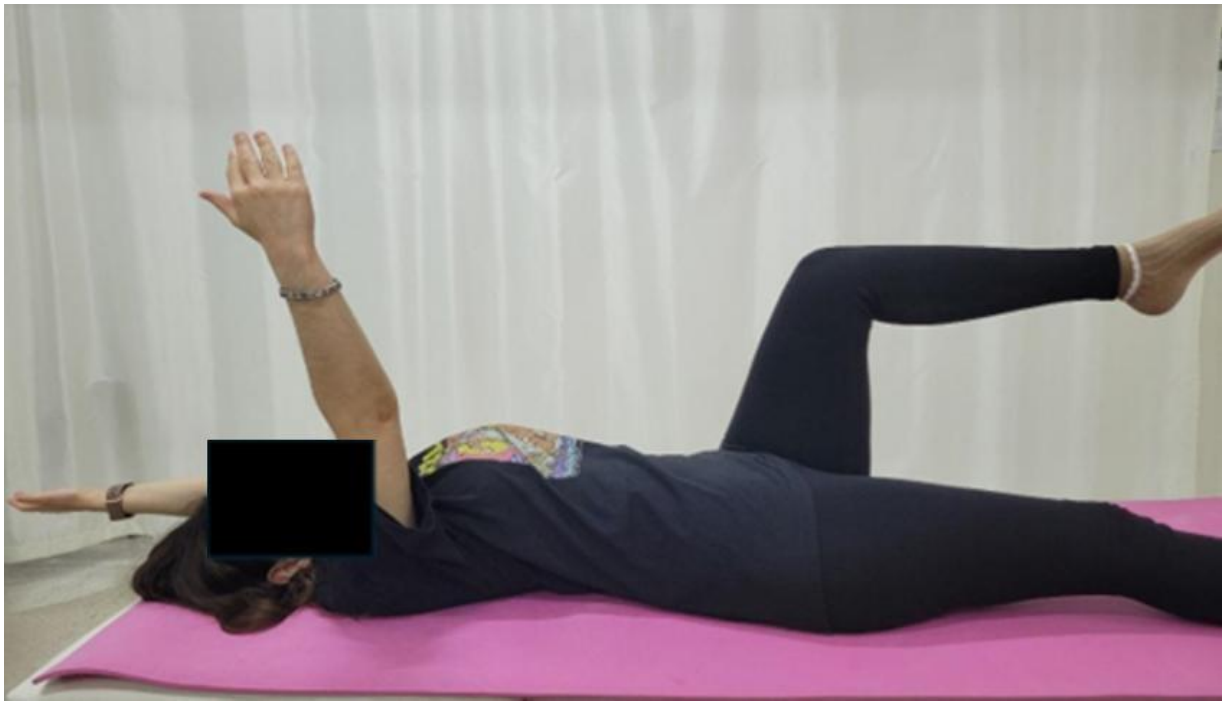

Figure 25 Dead Bug Exercise

Figure 26 Neutral Spine Exercise

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9 NON-VERBAL COMMUNICATION AS A PART OF A PROFESSIONAL INTERACTION IN NORWEGIAN PSYCHOMOTOR ASSESSMENT OF CHRONIC PAIN PATIENT

Marika Kiviluoma-Ylitalo

9.1 Chronic pain

Chronic or persistent pain is pain that carries on for longer than 12 weeks despite medication or treatment. Most people get back to normal after pain following an injury or operation. But sometimes the pain carries on for longer or comes on without any history of an injury or operation. (NHS 2023) According to the International Association for the Study of Pain (IASP 2023), chronic pain is defined as “pain that persists or recurs for longer than three months.”

Long-lasting musculoskeletal pain is characterized by reduced physical function, often linked with anxiety and depression, and with increased risk of developing other health conditions, early retirement, reduced wealth, and social participation, and increased all-cause mortality (WHO 2022).

Pain is an unpleasant sensory and emotional experience which is interpreted through the life history. What is the subjective meaning of pain is essential to understand. Chronic pain affects the whole person. In multidisciplinary holistic rehabilitation, it is essential to take care of the patient’s psychological distress. (Ojala et al. 2014)

Factors causing and sustaining long-lasting musculoskeletal pain differ between patients but must be identified in order to target treatment. During physiotherapy, there are multiple factors influencing the treatment outcome. (Dragesund & Oien 2021) Norwegian psychomotor physiotherapy (NPMP) is commonly applied for patients with long-lasting pain and complex health complaints. (Dragesund & Oien 2023)

9.1.1 Chronic Pain and Emotions

Negative emotions and chronic pain are deeply intertwined, each influencing and exacerbating the other. This complex relationship has profound implications for individuals' mental and physical well-being, underscoring the necessity for integrated approaches to treatment that address both emotional and physical aspects of health. (Lumley et al. 2011)

The interplay between negative emotions and chronic pain can be understood through several biological mechanisms. The brain regions involved in emotional regulation, such as the amygdala and prefrontal cortex, overlap with areas that process pain signals, such as the anterior cingulate cortex and insula. This overlap means that emotional states can directly influence pain perception. (Yang & Chang 2019)

Neurotransmitters, such as serotonin and norepinephrine, play crucial roles in both mood regulation and pain modulation. Imbalances in these chemicals can therefore contribute to both depression and heightened pain sensitivity. Additionally, chronic stress associated with negative emotions can lead to prolonged activation of the hypothalamic-pituitary-adrenal (HPA) axis, resulting in inflammatory responses that can worsen pain. (Bonanno 2024)

Chronic pain is a persistent pain lasting longer than three months, often without a clear cause. This enduring discomfort can significantly impact one's quality of life, leading to a cascade of negative emotions such as anxiety, depression, and frustration. These emotions, in turn, can amplify the perception of pain, creating a vicious cycle that is difficult to break. (Lumley et al. 2011)

Depression: Depression is prevalent among those with chronic pain. The constant struggle with pain can lead to feelings of hopelessness and helplessness, which are hallmarks of depression. Conversely, depression can lower pain thresholds, making individuals more sensitive to pain. This bidirectional relationship means that treating depression can sometimes alleviate pain, and managing pain can improve depressive symptoms. (Sheng et al. 2017)

Anxiety: Anxiety often accompanies chronic pain as individuals worry about the cause of their pain, the implications for their future, and their ability to manage daily activities. This heightened state of worry can lead to muscle tension, increased heart rate, and other physiological changes that exacerbate pain. Furthermore, anxiety can lead to avoidance behaviors, reducing physical activity and social interaction, which can further contribute to the severity of pain and the decline in overall health. (Burston et al. 2019)

Anger and Frustration: Chronic pain can also evoke anger and frustration, especially when the pain limits activities and diminishes quality of life. These emotions can create stress responses in the body, such as increased production of cortisol and adrenaline, which can worsen pain perception. Moreover, anger can strain relationships and lead to social isolation, removing critical support systems that might otherwise help in coping with pain. (Dueñas et al. 2016)

9.1.2 Chronic Pain and Fear of Movement

Chronic pain is not just a physical ailment but a multifaceted condition that significantly affects psychological and social aspects of a person's life. One of the most profound psychological impacts of chronic pain is the fear of movement, also known as kinesiophobia. This fear can lead to a debilitating cycle where the anticipation of pain prevents physical activity, further exacerbating the pain and limiting the individual's ability to function. (Mills et al. 2019)

Kinesiophobia is the irrational and excessive fear of physical movement and activity, resulting from the belief that such activities will cause pain or reinjury. This fear is particularly prevalent among individuals with chronic pain conditions, such as back pain, fibromyalgia, and arthritis. It stems from a heightened sensitivity to pain signals and the anticipation that movement will worsen their condition. (Bordeleau et al. 2022)

The fear of movement can significantly impact a person's mental health. It often leads to anxiety and depression as individuals become increasingly restricted in their daily activities and social interactions. The avoidance of movement and activity can result in feelings of helplessness, frustration, and isolation, further deteriorating their psychological well-being. (Li et al. 2023)

Anxiety and Hypervigilance: Individuals with chronic pain may develop heightened vigilance towards bodily sensations, constantly monitoring for signs of pain. This hypervigilance can lead to increased anxiety, as even minor movements are perceived as potential threats, creating a constant state of fear and apprehension. (Esteve & Camacho 2008)

Depression: The persistent fear of movement can lead to reduced participation in enjoyable activities, social withdrawal, and a decrease in overall life satisfaction. This reduction in activity can contribute to feelings of sadness, hopelessness, and depression, creating a negative feedback loop where the emotional distress further intensifies the perception of pain. (Steger et al. 2009)

The fear of movement can lead to physical deconditioning, where muscles weaken, and joints become stiff due to lack of use. This physical decline can create a paradoxical situation where the very fear that prevents movement leads to conditions that increase pain. (Physiopedia: Kinesiophobia 2024)

Muscle Atrophy: Avoidance of physical activity results in muscle wasting and weakness. Weaker muscles provide less support to the skeletal system, increasing the strain on joints and other structures, which can intensify pain. (Ambegaonkar et al. 2024)

Stiffness and Reduced Mobility: Lack of movement leads to joint stiffness and reduced flexibility. Over time, this can result in decreased range of motion and difficulty performing everyday tasks, further discouraging movement and perpetuating the cycle of pain and fear. (Ambegaonkar et al. 2024)

9.2 Norwegian Psychomotor Therapy

Norwegian psychomotor therapy is an holistic approach to the patient and based on a bio-psychosocial model of health. The body was seen first and foremost as an integrated harmonious unit. Symptoms were regarded as an expression of imbalance in the body, a sign that there was something wrong with the body as a whole. When working with the whole-body painful symptoms disappear. (Thornquist & Bunkan 1991)

It is based on the premise that stress resulting from physical, psychological and social situations may have effects on the body. Affecting muscle tension, breathing, posture, flexibility, balance, and movements. During assessment and treatment, all these elements are considered in order to achieve effective management. (Probst & Skjaerven 2017)

Norwegian psychomotor therapy explores the interconnected relationship between the regulation and restriction of muscular tension, breathing, movements, and emotions. Psychologically, muscular tension is understood as a mechanism for regulating emotions. By controlling muscle tension, individuals can manage their feelings. This tension inherently contains an emotional component. We often suppress and reject anything perceived as threatening. Consequently, relinquishing muscular tension is akin to relinquishing control. Releasing this tension requires the courage to acknowledge suppressed emotions. In essence, the act of relaxing tense muscles signifies a willingness to confront and recognize the feelings that have been repressed. (Thornquist & Bunkan 1991)

9.2.1 Norwegian psychomotor assessment

Assessment of a patient allows us to decide whether or not psychomotor therapy is suitable for the individual

Assessment consists parts:

- Case history
- An examination of the body: posture, respiration, physical function and reactions
- The patient’s reaction to the examination itself

It is preferred that the assessment is made in underwear but if the patient is uncomfortable the physiotherapist can also palpate through clothes. After that the physiotherapist starts the assessment with the posture, movements, and body composition where the order might vary depending on the patient.

The physiotherapist and the patient are making the findings in constant interaction. The emphasis of the assessment is on breathing and movement. The examination takes about a half hour and should not be prolonged.

The physiotherapist is observing through the assessment of the patient's autonomic nervous system reactions, emotional reactions, body awareness and overall sensations arising from the assessment in order for the patient to become aware about them.

CASE HISTORY AND EMPHASIS ON THE PATIENT'S LIFE HISTORY

Natural functions

What sort of physical problems has the patient experienced in life? There is interest in problems associated with musculoskeletal system but all bodily functions: stomach pain, digestive problems, difficulty in sleeping, hormonal disturbances etc. Questions about natural functions that include vegetative and hormonal conditions are important, as they rely useful information about the patient's general state of health balance.

Note! There is a close correlation between feelings and vegetative reactions. Stomachache or palpitations when we are worried or nervous. Autonomic disturbance and dysfunction are in general seen as an expression of emotional and mental stress.

Previous injuries and illnesses

No matter what the cause, pain results in reflex muscle tension. It can also result in a poor, ineffective movement pattern. Bad movement habits and ineffective use of the body may therefore be adopted due to negative reflex patterns. Asymmetrical tension and strain can arise because of an injury. Knowledge of a patient's previous illnesses, injuries and surgery is of diagnostic value and being helpful in adjusting treatment dosage.

Note! It is especially important to know what is happening to the respiratory organs.

It is the physical problems that bring the patient to us. And they must come first. Other information, marital problems, difficulties within the family etc. come at a time when contact and confidence are established. It is not only necessary to get information about the patient's life but also how the patient experiences it.

POSTURE

Any posture which is asymmetrical in relation to the central line indicates that there is abnormal tension somewhere in the body. In the ideal posture the tension is balanced between the front and back side of the body equally. The spine curves are adapted according to the position of the lower extremities and pelvis. The position of the upper extremities, shoulders and head has also an effect on the overall posture. Everyone has a personal posture which starts to form itself from childhood. Posture can be affected by physical factors like musculoskeletal injuries and psychological factors like emotions, unprocessed traumas and stress level. Posture can also give information about the patient's overall attitude toward life.

Bunkan has introduced 3 main types of posture according to the

psychological stage. There is evidence that stress and uncertainty of life has an effect on body posture.

1. This type of posture is called flexor posture. Common factor is strong contraction of the flexor muscles especially abdominals, inversion of the upper limbs, flexion of the elbows, pronation of the arms, tying hands front, flexion of knees, spine and pelvis, weakness in the lower extremities and holding the breath.

2. The second type of posture is collapsed posture. Sometimes it is hard to separate from the flexor position, the main separating factor is that in collapsed posture the muscles are hypotonic and in the flexor they are hypertonic. In collapsed posture the pelvis and head are front relative to the central axel.

3. The third type of posture what Bunkan mentions in her book is extension type. There the person is extending him/herself in order to cover the insecurity. This posture can be separated from the ideal posture with muscle tension. As mentioned before, in the ideal posture there is balanced muscle tone between the extensors and flexors but in extended posture there is increased muscle contraction in the extensor muscles.

Note! The position of the legs can give information about the person resources to cope with life from the body-mind point of view and how the person is facing life. In addition, the leg position is affecting the overall posture and that is why it gives the physiotherapist information.

The posture is assessed in the standing, sitting and laying down. It begins by asking the patient to stand in her/his typical standing posture. After that the physiotherapist asks the patient to take the standardized assessment posture where feet are hip width apart, the legs are parallel, knees are straightened and talocrural join is in 90 degrees. The weight should not be on the toes; in the posture, a patient is able to move their toes without changing the posture. The posture is assessed relative to the vertical axis. The vertical axis starts from the atlanto occipital joint, goes through cervix and thoracic junction, cut the lower part of sacrum, middle of the lower limbs until talocrural joint.

The physiotherapist assesses the symmetry and weight distribution of the body from the front, back and lateral direction. After that the physiotherapist is paying attention if there are deviations relation to the central and vertical axis, if there are findings she marks where and how much. Two other important marks are the spine and pelvis: how are the spinal curves (lumbar lordosis, thoracic kyphosis and cervical lordosis) and is the pelvis tilt forwards or backwards.

After assessing the standing posture, the physiotherapist repeats the assessment in the sitting and laying down posture and pays attention if there are changes when the gravitation is eliminated. When the patient is laying down the physiotherapist is paying attention if the legs are separated or tied together, and if the sacrum, shoulder blades and the knees are touching

the mat. If the patient's posture was tense in the standing posture and the patient is able to relax when lying down, it shows that the patient has resources. In the sitting position the physiotherapist is observing how the patient is holding the posture, where the hands are situated and what happens to the spinal curves.

RESPIRATION

The respiration is assessed through the test battery during the posture, movement and muscular consistency assessment. The emphasis is on the movement what happens during the breathing in standing, sitting and laying down posture. The optimal breathing movement is happening in the lower ribs, stomach and sternum is moving slightly up and outwards. The main muscles moving during the inhalation are diaphragm and the outer intercostal muscles. In addition, there is some muscle activation in the upper respiratory muscles in the neck and shoulder but during the optimal breath it is barely seen from outside. During the exhalation the inspiration muscles relax, and the chest cavity goes down and the pressure moves from the chest cavity to the stomach cavity. From outside the abdomen goes slightly inwards during exhalation.

When there is disturbance in the breathing pattern the inhalation happens more voluntarily. During the forced inhalation the muscles around nostrils and vocal cords, back extensors, sternocleidomastoid, scalene and pectoralis major and minor contract. That cause movement upwards in the shoulder and chest area. When exhale is done forced, we use abdominals and internal intercostals. This is causing tension and shortening in the abdominal muscles.

Note! Give attention to the breathing posture, respiratory muscles used, flexibility of the thoracic area, respiratory rate and the natural breaks between inhalation and exhalation

FUNCTION

The movement tests give information about the range of motion, muscle function and self-movement. The tests are connected to the patient's deeper resilience behind the

muscular movement, and it shows the person's ability to adapt to the situation and if one is feeling safe. The test pattern includes main joint movement tests, spinal mobility assessment and movements which show how the patient is able to relax during the passive movement. In addition to those the balance and flexibility is assessed because tensed muscle cause instability in the posture which can lead to musculoskeletal pain.

Functional tests assess body's flexibility and versatility. Functional tests are developed in such a way to give information about holistic qualities. Movement is considered good when it flows freely and is naturally accompanied by other movements throughout the body. If there is blocks to free movement and stretch impulses, there is less harmony between the various parts of the body demanding muscular effort in order to complete movements.

Note! Find out what breaks are applied and what sort of blocks does the individual have.

Relaxed stooped-standing position

Patient stands with body bent forwards, the upper body hanging down as relaxed as possible.

- The arms hang relaxed with the hands over the feet.
- The back has an even curve and neck is relaxed
- The knees are stretched with minimal quadriceps activity.

In this position information is discussed and gathered:

- Mobility
- Elasticity in muscles and soft tissue
- Ability to relax and allow the neck to become integrated part of the trunk
- Ability to remain loose in the upper body while legs remain stretched, stable and active

The long-sitting position

The patient sits with legs parallel and stretched out in the front of the body. The muscles on the back of the body are stretched.

How the person adapts to this position. In order to localize and differentiate whether the brakes are in the legs, back or neck, these parts are independently flexed.

Note! Activity in the extensors of the body are part of the “pull yourself together” pattern. Increased tension and static muscle work in the extensor apparatus results in less stretchability over a period of time.

The two functional tests response in person’s with a more or less “pull yourself together” attitude. In people with reduced stretching length in the extensor system, we frequently find that the flexor muscles are also shortened. The individual is in other words more or less totally protected and stiff.

Free movements between various parts of the body and isolated muscle contraction and the ability to relax

The patient is standing still, and the physiotherapist is applying little bit force on the sacrum of the patient and then the physiotherapist is observing how is the movement of the whole body: is it stiff or is it wavelike movement. This can show how the patient is letting the movement flow

through the body and the physiotherapist can see the body part where the movement is stopping. The patient is asked to let the movement flow through the body without stopping it. If the patient is losing the balance, it is a sign of a tension somewhere in the body.

The assessment is continuing in the supine position by assessing the passive shoulder join movement in flexion position. Physiotherapist is assessing if the patient can let the hand move freely without assisting the movement or is the patient possibly resisting the movement. If the patient is assisting or resisting the movement, it shows that one is not able to be passive. The passive range of motion assessment continues with hip and knee joint flexion by observing the same principals as in the shoulder joint assessment. The last part of the assessment in supine position is the cervical spine passive flexion and rotation.

The patient is in sitting position. First the patient is asked to lean forwards and curve the spine where the physiotherapist is assessing the position of the head, upper back and middle back. After that patient is asked to straighten the back slowly and the physiotherapist is observing is the movement happening in the whole spine or is there parts which stay stiff. In addition, the physiotherapist is assessing if the pelvis area is staying stable while straightening the spine. Last part in the sitting position is knee lift where the physiotherapist is paying attention on the movement control.

Note! There is a psychological difference between individuals that resist passive movement and those that assist. People that resist have difficulty allowing others to control them. Such a person may have a deep sense of insecurity that emerges in uncontrollable resistance. Resistance seems to be a result of factors such a protest, reservation, anxiety, anger etc. Those that are assisting also express insecurity which would seem to be related to negative “ego feelings”.” I am not good enough”. “I have to help so as to be appreciated”.

PALPATION OF MUSCULATURE

The assessment is made by palpating the certain muscle groups in laying down position where the gravity is eliminated, and the entire body is relaxed. when palpating the grip is firm in order to feel through the tissues. The main idea behind the muscle consistency

assessment is that tensing the muscles is one of the most common defense mechanisms.

During the palpation the physiotherapist is mainly paying attention on the size of the muscle if there is difference between sides, muscle tension and if the patient is feeling discomfort during the assessment. The physiotherapist is marking with colors on the assessment form is the muscular tension very high or is the tension below the normal

muscle tone. From the picture the physiotherapist can see if the tension or lack of muscle tone is symmetric or affecting only certain muscle groups. When the physiotherapist is doing the palpation, she/he is asking if the patient is feeling the same.

If the findings of the physiotherapist and the feeling of the patient is matching it tells that the patient has good body awareness. Emotional and autonomic nervous system reactions are also marked down.

AUTONOMIC NERVOUS SYSTEM REACTIONS

The autonomic nervous system is divided into parasympathetic and sympathetic division. The autonomic nervous system is connected to our breathing, muscles, posture and movement. It is also regulating the function of many internal organs, the heartbeat for instance. The parasympathetic division is responsible for the “rest and digest” responses and the sympathetic for the “flight and fight” response. The internal organs have nerve branches from both divisions, depending on the nerve message, one of the divisions increase or decrease the activation of the organ in order to maintain the health.

The autonomic nervous system reactions are assessed through all the four main parts of the assessment. Those reactions can tell important information about the alertness of the patient, and about how the person is sensing safety and danger. The reactions are assessed before, during and after the assessment. Those reactions can be for instance: changes in the color of the skin, temperature of the body, swelling, sweating or freezing, smell or changes in the breath. The goal is to create overall picture of the symptoms and make a conclusion regarding on that.

BODY AWARENESS

Body awareness is very crucial part of our resources in life. The more we are aware of our body and the better the body image is the more we have resources. Body awareness means our ability to sense and be aware about our bodies. The awareness from the body parts is crucial for the overall situation, it tells if the patient has connection to the body parts and if they are part of their self-image. The body awareness is assessed through the whole assessment by comparing the findings of the physiotherapist and the patient.

Contraindications for Norwegian psychomotor therapy:

Since a person’s ability to adjust (physically and mentally) is central to psychomotor therapy, this does not imply that everyone is bale to profit from this therapy form. Should the examination show inability to adjust, one concludes that the individual is unsuitable for trearment. Physical, psychological and social factors may limit a patient’s potential to take advantage of this treatment. (Harjunen, 2020, Thornquist & Bunkan, 1991)

9.3 Non-verbal communication

Nonverbal communication is the transmission of messages or signals through a nonverbal platform such as eye contact, facial expressions, gestures, posture, use of objects, touch and body language.

Non-verbal behaviour forms the major part of communication; responses in interactions are based on the subconscious perception and interpretation of non-verbal messages. Through intuition and experience, most physiotherapists develop the skills necessary to aid their understanding of the behaviour and responses of patients. Increased awareness of non-verbal skills and the importance of their use will enhance both the physiotherapist-patient relationship and the quality of treatment. (Hargreaves 1982)

In physiotherapy, communication that actively involves the patient is seen as the foundation of patient-centered treatment. Research on communication in physical therapy highlights how patients' opportunity to actively participate is often limited by the therapists' focus on biomedical facts and clinical tasks. Physiotherapists' self-awareness around communication and how to get in touch with patients. Good communication is pointed to by patients as important for feeling involved in the treatment process and for their participation (Cooper 2007). In general, the literature on patient centeredness in physical therapy commonly emphasizes the fact that physical therapy practice is heavily rooted in the culture of medicine, and that physical therapists often feel insecure when moving beyond their field of expertise—i.e., the physical body—and communicating with patients about their social and emotional life. (Mudge et al 2014)

Communication is the process of sending and receiving messages to share skills, knowledge and attitudes. Communication is a fundamental clinical skill as it helps to establish the therapeutic relationship between clinicians and their patients. There are many benefits of effective communication in healthcare, including improved health status, functioning and patient satisfaction. (Physiopedia 2023)

Effective communication between patient and provider requires a bidirectional dialogue where each party respects the other. Both parties will be able to:

1. exchange information
2. speak and listen without interruption
3. express opinions
4. ask questions for clarity

Non-verbal communication is the expression of information through the body, face or voice. It provides a way to convey emotion and information without using words. It can give the listener additional information, sometimes contradicting the spoken message.

It includes a wide range of physical signs such as:

- facial expressions / gestures
- body language / posture
- eye contact
- shrugging
- pointing

Individual and cultural differences can impact non-verbal communication as different cultures and people may have different norms and conventions for non-verbal cues. (Physiopedia 2023)

9.3.1 Intercultural differences in non-verbal communication

Non-verbal communication, encompassing gestures, facial expressions, posture, eye contact, and other forms of body language, plays a critical role in human interactions. However, its interpretation can vary significantly across different cultures. Understanding these intercultural differences is essential for effective communication in a globalized world.

Gestures

Gestures are a common form of non-verbal communication, but their meanings can differ dramatically between cultures.

- **Hand Gestures:** A gesture as simple as a thumbs-up can have varied interpretations. In many Western cultures, it is a sign of approval or a job well done. However, in parts of the Middle East and South America, it can be seen as offensive. Similarly, the "OK" sign (a circle formed with the thumb and index finger) is positive in the United States but considered rude in some Mediterranean and South American countries.
- **Nodding and Shaking Head:** In most Western cultures, nodding typically signifies agreement, and shaking the head indicates disagreement. Conversely, in some parts of India and Bulgaria, a side-to-side head tilt can mean agreement, which might be confusing for those unfamiliar with these cultural norms.

Facial Expressions

While some facial expressions are universal, such as smiles indicating happiness and frowns indicating displeasure, the context and extent of their use can vary.

- **Smiling:** In many Asian cultures, smiling is not just a sign of happiness but also used to mask discomfort or embarrassment. In contrast, Western cultures often interpret smiling strictly as a sign of friendliness or happiness.
- **Eye Contact:** Eye contact norms vary widely. In Western cultures, maintaining eye contact is often seen as a sign of confidence and attentiveness. However, in many Asian, African, and Middle Eastern cultures, prolonged eye contact can be seen as confrontational or disrespectful, especially when directed towards authority pictures.

Posture and Proximity

Posture and the use of personal space can also convey different messages across cultures.

- **Posture:** In the United States, a relaxed posture might be perceived as a sign of ease and comfort. However, in Japan, where formality is highly valued, a straight and formal posture is expected in most social interactions.
- **Personal Space:** Proxemics, the study of personal space, reveals significant cultural differences. In Latin American and Middle Eastern cultures, people tend to stand closer together when conversing, which is a sign of warmth and friendliness. In contrast, Northern Europeans and North Americans generally prefer more personal space and standing too close can be perceived as intrusive or aggressive.

Touch

Touch is another non-verbal cue with varying interpretations.

- **Handshakes and Greetings:** In the United States and much of Europe, a firm handshake is a common greeting and a sign of confidence. In contrast, in some Asian cultures, a gentle handshake or a bow is more appropriate. In India, the traditional greeting is the Namaste, a slight bow with hands pressed together, which conveys respect.
- **Public Display of Affection:** In many Western cultures, light touches such as handshakes, hugs, and pats on the back are common and acceptable. However, in many Muslim-majority countries, public displays of affection, even between close friends, are frowned upon.

Silence

Silence can also carry different meanings across cultures.

- **Silence as Respect:** In Japan and Finland, silence is often used as a sign of respect and contemplation. People might pause before responding to show they are thoughtfully considering what has been said. In contrast, in the United States, prolonged silence can be perceived as awkward or indicative of disagreement.

- **Communication Style:** Cultures with high-context communication styles, such as those in Asia and the Middle East, rely more on non-verbal cues and the context of the message rather than the words themselves. In contrast, low-context cultures like the United States and Germany prefer direct and explicit verbal communication, where words are the primary carriers of meaning.

Understanding intercultural differences in non-verbal communication is crucial for fostering effective and respectful interactions in our increasingly interconnected world. Recognizing and adapting to these differences can help prevent misunderstandings, build stronger relationships, and facilitate smoother communication across cultural boundaries. As globalization continues to bring diverse cultures into closer contact, cultivating cultural sensitivity and awareness becomes ever more important for personal, social, and professional success. Reynolds, S., & Valentine, D. (2004)

9.4 Cooperation with psychiatrists/psychologists

Physiotherapists receive many patients for psychomotor therapy who do not first see the connection between their physical and emotional/social problems. The aim of psychomotor therapy is give the patients better contact with their emotional life. When there are changes in the body and respiration is released , the patient registers a deeper contact with feelings.

If conflicts and emotions start becoming a problem, or treatment comes to a standstill, then the question of psychotherapy becomes to relevant. Usually psychomotor therapy and psychotherapy are used in combination. The psychomotor therapy, when followed immediately by psychotherapy, is most effective.

If the patient’s life is full of conflicts, then maybe psychotherapy alone will prove sufficient for a while. It is rarely necessary to discontinue psychomotor therapy altogether because it can be used to stabilize the patient. In the other words, help the patient to stand on his own feet, so that he finds it easier to look face reality.

When considering emotional crises, the use of sedatives and antidepressant drugs can be useful for limited period of time.

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10 METHODOLOGY OF ASSESSING DUAL-TASK GAIT WITH CONSIDERATION FOR LINGUISTIC AND CULTURAL VARIATIONS IN THE KNOWLEDGE LEVELS OF THE PARTICIPANTS

Agnieszka Kreska-Korus, Teresa Gniewek, Joanna Golec, Agata Milert

10.1 Introduction

Walking is a fundamental human locomotor activity. During walking, individuals commonly engage in additional tasks such as conversing, using a smartphone, window-shopping, or planning a route. In these moments, the human nervous system not only governs walking but also manages these concurrent activities, demanding more of its resources compared to situations where walking is the sole focus. Consequently, under conditions involving an additional task, it becomes possible to identify disorders that might not be evident in a traditional gait examination.

The methodology of dual-task gait analysis enables the examination of everyday walking patterns in clinical settings. This approach facilitates the observation of changes in gait patterns resulting from aging, medical conditions, or injuries, and it aids in assessing the effectiveness of interventions designed to enhance locomotion.

The evaluation of gait with an additional task is increasingly utilized in physiotherapy and can be valuable in assessing fall risk, the potential for return to sports after an injury, or the effectiveness of gait re-education.

The objective of this lesson is to introduce best practices for the proper execution of gait testing with an additional task, drawing from a comprehensive review of the literature and our own expertise.

10.2 Methodology of assessing dual-task gait

10.2.1 Dual-task paradigm

To identify differences in gait conditions with an additional task, the dual-task paradigm is utilized. Its premise involves performing each of the tasks first individually and then simultaneously executing both tasks. Each task should have the same conditions during both single and dual-task performance (Pineda et al., 2023) (McIsaac et al., 2015).

10.2.2 Preparation for the examination:

Before starting the examination, it's essential to inform the person being examined about the purpose of the study, how it will be conducted, and assure them that the examination is non-invasive and painless.

If markers will be applied directly to the body (skin) during the examination, it's also important to let the individual know when scheduling the appointment that they should avoid using moisturizing or oily skin products (like lotions or balms) to prevent the markers from coming off.

10.2.2.1 Preparation for gait analysis in the dual-task paradigm:

Before conducting gait analysis in the dual-task paradigm, several steps need to be taken:

- **Interview:** Collect information about the individual's age, existing medical conditions, past injuries, occupation, hobbies, and the reason for undergoing the study.
- **Anthropometric Measurements:** Gather measurements necessary for the specific gait analysis system in use, such as body height and the length of the lower limbs.
- **Additional Measurements:** Include any extra measurements, for example, an assessment of the dominant lower limb (if needed for the study).
- **Attachment of Sensors/Markers:** Securely attach the motion analysis system's sensors or markers to the individual's body and calibrate the system to ensure accurate data collection.

10.2.3 Gait Analysis in Single-Task Conditions (Single Task - ST):

During gait analysis in both single and dual-task conditions, we utilize gait analysis systems to obtain spatiotemporal gait parameters. Depending on the equipment used, it's important to consider its limitations, which can arise from measurement accuracy and cultural factors (such as how and where sensors/markers are attached).

After attaching the sensors/markers of the selected gait analysis system, it is advisable to acclimate the individual to walking in the measurement environment. Our observations suggest that a patient's awareness of having elements of the system attached to their body or that their gait is being recorded can impact their locomotion. A best practice in our motion analysis laboratories is to allow the individual to walk the measurement path multiple times before the actual data recording.

Gait Recording:

Typically, gait analysis is conducted at the participant's preferred walking speed (Langeard et al., 2021). However, there is also the possibility to perform the study at a slow or fast walking pace (Schättin et al., 2016).

To prevent measurement errors during the study, it is recommended to:

- Ensure that only research equipment, and not personal phones or electronic devices, are in use by both the participants and the examiners.
- Limit the number of people in the room to only the individuals being tested and the examiners.
- Secure the area to prevent unauthorized individuals from entering the room where the study is conducted.
- Eliminate external distractions, such as blocking windows, closing doors, and reducing external noises.

The measurement path should be determined with the following considerations:

- The path's length should be suitable for the participant's physical capabilities.
- The participant should be able to walk in a straight line (they can turn around, but this stage is not included in the measurements).
- A measurement path located in a space that is too small can disrupt the results by altering gait parameters due to locomotion initiation or approaching an obstacle like a wall.

- A path that is too short or too long may hinder or prevent the performance of additional tasks in dual-task conditions.

According to the dual-task paradigm, it is essential to ensure the same testing conditions and conduct the same number of walking cycles in both single and dual-task conditions (Plummer et al., 2013). This consistency is crucial for reliable and meaningful comparisons in gait analysis when individuals are performing tasks that require their attention simultaneously.

10.2.4 Researching additional tasks in single-task conditions (Single Task – ST)

Despite the increasing number of scientific reports regarding cognitive task assessment, there is a lack of standards defining the principles of their application. The following tasks are most commonly used in research:

- **Serial counting backward from 50 or 100** (the participant verbally counts numbers, e.g., 100, 99, 98...) (Beauchet et al., 2008) (Beauchet et al., 2007) (Yamada et al., 2011).
- **Serial subtraction of 7 or 3 from a specified number** (the participant provides the results of subtracting from the given number, e.g., subtracting 7 from 376, the patient should list numbers like 376, 369, 362, 355...) (Maclean et al., 2017).
- **Listing animals or professions without repeating names** (the participant lists professions like chef, doctor... or another version involves naming animals starting with a specific letter, e.g., C, then providing names like “cat”, “cow”, “crocodile”) (Freire Júnior et al., 2017).
- **Using a mobile phone**, e.g., the participant writes a text message (Krasovskyi et al., 2017) (Ehlers et al., 2017) (Lin and Huang, 2017).
- **Moving a cup of water** (the participant's task is to transfer a cup of liquid or a tray with cups of water) (McIsaac et al., 2015).
- **DIVA-gait computer test** (a computer program created at the Academy of Physical Education in Krakow by the team of A. Kreska-Korus, E. Golec, A. Wojtowicz, based on the DIVA program by Nęcka, 1994) (this task was presented in **VIDEO 3**).

Course of the Study:

- Explain the additional task to the participant, detailing what it entails. If the study requires it, conduct sessions in which the participant learns how to perform the task.

- Record the progression of the additional task study, and document the results

During the additional task study, the most commonly measured indicators are reaction time and the quantity of correct tasks or the number of errors.

When selecting the type of additional task, remember that it must be achievable under the same conditions as during the dual-task gait analysis. You can find more information on this topic in the section about cross-cultural communication.

10.2.5 Gait analysis in dual-task conditions (Dual Task - DT):

According to the dual-task paradigm, the final stage involves simultaneously performing both tasks (walking and the additional task) under the same conditions in which the single tasks were conducted. The same indicators are recorded for this dual-task performance.

10.3 Development of indicators

10.3.1 Development of gait indicators

To conduct gait analysis with an additional task, it's necessary to develop indicators for each part of the study.

For gait analysis, these indicators will mainly involve spatiotemporal measurements. However, it's important to select a consistent sample for both the single and dual-task conditions. In the analysis, one cycle of gait for each limb from each pass along the path should be considered. To do this, appropriate actions need to be taken within the operating system of the measurement device to identify and include only the chosen gait cycles, recorded in the middle section of the path/measurement (Schättin et al., 2016).

For selected indicators, calculate their average values and standard deviations.

Further analysis may involve considerations such as the dominant and non-dominant limb, limbs affected by pathological processes either directly or indirectly, and so on.

10.3.2 Development of additional task indicators

The most commonly used indicators for additional tasks are:

- Reaction time,
- Quantity of correct responses,
- Number of errors.

To obtain these indicators, you can count correct events (correct counting results, named animals or professions), errors, and determine reaction times. This can be done in three ways:

1/ The least demanding but most error-prone method is counting correct reactions during the study and measuring the study time using a stopwatch. By dividing the study time by the number of correct responses, you can calculate the reaction time.

2/ Recording the study on a Dictaphone and later calculating the number of correct responses and reaction times from the recording. The recorded study can be listened to for error elimination.

3/ Using a computer program that automatically records study results. The DIVA-gait test, for instance, records:

- Detection time (only considering correct reaction time),
- Number of detections,
- Number of errors, including the following error types:
- No alarm: the participant did not activate the reaction button when the signal letter was displayed.
- Double alarm: the participant pressed the reaction button a second time when the signal letter was displayed.
- False alarm: the participant activated the reaction button when the signal letter was not displayed (see **VIDEO 3**).

10.3.3 10.3.3. Gait indicators with an additional task

Distinctive indicators for gait analysis with an additional task include variability of gait cycle time/step time, variability of gait cycle length/step length, Dual-Task Effect, Mean Dual-Task Effect.

10.3.3.1 Variability:

For each of the individuals being studied, you can calculate:

- The variability of gait cycle time/step time (depending on the available data in the gait analysis system).
- The variability of gait cycle length/step length.

To calculate this variability, you can use the following:

$$V = \frac{SD}{m} * 100\%$$

V - variability, SD - standard deviation, m - mean.

It is essential to pay special attention to the precision of measurements, which is particularly important for the reliability of variability. Regarding the dual-task paradigm, it's crucial to replicate the testing conditions during both single and dual-task gait analysis. The repeatability of the sample size and obtaining unaltered gait indicators unaffected by other events, such as the initiation of gait or the presence of external individuals, is key.

10.3.3.2 The Dual-Task Effect

The Dual-Task Effect is calculated for each of the indicators according to the following formula (Plummer-D'Amato et al., 2012):

$$\alpha DTE = \left| \frac{\alpha DT - \alpha ST}{\alpha ST} \right| * 100\%$$

α DTE- Dual-Task Effect for indicator α

α ST - the value of the indicator under single-task conditions, α

DT - the value of the indicator under dual-task conditions.

The α indicator can be any of the indicators studied in walking or in the additional task (e.g., Dual-Task Effect on walking speed or Dual-Task Effect on reaction time).

When interpreting the indicator's values, it's important to be particularly attentive: for speed, an increase in the indicator will signify greater task efficiency, but in the case of reaction time, it will indicate decreased task efficiency.

10.3.3.3 Mean Dual-Task Effect

Mean Dual-Task Effect is calculated according to the following formula:

$$mDTE = \frac{\alpha DTE + \beta DTE}{2}$$

m DTE - Mean Dual-Task Effect,

α DTE - Dual-Task Effect for indicator α (gait indicator)

β DTE - Dual-Task Effect for indicator β (additional task indicator)

The Mean Dual-Task Effect is most commonly calculated for gait speed and reaction time. It can also be applied to other indicators, but it's essential to note that one must relate to walking, and the other to the additional task.

In cases where an increase in one indicator represents improvement while an increase in the other signifies a decrease in task efficiency, applying this formula indiscriminately can lead to a misrepresentation of the result. In such a situation, for the second indicator, you should place a minus sign (-) before conducting the operation. This scenario occurs when the Mean Dual-Task Effect is calculated for gait speed and reaction time.

In situations where both Dual-Task Effects show the same directional change (e.g., gait speed and the number of correct task completions), it's necessary to consider whether this alteration represents an improvement or a decline in task performance efficiency.

10.3.4 Interpreting results

To interpret the results of gait analysis with a dual task, you should consider the following aspects.

10.3.4.1 Assessment of spatiotemporal gait indicators in relation to normative values

Norms for specific gait indicators are available in the literature concerning gait analysis in single-task conditions. If the person being examined experiences disruptions in their gait pattern due to changes in range of motion, muscle strength, etc., these factors will influence gait indicators, both in single-task and dual-task conditions. The application of the dual-task paradigm allows for the evaluation of gait under the additional cognitive load, helping identify disruptions that may not be detected in traditional gait assessments. Assessing gait with a dual task reflects locomotion as it occurs in everyday life.

Walking speed is considered a fundamental gait indicator. It holds significant clinical importance due to its simplicity. Schmid (2012) and colleagues have indicated that a minimum walking speed necessary for societal functioning is around 0.8 m/s. When analyzing gait, it's also essential to consider factors such as stride frequency and stride length, as these indicators have a profound impact on walking speed.

10.3.4.2 Analysis of additional task indicators

In gait analysis with a dual task, the most commonly analyzed indicator is the average reaction time. In our own studies conducted using the DIVA-gait test, this indicator has proven to be the most sensitive measure of the additional task. Our experiences suggest that in cases of outlier results, it's advisable to consult with a psychologist for further interpretation and insights.

10.3.4.3 Analysis of gait indicators with an additional task

The Dual-Task Effect and Average Dual-Task Effect are referred to as absolute indicators (expressed in percentages). In addition to these, the variability of the gait cycle is also analyzed.

10.3.4.3.1. Dual-Task Effect

The Dual-Task Effect allows the assessment of the magnitude of change in a specific indicator, expressed as a percentage. It enables the evaluation of a chosen variable between different assessments and a comparison to identify where the most significant changes occur.

For example, if an individual exhibits a reduction in stride length by 0.1 meters and a decrease in speed by 0.1 m/s when an additional task is introduced, it can be challenging to determine which change is more substantial. However, if we calculate the Dual-Task Effect for stride length and find it to be 16%, and the Dual-Task Effect for gait speed is 10%, we can conclude that the greater changes have occurred in stride length.

Comparing the Dual-Task Effects for gait performance indicators (e.g., gait speed) and the additional task (e.g., reaction time), we can determine the attention-sharing strategy employed by the nervous system and which task experienced more significant changes.

10.3.4.3.1 Mean Dual-Task Effect

The Mean Dual-Task Effect is an indicator that assesses the efficiency of performing both tasks simultaneously in comparison to performing them in single-task conditions. It informs us whether the nervous system possesses sufficient resources to control the simultaneous execution of both tasks. A worsening of this indicator indicates that operational capacities have been exceeded, resulting in a decreased efficiency in task performance.

Plummer and Eskes (2013) emphasize the importance of distinguishing attention allocation strategies. They provide an example that interpreting the Mean Dual-Task Effect with the same value can indicate different types of attention allocation. It may reflect changes in both tasks

concurrently, but it can also signify situations where there is only a reduction in the efficiency of either gait or the additional task.

The Average Dual-Task Effect allows for comparisons of walking abilities under dual-task conditions across different study groups. It can be utilized to identify conditions where the most significant changes occur and to assess the effectiveness of therapeutic interventions.

10.3.4.3.2 Variability

Variability in stride length and stride time indicates the extent to which these indicators change during locomotion, expressed as a percentage. Larger changes suggest poorer motor control of gait. Although this area requires further research, it appears that measures of variability in stride length and stride time can be considered sensitive risk indicators for falls during walking (Herman et al., 2020) (Maki, 1997). Gabell and Nayauk (1984) found that variability in stride length and stride time did not exceed 6% in healthy individuals.

10.3.4.3.3 Interpreting Results – summary

A specific interpretation of the results in gait with an additional task involves considering the following aspects:

1. The Average Dual-Task Effect indicates whether the individual has the neural resources to perform both tasks simultaneously.
2. Analysing the Dual-Task Effects for both tasks allows for the determination of the strategy being employed (whether gait and/or the additional task is affected).
3. Variability indicators determine if there has been a deterioration in motor control. If the magnitude of variability exceeds the norm, it is associated with an increased risk of falling.
4. A gait speed below 0.8 m/s can identify individuals with limited societal functioning (Schmid et al., 2007).
5. Analysing gait and additional task indicators can help understand the mechanism of motor control during gait with an additional task.

10.4 Communication with the patient

Effective communication with the patient plays a pivotal role in the context of gait testing with an additional task, as it can influence the outcomes. The choice of the supplementary task during the test may also be influenced by language, culture, or the individual's level of knowledge and skills. Familiarity with modifications to the test methodology creates the opportunity to adapt it in accordance with the patient's cultural sensitivities. Furthermore, certain approaches to locomotion testing may be incompatible with specific worldviews. Simultaneously, understanding the limitations of the methods employed enables the selection of the most suitable approach for testing or accurately interpreting the results.

In this course, we will present various options for tailoring the test methodology to meet the diverse needs of patients, along with recommendations for effective patient communication.

During the assessment of gait with an additional task, several areas can be sensitive to cross-cultural communication.

10.4.1 Communicating information to the patient and issuing instructions during the course of the study:

During gait assessments with an additional task, the identification of the strategy used to allocate attention between the tasks is crucial. It is essential to evaluate whether gait, the additional task, or both are affected. When explaining the purpose and process of the assessment to the participant and providing instructions, it's important not to suggest that one of the tasks is more important than the other (Maclean et al., 2017). Additionally, care should be taken to avoid situations that may evoke emotional responses in the participant, as emotions can also influence the assessment results (Gross et al., 2012).

This approach ensures that the participant does not feel pressured or anxious about the tasks and can perform them as naturally as possible, which is essential for obtaining accurate results during gait assessments with an additional task.

10.4.2 Selection of an Additional Task

Current scientific research results do not provide an answer to the question of which additional task is the best choice during gait assessments with an additional task.

Culture, understood as the entirety of material and spiritual heritage handed down from generation to generation, has a significant impact on human development, the type of information acquired, and competencies. Most of the additional tasks used are based on the participant's skills and knowledge, which can influence the results obtained. For example, if the task involves naming animals starting with a given letter (differently in single and dual tasks), the task's effectiveness, measured by the number of named animals and average reaction time, depends on the participant's knowledge. Their knowledge may be related to their education, hobbies, upbringing in various cultural contexts, and language. In different languages, both the number of animal names starting with a particular letter and the time to pronounce them differ. Therefore, when selecting an additional task and interpreting the results obtained, caution is necessary. It is advisable to choose tasks that do not pertain to areas of knowledge or skills that are particularly developed or limited in the participant (e.g., backward counting is not recommended for individuals with dyscalculia or accountants, and naming animals is not suitable for biologists). It's also important to remember that each additional task places a different burden on the nervous system. Therefore, results obtained from assessments using different additional tasks are not directly comparable.

In our own research, to avoid cognitive tasks related to the participant's knowledge and skills, we use the computer program DIVA-gait. When employing this tool, the type of alphabet typically used by the participant in their daily life should be considered (a cultural factor). While the Latin alphabet is commonly used, the DIVA-gait program can be applied to all alphabets that include uppercase and lowercase letters.

10.4.3 Selection of research method with respect to the client's cultural needs

Religious beliefs and individual sensitivity can make gait assessments challenging when using systems that require exposure of significant areas of the body. The consequence may be a refusal to participate in the study or a high level of stress that could affect the results. Having various measurement systems facilitates the optimal adjustment of the study conditions to the patient's needs.

A patient has the right to medical care, taking into consideration respect for the attitudes, values, and customs presented by them. This also applies to beliefs related to their religious affiliation. The pre-interview is an opportune moment to establish a diagnostic and therapeutic plan with the patient. The patient should be informed about the purpose of the planned procedure, how to prepare for it, and have the opportunity to ask questions. If the patient does not accept the planned treatment for religious reasons, it is good practice to emphasize that we respect their worldview. During the conversation, it is helpful to determine whether the issue lies with the entire procedure or just a specific element. We should present alternative options to the patient, which may involve modifying the procedure or exploring other forms of treatment. It is important to communicate the consequences of changing the diagnostic and therapeutic plan, such as lower treatment effectiveness, more general outcomes, or a longer duration of the procedure. It is crucial for the patient to consciously decide on the planned treatment, understanding the consequences of their choices.

One example of the impact of religious beliefs on the rehabilitation process could be the reluctance of nuns to undergo examinations in underwear or swimwear. It's important to note that this situation may vary depending on the particular convent to which the nun belongs and her individual beliefs. Therefore, having a conversation with each patient and determining an

A patient has the right to medical care, taking into consideration respect for the attitudes, values, and customs presented by them. This also applies to beliefs related to their religious affiliation. The pre-interview is an opportune moment to establish a diagnostic and therapeutic plan with the patient. The patient should be informed about the purpose of the planned procedure, how to prepare for it, and have the opportunity to ask questions. If the patient does not accept the planned treatment for religious reasons, it is good practice to emphasize that we respect their worldview. During the conversation, it is helpful to determine whether the issue lies with the entire procedure or just a specific element. We should present alternative options to the patient, which may involve modifying the procedure or exploring other forms of treatment. It is important to communicate the consequences of changing the diagnostic and therapeutic

plan, such as lower treatment effectiveness, more general outcomes, or a longer duration of the procedure. It is crucial for the patient to consciously decide on the planned treatment, understanding the consequences of their choices.

Useful solutions might include:

- If a nun is unwilling to remove her habit but lower limb exercises are planned, suggesting the use of training pants could allow for more comfortable exercises without exposing the habit.
- If a nun does not accept removing her habit or veil but it hinders physiotherapy (e.g., a plastic element of the veil obstructs neutral head positioning in a treatment bed opening), asking if it's possible for the nun to use a mission dress during medical procedures, as it is more comfortable to use.
- Some nuns may accept removing their habit with a limited number of people present (e.g., individual baths or exercises, treatments in separate rooms, or therapy conducted only by female physiotherapists).
- There are also nuns for whom the issue is not the removal of the habit itself but the societal reaction to this fact; That's why they prefer to come to the clinic already dressed in civilian clothing (other than their religious habit).

10.5 Suggestions on cooperation with other members of the therapeutic team and people from the patient's close environment

To ensure high-quality research, collaboration in a multidisciplinary team is essential, involving physiotherapists, physicians, biomechanics, and psychologists.

If research results indicate significant disturbances in dual task gait, it may be necessary to refer the patient for further diagnostics (e.g., in situations where low cognitive function is suspected – which may be a symptom of dementia). However, if we observe a high risk of falls, we provide information to the physiotherapist responsible for the patient about the need for implementing appropriate therapy. Both the patient and the family, caregivers, or nurses should be aware that avoiding dual tasks during walking is essential to reduce the risk of falls.

10.6 Benefits of using gait testing methodology with an additional task

10.6.1 Importance of dual-task gait assessment in older adults

By 2050, approximately 400 million people worldwide will be over the age of 80 (Fong and Feng, 2018). Older adults experience a faster decline in lower limb function compared to upper limb function. Reduced mobility translates to fewer activities of daily living that a patient can perform independently (Zhang et al., 2018). This results in a decreased quality of life and the need for support from family or institutional care. Gait speed decreases with age. Smith et al. (2016) state that normal gait speed (under single-task conditions) is 1.29 m/s for individuals aged 60–69, 1.19 m/s for those aged 70–79, and 0.96 m/s for those over 80 years old. The measurement of gait speed is recognized by the British Geriatrics Society as one of the key indicators of functional decline and frailty, playing an important role in the long-term assessment and monitoring of older adults.

Additionally, there is a clear relationship between gait speed and falls. A significantly lower risk of falls has been demonstrated in individuals walking at a usual speed greater than 1.00 m/s (Smith et al., 2016). Older adults tend to reduce gait speed under dual-task conditions, lengthen gait cycle time and double support time compared to younger individuals, and show increased variability in gait cycle time and stride length (Springer et al., 2006; Hollman et al., 2007; Zhang et al., 2018; LaRoche et al., 2014; Hupfeld et al., 2022). LaRoche et al. (2014) found that deterioration in dual-task gait was correlated with cognitive function levels. Unfortunately, norms for spatiotemporal gait parameters under dual-task conditions or the dual-task effect have not yet been established. One main reason is the high variability in methodologies used, particularly the use of different additional tasks, resulting in considerable discrepancies in indicators.

The greater dual-task effect in older adults appears to be partially related to age-related brain atrophy, with the frontal cortex atrophying earlier and faster than other brain regions. Hupfeld et al. (2022) hypothesize that aging increases reliance on alternative (i.e., non-motor) neural resources, such as the frontal cortex, to compensate for brain atrophy in sensorimotor regions. Thus, deficits in the latter may contribute to reduced dual-task gait efficiency. Their neuroimaging studies indicated extensive age-related atrophy in cortical, subcortical, and cerebellar regions, particularly in areas involved in sensorimotor processing (e.g., precentral and postcentral gyrus). This identified potential compensatory relationships between better-preserved brain structure in regions not classically associated with motor control (e.g., temporal cortex) and preserved dual-task walking abilities in older adults. This suggests the temporal cortex's role in maintaining behavioral functions during aging, especially when other brain regions responsible for locomotor control (e.g., sensorimotor cortex, basal ganglia, and cerebellum) are largely atrophied. Additionally, they indicated a relationship between less specific subcortical atrophy (i.e., larger lateral ventricles) and greater decreases in gait speed under dual-task conditions.

The discovery of the dual-task interference phenomenon in gait among older adults has driven the development of new therapeutic programs. Although a universal treatment scheme has not been defined, Tait et al. (2017) suggest that the optimal training dose should last from 1000 to 3000 minutes, conducted 1-3 times a week. It should include both physical and cognitive training, and sensory exercises are also beneficial. Cognitive and physical training may stimulate similar neurobiological processes, evoking a synergistic response. They increase cerebral blood flow and induce angiogenesis in the cortex and cerebellum. Both forms of training can contribute to the plasticity of related areas and increase brain volume. Exercise may also protect blood vessels and neural tissue by counteracting the age-related increase in circulating inflammatory biomarkers linked to cognitive decline and dementia. Physical exertion-induced release of growth factors such as BDNF (brain-derived neurotrophic factor) and IGF-1 (insulin-like growth factor) also plays a significant role in neurogenesis, angiogenesis, and synaptic plasticity (Tait et al., 2017).

The use of dual-task gait methodology can be useful in identifying older adults with mild cognitive impairment. Zhou et al. (2021) reported that changes in gait parameters under dual-task conditions could be observed before cognitive changes. At this stage, conventional functional assessment tests would not be sensitive enough to detect these changes (Zhou et al., 2021).

Increasing importance is attributed to dual-task gait assessment methodology as a marker of fall risk, emphasizing that it is more sensitive than clinical tests (Kressig et al., 2008; Commandeur et al., 2018; Wayne et al., 2015). Wayne et al. (2015) emphasized that the dual-task effect size is higher in older adults who fall compared to non-fallers and that gait cycle variability during dual-task walking may be a particularly sensitive predictor of falls in older adults (Kressig et al., 2008).

Hupfeld et al. (2022) indicate that poorer dual-task walking skills are associated with increased fall risk, functional decline, frailty, disability, and mortality. Dual-task gait assessment methodology thus plays an important role in diagnosing older adults. Older adults exhibit age-related changes and a higher prevalence of diseases. Both factors can lead to a deterioration in dual-task gait indicators. In summary, significant dual-task effects should prompt the therapist to conduct a thorough diagnosis to determine the causes and implement a program to improve dual-task gait.

10.6.2 Examples of the application of dual-task gait methodology in neurology

Introducing a dual-task paradigm into gait assessment in stroke survivors helps identify long-term impairments that are not detected in other clinical evaluations (Kemper et al., 2006). Compared to single-task gait, dual-task gait is characterized by a reduction in gait speed (Bowen et al., 2001; Canning et al., 2006; Plummer-D'Amato et al., 2010), lower cadence (Canning et al., 2006; Plummer-D'Amato et al., 2010), increased cycle time (Plummer-D'Amato et al., 2008), and increased double support time (Bowen et al., 2001).

Plummer-D'Amato et al. (2010) suggest that loading the paretic limb may be the most attention-demanding phase of the gait cycle in individuals with hemiparesis. This has significant clinical implications. It seems reasonable to focus on re-educating this phase of the gait cycle under single-task conditions to improve the automatism of loading the paretic limb.

Gait impairment, on the other hand, is one of the primary motor symptoms of Parkinson's disease and worsens as the disease progresses, potentially leading to falls and subsequent disability (Zhang et al., 2022). Additionally, the study by Del Din et al. (2019) demonstrated that gait disturbances can be observed approximately four years before diagnosis. Gait analysis in single-task conditions identified the following changes: decreased gait speed, reduced stride length, diminished arm swing amplitude, and increased interlimb asymmetry and gait variability (Del Din et al., 2019; Zhang et al., 2022). Del Din et al. (2019) suggest that these may be among the earliest symptoms of Parkinson's disease. Introducing a dual-task paradigm to gait in early-stage Parkinson's patients significantly reduced gait speed, decreased stride length, increased support and swing phase duration, and increased cycle time variability (Zhang et al., 2022).

Raffegeau et al. (2019) report that the progression of Parkinson's disease affects dual-task gait such that patients with a gait speed higher than 1.1 m/s under single-task conditions experience a greater reduction in gait speed during dual-task walking compared to patients walking below 1.1 m/s under single-task conditions.

Monaghan et al. (2023) indicate that the gait of Parkinson's patients who experience freezing of gait (FOG) differs from those who are free of FOG in terms of higher dual-task effects on measures such as foot angle at ground contact and its variability, stride length, and arm swing range of motion. Researchers suggest that dual-task gait methodology can help identify individuals most susceptible to dual-task walking deficits in daily life and optimal candidates for dual-task gait training.

10.6.3 Dual-task gait assessment in orthopedic patients

There is significant interference between cognitive load and motor tasks in individuals with knee osteoarthritis (Hamacher et al., 2016; Abdallat et al., 2022). A marked increase in the dual-task effect has been noted. Furthermore, pain affected motor performance in patients with knee pain, indicating that many of these patients do not seem to have the cognitive capacity to manage dual tasks without altering either cognitive or motor abilities. It appears that these individuals walk with greater compensatory executive control and less automatism. Conversely, a reduction in pain intensity was associated with an decrease in dual-task effects, suggesting that such a decrease would reduce the risk of tripping and that pain has a detrimental impact on motor-cognitive interaction (Hamacher et al., 2016; Abdallat et al., 2022).

Hamacher et al. (2014) compared dual-task gait in healthy individuals and those experiencing back pain. Higher gait variability indices were observed in patients suffering from back pain. The authors suggested that chronic pain reduces the motor-cognitive capacity to perform dual

tasks. Furthermore, they postulated that the harmful effects are caused by central mechanisms, where pain disrupts executive functions, which in turn may contribute to an increased risk of falls. Yogev-Seligmann et al. (2008) noted that the prefrontal cortex is involved not only in executive functions but also in pain processing and prioritizing tasks that require attention (Yogev-Seligmann et al., 2008; Nguyen et al., 2023).

Although the number of publications on dual-task gait assessment in orthopedics and traumatology is significantly smaller than that concerning the elderly or neurological patients, it appears that the dual-task paradigm has important diagnostic value for orthopedic and traumatology patients. It allows for the assessment of gait under conditions similar to daily life environments and may also contribute to identifying patients at high risk of falls. Further research is needed to identify conditions with high dual-task effects, determine the causes of such changes, and develop physiotherapy programs aimed at restoring efficient gait under dual-task conditions.

10.6.4 Application of dual-task gait assessment in sports medicine

Both daily activities and sports necessitate the simultaneous coordination of motor and cognitive tasks by the central nervous system (Howell et al., 2018). During gait, the CNS must receive and process sensory information from the musculoskeletal and vestibular systems along with visual stimuli, manage muscle work, and control the influx of information from the surrounding environment, all while managing additional motor and/or cognitive tasks (Socie & Sosnoff, 2013). During sports activities, the nervous system oversees motor tasks related to locomotion and additional activities (e.g., catching a ball), as well as cognitive tasks related to the strategy employed by the athlete. Dual-task gait assessment can enhance sports medicine by evaluating the allocation of attention in both cognitive and motor domains (Howell et al., 2018). The diagnosis and training of dual-task gait is a new but rapidly evolving field in sports medicine. The assumption that corrects gait is a prerequisite for initiating the return-to-running process is already a standard in rehabilitation protocols (Cole, 2016). It seems that restoring the ability to perform dual-task gait may be an important step in returning to training, especially in sports that combine locomotion with additional tasks.

Many publications on the use of dual-task gait assessment in sports medicine relate to concussion. Khurana and Kaye (2012) indicate that concussion is a common injury in contact sports such as American and Australian football, rugby, soccer, boxing, wrestling, basketball, field hockey, and lacrosse, presenting a significant challenge for healthcare professionals working with athletes. Research conducted by Howell et al. (2018) on dual-task gait in athletes post-concussion showed that those who exhibited reduced gait speed under dual-task conditions were at a higher risk of injury upon returning to sports. It is noteworthy that the assessment using the Post-Concussion Symptom Scale did not correlate with the extent of dual-task gait disturbances. This suggests that dual-task gait assessment can provide unique and significant information regarding functional recovery after injury (Howell et al., 2018).

Results from dual-task gait assessments indicate gender differences. Adolescent females who sustained concussions were observed to have a lower Dual-Task Effect on cadence compared

to males (Howell et al., 2017). This highlights that conducting assessments measuring attention allocation in cognitive and motor domains can provide valuable new data, allowing for more individualized physiotherapy and return-to-training processes for athletes. Lee et al. (2013) emphasize the role of dual-task gait assessment as a diagnostic method that identifies subtle physical and cognitive impairments, which may not be detected by traditional assessment strategies.

Another common injury among athletes is the rupture of the anterior cruciate ligament (ACL) of the knee. This type of injury presents numerous challenges for the medical and coaching teams, starting with the surgical reconstruction of the knee, guiding the athlete through the rehabilitation process, and ensuring a safe return to sports training and competition. Gait can be impaired due to symptoms caused by the ligament damage itself or the consequences of the surgical procedure (pain, swelling, decreased muscle strength). The ACL undergoes significant stress during gait, particularly during the swing phase (Brinnlle et al., 2022).

Individuals with anterior cruciate ligament (ACL) injuries and those who have undergone ACL reconstruction show poorer performance in dual-task gait assessments compared to healthy individuals. This manifests as lower efficiency in performing cognitive tasks and reduced locomotion speed (Abdall at al., 2020; Ness et al., 2020). The cause of these changes may stem from damage to the proprioceptors located in the ACL, which detect changes in tension, speed, acceleration, and direction of movement, and allow for the subconscious determination of the knee joint's position in space (Dhillon et al. 2012).

Kapreli et al. (2009) assert that ligament damage leads to disturbances in neuromuscular control, affects central programs, and consequently impacts motor response, causing significant dysfunction of the affected limb. Brain activation studies using functional magnetic resonance imaging indicate that anterior cruciate ligament (ACL) damage may result in central nervous system reorganization, suggesting that such damage can be considered neurophysiological dysfunction rather than a simple injury to the peripheral musculoskeletal system (Kapreli et al., 2009). Patients with anterior cruciate ligament deficiency had diminished activation in several sensorimotor cortical areas and increased activation in 3 areas compared with controls: presupplementary motor area, posterior secondary somatosensory area, and posterior inferior temporal gyrus. It appears that during walking under conditions of an additional cognitive task, sensory information deficits are compensated for by the involvement of additional areas of the nervous system, which reduces the available attentional resources for performing both tasks simultaneously. As a result, this leads to a deterioration in the efficiency of walking or the additional task.

Abdalla et al. (2020) concluded that the utilization of dual-task paradigms holds the potential to enhance and implement new strategies for rehabilitation programs and various therapeutic options for individuals with anterior cruciate ligament (ACL) injuries.

The potential and challenges for dual-task gait assessment in sports medicine

It seems that dual-task gait assessment has the potential to complement the diagnostics of athletes by providing the ability to allocate attention to both motor and cognitive domains. It

allows for the evaluation of motor control in more challenging multitasking conditions, which closely resemble the demands during sports activities. However, it is important to bear in mind that dual-task gait represents a lesser challenge compared to actual sports activities. This methodology enables the monitoring of improvement in dual-task gait, where optimal quality appears to be a significant element in physiotherapy, influencing proper locomotion in daily life and a safe return to sports activities. Finally, dual-task training may yield greater benefits compared to single-task training in terms of skill development in sports (Lee et al., 2013).

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11 THE RETURN-TO-SPORT DECISION AS A COMPLEX BIOPSYCHOSOCIAL PROBLEM

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11.1 Sports injury - definition

A sports injury is most often defined as an unfortunate event during sporting activity (amateur or professional), which results in immediate pain, discomfort, and reduction or loss of function. However, it should be remembered that repeated training loads are often the cause of overload syndromes, the symptoms of which do not have a specific, strictly defined time onset. Pain and functional limitation increase gradually as the athlete continues to train and compete. However, in both cases (sudden and delayed cause), the impairment of body functions in a sports injury is caused by specific forces acting on the body during sports activities.

According to Timpek et al. (2014), a sports injury can be considered on three levels. Firstly, as a trauma experienced by the athlete at the time of pain, discomfort, and/or loss of function, secondly as a sports injury, i.e. structural damage or dysfunction of the body assessed by a physician on the basis of objective examinations, and thirdly as an impairment, and inability to practice sports stated by an authorized sports medicine body based on a medical examination.

11.2 Causes of injuries in sport

The causes of sports injuries can be divided into physical, environmental, sociocultural, and psychological causes.

- Among the physical causes, the most common are age and biological sex, intensity and type of training, player's mistakes, for example improperly conducted or omission of warm-up, but also previous injuries and diseases, overloading, and current level of fatigue.
- Environmental reasons include practiced sports discipline, poor technical condition of the stadium, gymnasium, sports equipment, etc., but also bad weather conditions.
- Sociocultural causes of sports injuries can be non-compliance with current regulations, ignoring lower-intensity pain or minor injuries for fear that seeking help for them will be seen as a sign of weakness and negatively affect the athlete's position on the team, pressure from teammates, coaches, family or supporters, pressure from the schedule of important

sporting events and an opportunity that 'may not happen again', the opinion of those closest to the athlete that pain in sport is the norm and taking a painkiller is enough.

- Psychological causes of sports injuries can include disturbed self-esteem, excessive optimism or pessimism, low psychological resilience, excessive perfectionism, high levels of anxiety, impulsivity, misplaced sense of control, and excessive desire to compete and win (Blecharz, 2008).

Regardless of what was the cause of the injury, it has a negative impact on the physical functioning of the athlete and often has a negative impact on his mental state. From the moment an injury occurs and is diagnosed, an athlete needs support from the medical team, sports psychologist, coach, and teammates, family, and friends. The basic tasks of the medical team include explaining to the athlete what the injury was and how the treatment and rehabilitation will proceed, as well as motivating the athlete to actively participate in the therapy. It is also very important to maintain a positive relationship with the athlete and maintain respect for his sports goals but also to protect against returning to the game too quickly, for example under pressure from the coach or other people. The responsibility of the medical team is expressed in professionalism, high competence, empathy, and openness as well as the ability to create optimal conditions for recovery (sometimes it is calming down the player, using mental training techniques and sometimes ensuring the possibility of being close to the team, e.g. therapy conducting at the same time and place as training colleagues).

11.2.1 Football injuries

Researchers believe that a greater understanding of the etiology of injuries will allow for more effective injury prevention. Hence, there is a growing body of research on risk factors and exposure in terms of the timing of exposure and intensity of the stimulus and the occurrence of injuries in sports. Sports medicine physicians, physiotherapists, coaches and statisticians, specialists in data analysis, collaborate in these studies (Nielsen et al., 2016).

Studies show that in football players, injuries most commonly affect the knee joint, ankle and knee joint, thigh muscles and groin area. In the 2021/2022 season, as many as 88.4% of injuries in football players were acute injuries. Almost the same number of injuries occurred during training (49.6%) as during a match (50.4%). One in five injuries (21.5%) were severe injuries, almost half (46.3%) were moderately severe injuries and about one-third of injuries (32.2%) were light in nature. Most injuries (54.5%) involved muscles, but only slightly fewer injuries (42.1%) involved joints and ligaments. Among muscle injuries, the main diagnoses were tears (44.6% of all injuries) and ruptures (6.6% of all injuries). Ligament and meniscus injuries accounted for one in three (30.6%) of all injuries diagnosed during the season and tendon damage was found in one in 15 players (6.7%) (Maestro et al., 2022).

Knee joint injuries

The most common injury to the knee joint in football is damage to the cruciate ligaments. Most injuries to the knee joint occur without contact with another player, as a result of dynamic

movement combined with a change of pace and direction, landing on the lower limb when the knee joint is in extension or rotation of the knee joint when the foot is firmly stabilised on the ground. In the situations described, forces act simultaneously on the knee joint in the frontal plane (valgus or varus), transverse plane (external or internal rotation) and sagittal plane (translation, as in drawer tests). The risk of injury is increased by generalised joint hypermobility and also by certain anatomical features of the knee joint, such as a small and narrow intercondylar notch or a thin and weak anterior cruciate ligament. Additional risk factors are sex hormones in women and core instability and abnormal posture in both sexes (Alentorn- Geli et al., 2009).

Injuries to the ankle and knee joint

The high incidence of injuries to the ankle and knee joint in football is related to the fact that the joint absorbs significant mechanical loads as a result of the foot reacting with the ground. One of the most common injuries to the ankle and knee joint is a sprain, which damages the collateral (fibular) ligaments and reduces the stability of the foot (Kolokotsios et al., 2021). Due to overload and trauma, the risk of osteoarthritis of the ankle and knee joint (as well as the knee joint) is higher in football players than in the general population (Kuijt et al., 2012). Ankle and knee joint injuries cannot be easily linked to isolated risk factors such as strength or joint range of motion. Rather, it seems that these injuries are the result of multiple factors acting simultaneously, among which the athlete's mental state, his or her BMI, or the level of coordination and balance as measured, for example, by the Y Balance Test (YBT) should be calculated (Manoel et al., 2020).

Muscle injuries of the thigh

The muscles most frequently injured are the ischiofemoral muscles and ruptures and tears of these muscles more often affect the kicking lower limb than the supporting limb. The injury usually occurs during running and, more specifically, at the end of the swing phase, when the ischiofemoral muscles, while still being dynamically stretched at high speed, begin to decelerate and contract eccentrically. The injury usually involves the proximal part of the biceps femoris or semitendinosus muscle (Cabello et al., 2015). Risk factors for ischiofemoral muscle injury include gender, age, previous injuries, lack of muscle flexibility and muscle strength balance, poor motor control and incorrect running technique, lack of trunk stability, fatigue and poor external conditions (weather, pavement, etc.) (Van Beijsterveldt et al, 2013.The most serious risk factor, more than doubling the likelihood of a sciatic-shin muscle tear, appears to be a past injury (Engebretsen et al., 2010).

Groin injuries

Acute groin injuries are diagnosed in 5-15% of footballers each season. The most common cause of these injuries is muscle and tendon rupture and accompanying haematoma, much less common are complications of an inguinal hernia or avulsion fractures in the pelvis. Acute groin pain is more common in football players than in runners or swimmers. (Paajanen et al., 2011). Chronic groin pain in football players, on the other hand, is most often a symptom of hip dysfunction, adductor muscles, rectus abdominis muscle or so-called inguinal pubalgia

sometimes referred to as sports hernia (intractable groin pain resulting from strain or tear of the muscle, ligaments or tendons attaching to the pubic bone or damage to the posterior wall of the inguinal canal) (Candela et al., 2019). So far, the specific risk factors responsible for groin injuries in football players have not been clearly defined, although they have been linked to the repeated repetition of dynamic, even violent rotational movements combined with sudden stops and/or changes in pace and direction of movement.

11.3 Reaction to injury

It is difficult to predict what an athlete's reaction to an injury will be. It depends on many factors: related to the injury itself (its type and severity), the situation in which the injury occurred (e.g. injury shortly after winning the gold medal in the world championships or just before the Olympic Games, at the beginning or end of the season, etc.), temperament and personality of the athlete (tendency to anxiety, depression and catastrophizing the situation or a positive attitude and assessment of the injury as a challenge that needs to be overcome), family and financial situation, internal pressure (strong need to compete and win) and external pressure (fear of losing position in team, being forced to return to the game quickly) (Blecharz, 2008).

The reaction to injury is a dynamic process. It can range from shock, disbelief, denial, anger, and disapproval *("Why me?", "How could this have happened?"*), depression and self-blame *("If only I had prepared better...", " If only I hadn't neglected the warm-up..."*), blaming others (for a poorly prepared stadium, defective equipment, imposed too burdensome training plan, insufficient care of a physiotherapist) usually to acceptance. Of course, this pattern is not permanent, and each athlete experiences his injury differently.

Depending on the coexistence of internal and external factors, the trauma may ultimately be perceived only negatively, it may be a contribution to reflection and the search for positive sides, or it may be underestimated.

Negative emotions related to the trauma may manifest themselves in the evaluation of the trauma as:

- a misfortune and unnecessary suffering,
- an enemy and an obstacle to achieving a goal,
- an irreversible obstacle to achieving one's dreamed success,
- a cause of isolation and loneliness,
- a source of anxiety and low mood,
- loss of motivation to act,

- sources of anger and jealousy towards other athletes who can train and improve their performance,
- a source of family problems, including financial ones,
- a sign of weakness,
- an invitation to manipulate the environment.

Among the positive emotions associated with the injury, the following can be noted:

- reflection and looking for positive sides (e.g., more time to spend with family),
- revaluation of one's life plans and goals (e.g., finding an alternative hobby, or activities),
- building work motivation,
- training humility and patience,
- strengthening mental resistance,
- overcoming an unexpected challenge and strengthening self-confidence,
- greater empathy for other athletes struggling with injuries.

The downplaying attitude is characterized by the perception of an injury as:

- an accidental event that will happen to every athlete someday,
- a normal event in sport that will soon be forgotten,
- events that are not of major importance for health and sports career,
- an excuse to rest from sport and carefree laziness,
- excuses from all duties.

Of course, the best prognosis is cooperation with an athlete whose attitude can be described as a reflective optimist. One of the tasks of the therapeutic team is to support the athlete in achieving such an attitude towards the injury.

Ways to deal with injury-related stress

In order to reduce the stress associated with the injury, it is important for the athlete to understand his own condition (the nature and consequences of the injury, the purpose and course of therapy), accept it, regain a sense of control, and take responsibility for their actions. It seems crucial to focus attention on positive emotions, which can be achieved using the athlete's internal resources (self-efficacy, internal locus of control, positive self-esteem, independence, consistency in action reinforced by relaxation techniques, prayer, meditation) or external resources (support from the environment). The athlete should actively cooperate with the therapeutic team, communicate their concerns (e.g., ask about disturbing symptoms), talk about difficulties, and not hesitate to ask for help.

The basic recommendations for an athlete after an injury are:

- use pharmacological treatment and perform follow-up examinations as prescribed by the doctor,
- work systematically with a physiotherapist,
- perform the recommended exercises between appointments with the physiotherapist,
- apply recommendations for modification of daily physical activity, diet, sleep, and rest.
- cooperate with a sports psychologist.

Factors interfering with rehabilitation

The main factor interfering with the rehabilitation process and constituting the greatest obstacle to its effectiveness is pain. Thus, one of the most important tasks of medical personnel is to help relieve pain.

Other difficulties interfering with the course of rehabilitation can be divided into:

Emotional problems

Examples: negative emotions, emotional suppression, depressiveness, sleep problems, and in extreme cases suicidal thoughts

Support that can be provided: presence, showing interest and concern, talking, listening, creating opportunities to express concerns and release negative feelings

Consequences of lack of support: deterioration of well-being and increasing tension associated with suppressing emotions

Cognitive problems

Examples: a distorted or incomplete understanding of the nature of the injury, the purpose and course of treatment, misconceptions about the consequences of the injury, the time needed for recovery and fitness, misconceptions about the prognosis, incorrect implementation of the doctor's and physiotherapist's recommendations

Support that can be given: giving information in a clear and comprehensible way, giving the opportunity to talk to someone who has had similar experiences, making a note of how to take medication when appointments and check-ups are scheduled, detailed instruction on how to do exercises (e.g. making short videos with a mobile phone)

Consequences of lack of support: Anxiety and pessimistic attitude to therapy or belittling of the problem, lack of motivation to actively participate in the rehabilitation process, lack of progress in rehabilitation, discouragement.

Material problems

Examples: financial problems related to the lack of earning opportunities, lack of access to specialist treatment

Support that can be provided: assistance in obtaining financial support, assistance in obtaining access to specialist treatment

Consequences of lack of support: lack of therapy progress, permanent loss of health and fitness, emotional and family problems (Blecharz, 2008).

11.4 Kinesiophobia and fear of re-injury

One common reaction to an injury is fear of movement and re-injury. In the initial phase after the injury, this fear is justified and is a protective factor. As the athlete recovers and returns to fitness, the fear of movement should decrease. It happens, however, that despite effective treatment and the lack of medical contraindications to physical activity, the fear of movement and re-injury remains high. This situation is very unfavourable and is regarded as a factor increasing the risk of re-injury. Even if, from the point of view of medical and fitness assessment, the athlete is ready to return to sport, but still has a fear of movement, the return to sport should be postponed and the athlete should be provided with support, e.g., a session with a sports psychologist.

Tampa scale

One of the most commonly used tools to assess fear of movement is the Tampa Scale of Kinesiophobia (Miller et al., 1991). This scale consists of 17 statements, examples of which are: *"I am afraid that I may hurt myself if I exercise", "Pain always means that I have damaged my body", "No one should exercise when in pain"*. Statements are scored on a Likert scale from 1 to 4: 1 - strongly disagree / 2 - disagree / 3 - agree / 4 - strongly agree (higher scores

indicate greater severity of kinesiophobia). The respondent can receive from 17 to 68 points, with a score of 37 or more indicating kinesiophobia. Free access to the electronic scale calculator in English can be found at: https://www.physiotutors.com/questionnaires/tampa-scale-kinesiophobia/ (access: 10/04/2024)

The scales described below can also be useful in assessing an athlete's psychophysical well-being:

KSC - Kinesiophobia Causes Scale

This tool is used to diagnose the causes of physical activity limitation related to phobic behaviour in the biological and psychological domains. Both domains/subscales contain four factors. The biological subscale assesses morphological parameters, individual need for physical activity, energy resources and biological drives, while the psychological subscale assesses self-acceptance, self-assessment of predisposition to sport, well-being and vulnerability to social influences. A score can be calculated for each subscale separately or for the scale as a whole. The score is given as a percentage. The higher the score, the stronger the fear of movement (Knapik et al., 2011).

SCAT - Sports Competitive Anxiety Scale (Sports Competitive Anxiety Test)

The SCAT scale was developed in 1977 by R. Martens et al. Martens et al. This tool consists of 15 statements to which the respondent answers: rarely - 1 point; sometimes - 2 points; often - 3 points. Five of the 15 statements are items that are not taken into account in the calculation of the score; their introduction into the scale was intended to conceal its essential elements. The remaining 10 statements describe somatic symptoms of stress (8 statements) and cognitive symptoms of stress (athlete's fear of failure) (2 statements). The scoring of two statements should be reversed so that a higher score consistently indicates a high and a lower score consistently indicates a low level of competitive anxiety.

Example statements of the SCAT scale: "Before the game I am anxious", "Before the game I fear I will perform badly:", "Before the game I feel nauseous in my stomach".

SAS - Sport Anxiety Scale (SAS)

The SAS scale, developed in 1990, consists of 21 statements that assess individual differences in somatic anxiety (9 statements, e.g. "I feel my body is tense"), cognitive anxiety in terms of anxiety (7 statements, e.g. "I doubt myself") and cognitive anxiety in terms of concentration (5 statements, e.g. "During competition, I often don't pay attention to what is going on"). The respondent answers using a 4-point Likert scale (1 - not at all; 2 - somewhat; 3 - moderately; 4 - very often). In 2006, a modified and shortened to 15 statements SAS-2 scale was published, which was adapted for children but can also be used with adults (Smith et al., 2006). The SAS scale has been translated and validated into various languages, including Polish (Tomczak et al., 2022).

In addition to those described above, the following can be used in working with athletes:

- Physical Activity and Sport Anxiety Scale - PASAS (Physical Activity and Sport Anxiety Scale) (Norton et al., 2004);
- Competitive Sport Anxiety Inventory - CSAI-2 (Competitive Sport Anxiety Inventory-2) (Lane et al., 1999);
- Perfectionism in Sport Scale - PSS (Perfectionism in Sport Scale) (Hill et al., 2016);
- Sport Motivation Scale - SMS (Sport Motivation Scale) (Pelletier et al., 2013; Wlaczak and Tomczak, 2019).

11.5 The process of making decisions about returning to sport

Thanks to the development of neuroscience, we are learning more and more about the mechanisms of the mind. Research shows that the feelings a person has about their body are made up of the body's physical state, mood, and emotional state to a similar extent. Therefore, when considering the best post-traumatic rehabilitation plan, it is necessary to consider not only the clinical examination result and the pattern of physical symptoms, but also the patient's cognitive, emotional, and behavioural responses (Craig, 2009).

The decision to return to sport after an injury should take into account the patient's clinical condition, mental state, and short- and long-term sports goals. When making such a decision, you always try to find a balance between the athlete's health and his effectiveness in the field. Unfortunately, this is always fraught with risk. Returning too early may have negative consequences for the athlete's health (e.g. re-injury), being too cautious and delaying the decision to return can eliminate the athlete from important competitions and cause them to lose their position in the team (Mayer et al., 2020). The decision to return to sport is usually supported by the opinions of several people. An important voice belongs to a medical doctor and a physiotherapist, but the opinion of a psychologist, trainer, and the closest environment of the athlete is also important. However, it is the athlete himself who makes the final decision. At this point, education about the nature of the injury and its consequences is very important, because research shows that athletes often neglect long-term health prognosis and decide to return to the game as soon as possible for short-term sporting success (Schnell et al., 2014). It is usually easy for athletes to make the decision to return to play too early when a risk-reducing factor is available to them. This may be a cue to wear a stabilizer for the duration of the activity, or to be active at less than 100%, possibly playing until it hurts, *"you can get off the field at any time, someone will replace you"* (Huber et al., 2009). Considering the athlete's well-being, it is desirable that the decision to return to sport is made more consciously, based on a thorough health and risk analysis. Normative tools such as StaRRT can help in this.

The Strategic Assessment of Risk and Risk Tolerance (StARRT) strategy was created to facilitate the decision to return to sport after a musculoskeletal injury (Shrier, 2015). The starting point for the creation of StaRRT was the return-to-sport decision-making model published in 2010 by Creighton et al. In this model, the decision process was based on the analysis of three groups of factors: medical factors, sports factors that may modify the risk associated with returning to sports, and factors modifying the decision to return to sports. In the StaRRT, the way of looking at the problem has changed a bit. The StaRRT assessment assumes that the decision to return to sport should be based on an assessment of the risk associated with this return and comparing it with risk tolerance. If the risk assessment is higher than the risk tolerance, a decision should be made to postpone the return to sport. In the first stage of the assessment according to the StaRRT model, it is estimated from the available information what load can be applied to the athlete's body before it is damaged. The tissue damaged in a sports injury should have optimal conditions for healing. Any stress on the tissue can interfere with the healing process. Therefore, the next step in the StaRRT model is to assess how the stresses of the planned sports activity may affect the risk of re-injury. The psychological readiness of the athlete is also considered at this stage of the return to sport decision process. In the last, third step of deciding to return to sport, the threshold of acceptable risk should be determined. This is not an easy task, because the risk acceptance threshold is highly subjective and largely depends on the athlete's personality traits and the values that guide the community that surrounds the athlete. For example, from a medical point of view, it can be determined that returning to sport is beneficial if the risk of re-injury is no more than 10%. But if an athlete has a vision of not competing in the Olympics and is at risk of depression because of it, the acceptable risk of re-injury can be raised to 15 or even 20%. The structure of the risk assessment and risk tolerance strategy is shown in Figure 1 below.

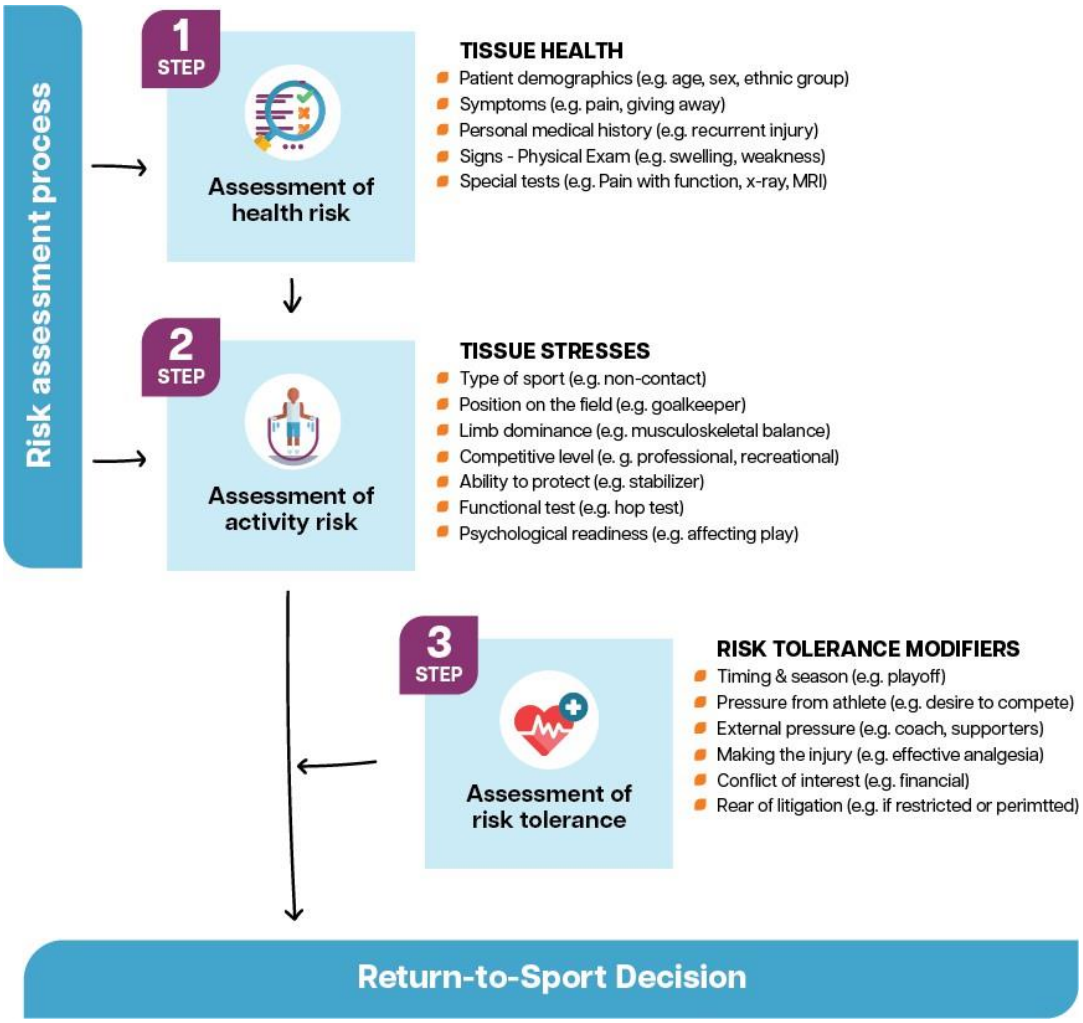

Figure 1 Strategic Assessment of Risk and Risk Tolerance framework, reproduced from Shrier, I. (2015). Strategic Assessment of Risk and Risk Tolerance (StARRT) framework for return-to-play decision-making. British journal of sports medicine, 49(20), 1311-1315.

11.5.1 The decision-making process for returning to sport

The decision-making process for returning to sport will be shown using the example of the athlete after ACL reconstruction, so a brief reminder is given below about the structure of the knee joint and the basic clinical tests that examine this joint (especially ligament and meniscus tests, as these are the structures that are most often damaged in sports injuries).

Structure of the knee joint

The knee joint is the largest and most commonly injured joint. Basic information on the structure of this joint and the ligaments that stabilise it is included in the table below.

Table 19. Characteristics of the knee joint (own elaboration based on Bochenek and Reicher, 2002)

Knee joint		
Joint surfaces	Convex surface	Condyles of the femur
	Concave surface	Tibial condyles
Mobility	Flexion - Upright	Maximum flexion is about 130 º of active flexion and about 160 º of passive flexion until the heel touches the buttock. At full extension, the shank and thigh are in alignment
	External rotation - Internal rotation	The range of outward rotation is greater than the range of inward rotation and varies with the degree of flexion of the knee joint. Rotation of the knee joint is not possible at full extension
Denervation	Nerve branches from the femoral, tibial, common fibula and obturator nerve	
Meniscus	Medial malleolus	Longer, wider, less curved, more firmly attached and less mobile, therefore much more frequently damaged.
	Lateral meniscus	Shorter, more strongly curved, more annular.
Ligaments	Patellar ligament	Extension of the tendon of the quadriceps muscle of the thigh, running to the tibial tuberosity
	Tibial collateral	From the medial epicondyle of the femur to the proximal end of the tibia on the medial side, inhibits the knee valgus movement
	Sagittal collateral	From the lateral epicondyle of the femur to the lateral surface of the head of the fibula, it inhibits the knee's rotation movement
	Front cross	From the posterior edge of the lateral condyle of the femur to the anterior intercondylar field of the tibia, does not allow the shin to extend forward relative to the thigh
	Rear cross	From medial femoral condyle to posterior tibial intercondylar field, shorter, stronger, steeper than anterior cruciate, does not allow posterior movement of tibia relative to thigh

	Oblique popliteal	From the lateral condyle of the femur to the posterior aspect of the joint capsule, fascia of the popliteus muscle and tendon of the semitendinosus muscle, inhibits over-extension and rotational movements
	Arcuate popliteal	From the lateral condyle of the femur to the posterior aspect of the joint capsule under the popliteal ligament, strengthens the posterior wall of the joint capsule
	Transverse ligament	Connects the anterior horns of the meniscus, tightens with outward rotation of the lower leg

Diagnostic tests

The most commonly used and considered to be the most accurate and reliable clinical tests of the knee joint are described below. The tests should be performed on the injured limb and the healthy limb and the results compared.

Anterior cruciate ligament assessment

Anterior drawer test

The examinee lies on his or her back and the therapist sits on the edge of the recliner on the side of the limb being tested, which is bent at the knee joint to a 90 º angle with the shin rotated outwards and the foot stabilised by the patient's thigh. The test subject tries to relax the muscles as much as possible. The therapist embraces the lower leg of the test limb just below the knee joint with both hands and pulls it forward trying to move it in relation to the thigh. More than 5 mm of forward extension of the lower leg indicates moderate and more than 10 mm indicates severe anterior cruciate ligament damage. Note that the test may be falsified if the posterior cruciate ligament is damaged at the same time.

Figure 2 Anterior drawer test

Lachmann test

The subject lies on their back and the therapist stands next to the recliner on the side of the lower limb being tested. The therapist stabilises the thigh from the ventral side with one hand, stabilises the lower leg from the dorsal side with the other hand and bends the test knee to an angle of approx. 15-30 °. The therapist then attempts to extend the shin forward relative to the thigh. Damage to the anterior cruciate ligament is indicated by forward extension of the shin by more than 5 mm and soft end resistance. The subject should relax the muscles as much as possible during the test.

Figure 3 Lachmann test

Pivot-shift test

The test subject lies on their back and the therapist stands next to the recliner on the side of the lower limb being tested. The therapist places one hand on the dorsal side of the knee joint palpating the anterior edge of the tibia, while the other hand embraces the subject's foot. The therapist then internally rotates and slightly valgus the lower leg of the test limb then, maintaining this position, straightens and flexes the knee. Anterior cruciate ligament damage is evidenced by anterior displacement of the shin in the knee extension position. When the knee is flexed, the patellofemoral band pulls the tibia back to its original position.

Figure 4 Pivot-shift test

Evaluation of the posterior cruciate ligament

Gravity drop test

The subject lies on their back and the therapist stands next to the recliner on the side of the lower limb being tested. The therapist flexes the test limb to a 90o angle at the hip and knee with one hand supporting the foot, the other hand holding the lower leg just below the knee joint. The therapist then takes the hand away from the knee area and observes if the tibia drops and the contour of the knee joint changes. This reaction is indicative of damage to the posterior cruciate ligament.

Figure 4 Gravity drop test

Back drop test

The client lies on their back and the therapist stands next to the couch on the side of the lower limb which is bent at the hip and knee with the foot resting on the surface of the couch. The test person tries to relax the muscles as much as possible. In the case of a posterior cruciate ligament injury, the proximal end of the lower leg drops under the influence of gravity and a posterior drawer sign is seen.

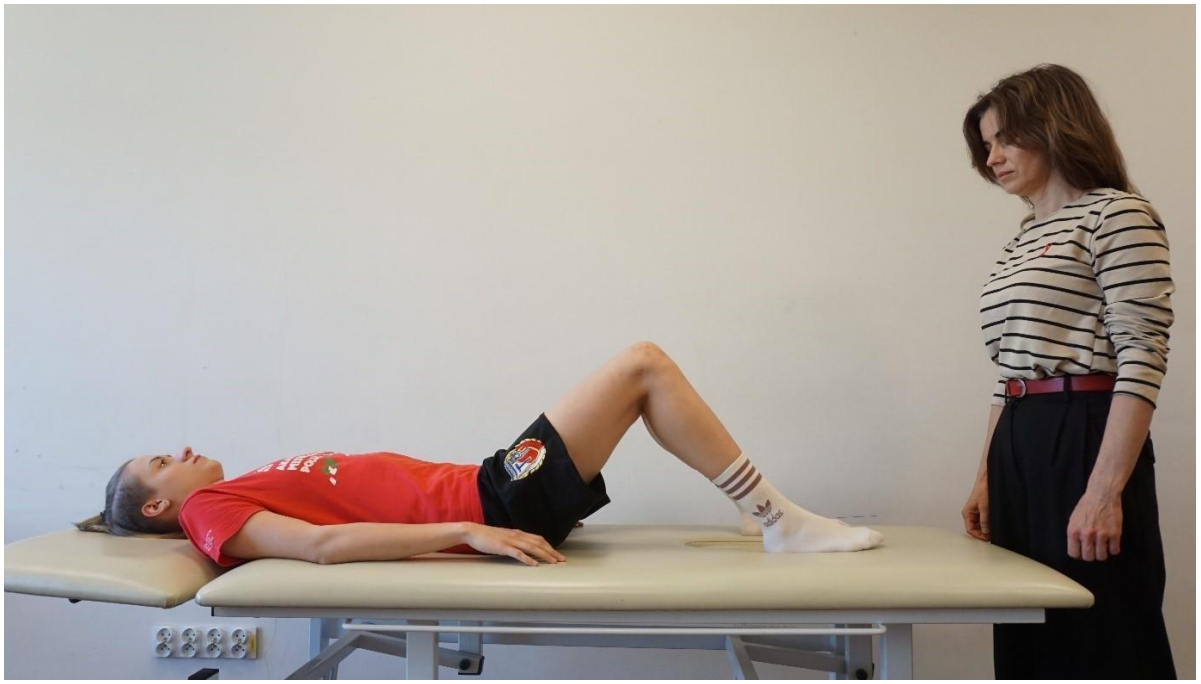

Figure 5 Back drop test

Evaluation of knee joint stability

External rotation and hyperextension test

The client lies on their back and the therapist stands next to the couch at the client's feet. The test person tries to relax the muscles as much as possible. Hold the forefoot and lift both feet slightly above the surface of the couch. Knee flexion with simultaneous external rotation of the shin in response to foot elevation is indicative of posterolateral instability and may be due to failure of the knee capsule in this area, damage to the anterior or posterior cruciate ligament, failure of the popliteal ligament, fibular collateral ligament, damage to the tendon of the biceps femoris muscle or the iliotibial band.

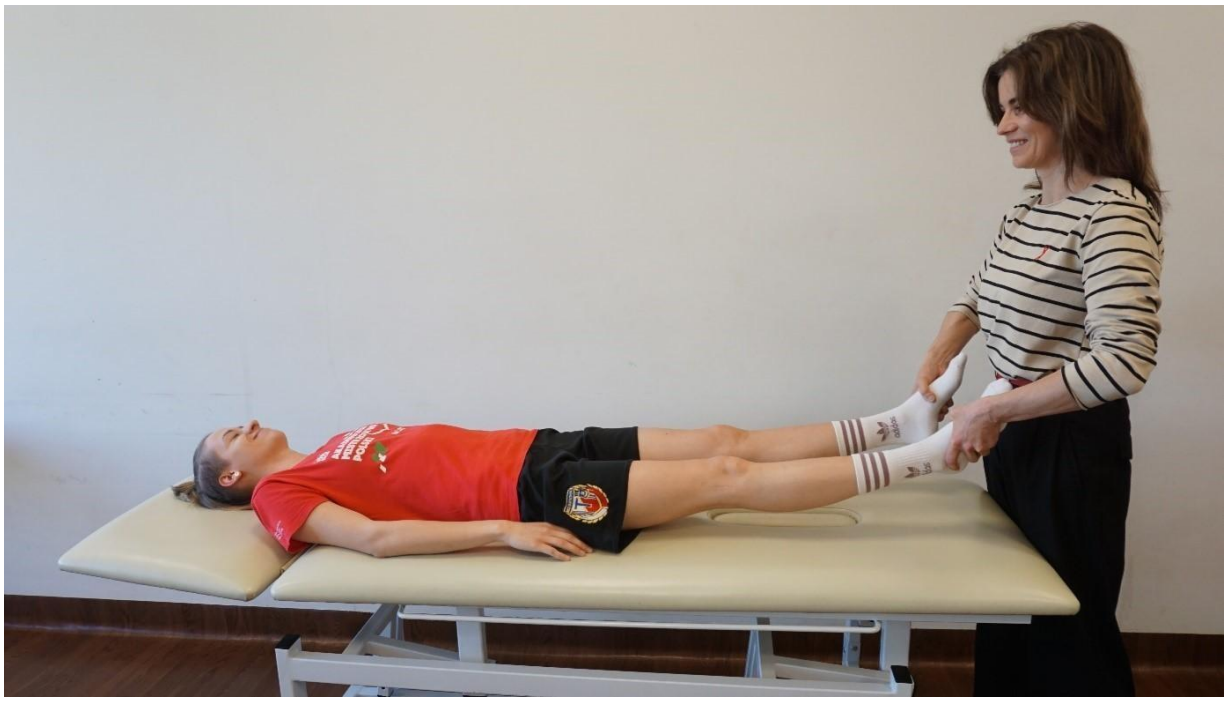

Figure 6 External rotation and hyperextension test

Valgus stress test and varus test

The test subject lies on their back and the therapist stands next to the recliner on the side of the lower limb being tested. Placing one hand on the proximal and the other on the distal part of the lower leg, the therapist tries to position the test limb first in valgus and then in talus of the knee joint. A positive valgus sign indicates damage to the tibial collateral ligament and medial instability of the knee joint, while a positive patellar sign indicates damage to the fibular collateral ligament and lateral instability.

Figure 7 Valgus stress test

Figure 8 Varus test

Meniscus evaluation

Bragard test

The subject lies on their back and the therapist stands next to the couch on the side of the lower limb being tested. The therapist bends the test limb to a 90o angle at the hip and knee joint with one hand supporting the foot, placing the other hand on the knee joint so that the thumb and index finger can feel the lateral and medial part of the joint crevice. The therapist then straightens the knee under examination with the shin in external rotation, to then repeat the same manoeuvre with the shin in internal rotation. Pain over the medial aspect of the knee joint talus that occurs when the knee is straightened with the shin in external rotation indicates

a medial meniscus injury. Pain over the lateral aspect of the knee joint talus that occurs when straightening the knee with the lower leg in internal rotation is indicative of a lateral meniscus injury.

Figure 27 Bragard test for the medial meniscus

Figure 10. Bragard test for the lateral meniscus

McMurray test

The test subject lies on their back and the therapist stands next to the recliner on the side of the lower limb being tested. The therapist supports the foot with one hand, places the other hand on the knee joint and flexes the test limb as far as possible at the hip and knee joint. The therapist then rotates the shin outwards and straightens the knee to a 90o angle, bends the knee again, rotates the shin inwards and straightens again to a 90o angle. If the posterior horn of the medial meniscus is damaged, pain occurs during straightening with external rotation of the shin. If the posterior horn of the lateral meniscus is damaged, pain occurs during straightening with internal rotation of the shin.

Figure 11 McMurray test for the medial meniscus

Figure 12 McMurray test for the lateral meniscus

Childress symptom

The examinee stands, the therapist stands next to him and observes his reactions. The examinee tries to perform a full squat and take several steps in each direction in this position. If the posterior horns of the meniscus are damaged, the examinee cannot assume a full squat position and/or take squat steps due to pain. Pain during the performance of this test may also result from increased osteoarthritis of the knee joint.

Figure 13 Childress symptom

Payra's sign

The subject sits in a cross-legged position. The therapist places his hands on the inner surface of the subject's knee joints and presses towards the ground. The examinee feels pain if the posterior horns of the medial meniscus, which are compressed in the cross-legged sitting position due to knee joint flexion and external rotation of the lower extremities, are damaged.

Figure 14 Parya's sign

Knee joint tenderness test

The client lies on their back and the therapist sits on the edge of the couch on the side of the lower limb being tested. The test limb is bent at the hip and knee and the foot is supported on the surface of the couch. The therapist holds the knee with one hand, stabilising the thumb and index finger on the medial and lateral malleolus, and the other hand grips the subject's foot. When examining the medial meniscus, the therapist rotates the shin outwards and tries to gently push the finger into the medial side of the knee joint crevice. When examining the lateral meniscus, the therapist rotates the shin inwards and tries to gently push the finger into the knee joint crevice on the lateral side.

Figure 15 Knee joint talar tenderness test for the medial meniscus

Figure 16 Knee joint tenderness test for the lateral meniscus

Lower limb dynamic tests

The tests presented below are designed to check whether an athlete after an injury and ACL reconstruction is ready to return to sport. To ensure the athlete's safety, you need to know that he is not in pain, has no signs of inflammation, no feeling of knee instability, or any visible compensation. The therapist should be sure that the athlete is prepared to perform the

exercises that are part of the tests, has adequate muscle strength and range of motion, has performed agility, running and plyometric exercises with you, and tolerates them well.

10 Single Leg Squats Test

The athlete's task is to perform 10 squats on one leg. The bending angle of the knee must be a minimum of 60°. The task is passed if the athlete efficiently performs 10 squats without any problem, loss of balance, or pain. It is required that the knee moves in alignment and does not deviate into valgus or varus. The athlete performs the test for both lower limbs.

Figure 17 Single Leg Squats Test

Single Leg Forward Hop Test

The athlete stands on the marked line and, starting from a single-legged position, performs a long jump as far as possible, landing on the same foot. After landing, the athlete should maintain balance. The test is performed on both legs. The task is passed if the distance of the jump landed on the involved leg is at least 90% of the result for the uninvolved leg.

Figure 18 Single Leg Forward Hop Test

Single Leg Triple Hop Test

The athlete stands on the marked line and, starting from a single-legged position, performs three long jumps in direct succession, as far as possible, and lands on the same foot each time. After landing, the athlete should maintain balance. The test is performed on both legs. The task is passed if the distance of the jump landed on the involved leg is at least 90% of the result for the uninvolved leg.

Figure 19 Single Leg Triple Hop Test

Timed 6-meter Single Leg Hop Test

The athlete stands on one foot on the marked line and jumps as fast as possible landing on the same foot to the line 6 meters away. The athlete should maintain balance during the test. The task is passed if the time taken to cover 6 meters while jumping on the involved and uninvolved leg differs by no more than 10%.

Figure 20 Timed 6-meter Single Leg Hop Test

Single Leg Triple Crossover Hop Test

The athlete stands on one leg on a marked line and performs three jumps forward and diagonally medially at a 45° angle as far as possible, landing on the same foot each time. After landing, the athlete should maintain balance. The task is passed if the distance of the jump landed on the involved leg is at least 90% of the result for the uninvolved leg.

Figure 21 Single Leg Triple Crossover Hop Test

Single Leg Lateral Hop Test

The athlete stands with one foot on the marked line and jumps to the side as far as possible landing on the same leg. After landing, the athlete should maintain balance. The task is passed if the distance of the jump landed on the involved leg is at least 90% of the result for the uninvolved leg.

Figure 22 Single Leg Lateral Hop Test

Single Leg Medial Hop Test

The athlete stands with one foot on the marked line and jumps medially as far as possible landing on the same leg. After landing, the athlete should maintain balance. The task is passed if the distance of the jump landed on the involved limb is at least 90% of the result for the uninvolved limb.

Figure 23 Single Leg Medial Hop Test

Single Leg Lateral Rotating Hop Test

The athlete stands on the marked line on one foot, jumps up, while rotating sideways in the air, and lands on the same leg. After landing, the athlete should maintain balance. The task is passed if the athlete is able to perform at least 90% of the rotation obtained on the uninvolved leg while jumping on the involved leg.

Figure 24 Single Leg Lateral Rotating Hop Test

Single Leg Medial Rotating Hop Test

The athlete stands on the marked line on one foot, jumps up while rotating medially in the air, and lands on the same leg. After landing, the athlete should maintain balance. The task is passed if the athlete is able to perform at least 90% of the rotation obtained on the uninvolved leg while jumping on the involved leg.

Figure 25 Single Leg Medial Rotating Hop Test

Single Leg Vertical Hop Test

The athlete stands on one foot and, raising his hand on the same side of the body, jumps up trying to reach as high as possible. The result is the height the athlete reached with his fingertips. The task is passed if the jump height on the involved leg is at least 90% of the jump height on the uninvolved leg.

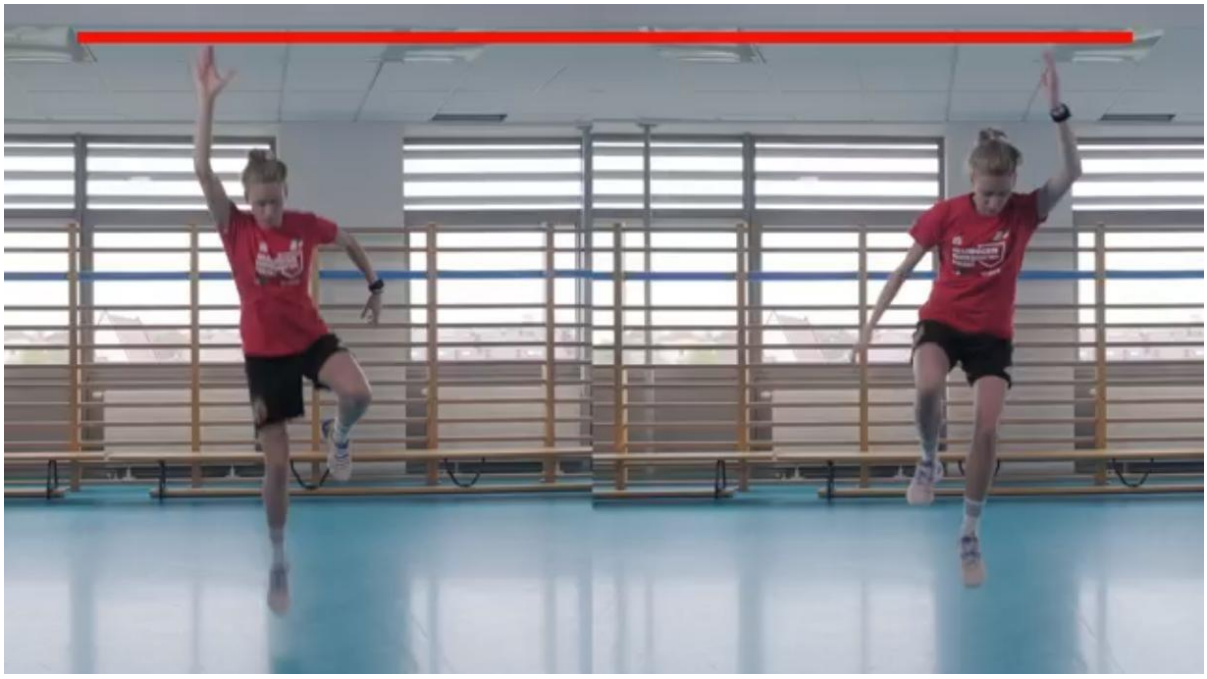

Figure 26 Single Leg Vertical Hop Test

Edgren Side-Step Test (ESST)

Five parallel lines should be stuck on the ground, spaced 1 meter apart, so that the distance between the extreme lines is 4 meters. The athlete stands on the outside of the left-most stuck line and, on the signal, begins to walk towards the right-most line, crosses it with both feet, and changes the direction of movement. The athlete tries to cover as much distance as possible in 10 seconds. The result is the number of 1-meter sections covered. The task is failed if the athlete does not cross the extreme line with the inside foot, crosses the legs or moves forward instead of to the side.

Figure 27 Edgren Side-Step Test

To sum up, it should not be forgotten how important is to ascertain the athlete's readiness to return to play before testing is carried out. According to the attending physician, can the athlete be tested if the muscle strength and range of motion are correct, the athlete does not feel pain at rest and during movement, there is no swelling and other disturbing symptoms, and the gait and run are normal, i.e., without pain, feeling of instability, compensation. It has not been clearly defined how many tests should be carried out, but it is important that they are not just tests consisting of forward jumps. Tests involving jumps to the side, medial, and with rotations may turn out to be crucial. The psychological readiness of the athlete is also important. It must not be forgotten that returning to sport is not the same as returning to competition. The competition requires tolerating full training sessions with opponents and contact (if the discipline requires it, e.g, judo).

In the Table below you can see what to look out for in the decision-making process regarding an athlete's return to play after injury.

Table 10 Criteria for making decisions about returning to sport after an injury (own elaboration based on the example: https://www.evolutionphysicaltherapy.com/post/acl-return-to-sport-testing-what-your-pt-should-look-at-before -clearing-you-to-return-to-sport/)

What should you measure	Why it's worth knowing	What result do you expect	How can you measure it
time since injury	you need to make sure that the tissues have had enough time to recover	depending on the type of injury, e.g. min. 9 months after ACL reconstruction	analysis of the athlete's medical history

symmetry of muscle strength of the right and left sides of the body	muscle strength asymmetry is strongly correlated with secondary injuries, symmetrical muscle strength is essential for proper movement technique / correct movement patterns	>90% symmetry	manual assessment of muscle strength, dynamometer, Biodex device or similar
muscle endurance	essential in running and many sports with repetitive movement patterns	satisfactory muscular endurance and >90% symmetry	adequate functional tests (e.g. toe raises for calf muscles), dynamometer, Biodex devices
range of motion	the correct range of motion reduces the risk of injury, allows to perform the correct movement without compensation, and generate maximum force	100% of the norm	goniometr
symmetry in dynamic tests, e.g., hop tests	using these tests, you will assess explosive strength power, dynamic balance and landing mechanism, the asymmetry of these elements in the involved and uninvolved limb is strongly correlated with secondary injury	>90% symmetry	adequate tests e.g. those contained in the e-manual
athlete's readiness to return to the game	strongly correlated with the risk of secondary injury	interpretation consistent with the recommendations for a specific scale or questionnaire	validated scales and questionnaires, you can use those proposed in the lesson or in the e-manual

In the process of assessing an athlete's readiness to return to sport after an ACL injury, you can use the gptpw examination protocol available at: https://www.melbourneaclguide.com/docs/ACL_Guide.pdf (access date: 21.04.2024)

It should be remembered that the primary task of the physiotherapist and the entire medical care team, the coach and the athlete himself is to prevent injury, to prevent the injury that has occurred from worsening and/or the appearance of another injury as a consequence of the primary injury (Meeuwisse et al., 2007).

Klügl et al. (2010) list three sports injury prevention strategies, which are related to:

- training, which should include full professional preparation, including attention to muscle strength, endurance and flexibility, level of coordination and balance, as well as discipline - specific technical skills;

- equipment and the organization of the athlete's environment, i.e. attention to the quality and fit of the athlete's footwear and clothing (including protective elements of sportswear), sports equipment, but also the proper preparation of the ground and the environment in which training and competitions take place;

- regulations, which should adequately govern the rules (including ethical rules) for the discipline.

Rehabilitation on the playing field

It should be remembered that one of the key elements of post-injury rehabilitation, which should by no means be overlooked, is rehabilitation on the field. This is the stage that combines rehabilitation in the gym or physiotherapy office with a full return to training and competition. Buckthrope et al (2019) described four pillars underlying this stage of rehabilitation. These include restoration of movement quality, improvement of physical fitness, re-education of movement patterns specific to the sport, and gradual introduction of full training load.

Rehabilitation after ACL reconstruction usually takes about 6 months, during which the athlete significantly improves muscle strength, joint range of motion, balance and coordination. Gym exercises, however, do not allow, for obvious reasons, to reproduce the conditions specific to a football player's normal training and match load. During the 90 minutes of a match, a soccer player covers up to 13 km running at varying speeds, often makes dynamic turns and stops, and quickly and often automatically decides on the next move while reacting to situations and the behavior of other players (Bangsbo, 1994). Lack of preparation for this load may partly explain the fact that 7% of football players experience a re-torn ACL less than 3 months after returning to play (Waldén et al., 2016).

Rehabilitation on the field should include individual training of technical skills, training with the ball in small groups and finally playing with the whole team. It is important to overtrain the technical elements of the game under the "pressure" of the real situation (unpredictable situations, real speed, interaction). New activities should be introduced gradually, giving the player as much time as he needs.

Stage 0: Assesment of the player's readiness

Safe training on the pitch requires the athlete to have no knee swelling, no pain, a feeling of knee instability, good knee stability and adequate range of motion in the joint where ACL regeneration has taken place, and symmetrical muscle strenght in both lower limbs.

Stage 1: Linear movement

The athlete performs one-way running tasks (forward and sideways) at a self-selected speed. It is imporant that the athlete introduces accelerations and decelerations of movement and control them well.

Stage 2: Multidirectional movement

The player performs tunning tasks in multidirectional movement with maximum or sub-maximum speed, also performs simple football drills such as dribbling, passing, etc.

Stage 3: Training of specific technical skills

At this stage, the athlete improves agility through reactive movements with decision-making in response to the changing situation on the pitch, but also gradually increases the training load to improve cardiorespiratory fitness.

Stage 4: Training of specific movement patterns

The player moves on to more intesive training with the team, including controlled contact training to gain confidence.

Stage 5: Simulation of full training

The athlete gradually returns to normal training, e.g. warm-ups or technical skills training for the whole team, takes part in modified training sessions as needed and gets used again to the full physical, technical and psychological workload of the discipline.

Figure 28 Stages of rehabilitation on the field (own elaboration based on Buckthrope et al., 2019):

The athlete should remember that spending the rehabilitation period in the gym or on the playing field is not a failure, but a result of reason and is intended to make the athlete safer and less likely to re-injure himself. In managing the pace of rehabilitation and motivating the player to persevere in the rehabilitation process, a well-trained physiotherapist, familiar with the specifics of soccer, who accompanies the player also during rehabilitation on the field, plays a huge role.

Intercultural communication recommendations

- Physiotherapists should educate themselves about the patient's cultural background, particularly regarding attitudes towards sports, achievement, and teamwork. Understanding these cultural nuances can help tailor the communication approach appropriately.
- Take the time to build a trusting relationship with the patient. Acknowledge their dedication to sports and their team, showing empathy for the impact the injury has on their identity and aspirations.

- Practice active listening to understand the patient's emotional state, concerns, and goals related to their sports involvement. Allow them to express their feelings without judgment or interruption.

- Validate the patient's emotions and the significance of sports in their life. Acknowledge their feelings of loss, frustration, or disappointment due to the injury's impact on their ability to play professionally.

- While maintaining empathy, provide realistic expectations about the recovery process and the possibility of returning to professional basketball. Help the patient understand the importance of prioritizing their health and well-being over immediate sports participation.

- Explore alternative avenues for the patient to remain involved in sports or contribute to their team in different capacities, such as coaching, mentoring, or sports administration. Emphasize the value of their experience and expertise beyond playing on the court.

- Suggest the option of seeking psychological support or counselling to cope with the emotional impact of the injury and transition away from professional sports.

- Emphasize the importance of physiotherapy and rehabilitation in achieving the best possible recovery outcomes. Provide personalized treatment plans tailored to the patient's needs and goals, considering their cultural attitudes towards health and wellness.

- Involve the patient in the decision-making process regarding their treatment plan and rehabilitation goals. Encourage them to take an active role in their recovery journey, empowering them to make informed choices about their health.

Recommendations typical for Polish culture

- In Poland family is extremely important. Every important event in a young person’s life is usually widely discussed by family members. The final decision regarding the event or issue, while taken by the young person, is expected to comply with the advice received from parents.

- In the Polish context of healthcare the doctor and/or the therapist advise the patient, showing various options, but it is the patient who must make the decision which option/treatment he/she will undergo. It may happen (as it is shown in the video) that he opinions of the members of the therapeutic team differ significantly.

- Sportspeople are considered to be both physically and emotionally strong, which puts pressure on an individual sportsperson who wants to live up to the expectations. They are likely to take decisions to benefit the team, even if their health may suffer because of them.

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12 ASSESSMENT OF PHYSICAL FITNESS OF ADULTS WITH INTELLECTUAL DISABILITIES AND THEIR SUPPORT IN UNDERTAKING PHYSICAL ACTIVITY

Marta Bibro

12.1 The concept of intellectual disability

The concept of intellectual disability and its definitions have been functioning in the literature for a relatively short time. It replaced such terms as: "retarded", "special needs", "disease", "handicapped", or "mentally handicapped". The concept of "intellectual disability" is included in both the classification of the American Association on Intellectual and Developmental Disabilities [AAIDD]) and The Diagnostic and Statistical Manual of Mental Disorders [DSM-5]) issued under the aegis of the American Psychiatric Association [APA]) (American Psychiatric Association, 2022; Schalock & wsp., 2010). In the latest edition of the International Classification of Diseases 11th Revision, the concept of mental retardation has been replaced by intellectual development disorders. This classification was approved by the World Health Organisation on January 1, 2022 and is gradually being introduced by more countries (World Health Organisation, 2022).

To diagnose intellectual development disorders, it is necessary to confirm:

1. significant limitations in intellectual functioning in various domains such as perceptual reasoning, working memory, processing speed, and verbal comprehension. If possible, scores should be measured using appropriately standardized, standardized tests of intellectual functioning and concluded that scores are approximately 2 or more standard deviations below the mean (i.e., less than the 2.3th percentile).

2. significant limitations in adaptive behaviours, which refer to a set of conceptual, social, and practical skills that people have learned and use in their daily lives.

3. onset occurs during the developmental period (K. Lee et al., 2024).

12.2 The concept of physical fitness

One of the key elements of planning and implementing activities in the field of sport, physical education and rehabilitation is the assessment of physical fitness. It is particularly important when working with people with various forms of disability. The results obtained during the

procedure allow for safe and effective planning of further actions and correction and modification of rehabilitation procedures.

The concept of physical fitness is understood as "the entirety of human abilities and skills enabling the effective performance of all motor tasks" (Szopa et al., 2000). Such broadly understood fitness of the body consists of, among others, such elements as cardiorespiratory efficiency, muscle strength and endurance, body composition, flexibility, balance, agility, coordination, reaction time and power. Physical fitness is often associated with the ability to achieve high performance in sports and in areas that require motor skills. However, a certain level of physical fitness is primarily one of the factors determining effective performance in the environment, it allows you to perform daily activities effectively, safely and with the least possible effort, and also allows you to stay healthy.

Among the numerous theories concerning physical fitness, the concept of Health-Related Fitness (H-RF) deserves special attention in the context of people with disabilities. According to it, the goal of physical fitness is "positive health that determines a low risk of health problems. Achievements, on the other hand, are aimed at the ability to engage in everyday tasks with adequate energy and satisfying participation in the sports of their choice."(Howley & Franks, 1997). The authors of this concept understand physical fitness in a multidimensional way, taking into account the components whose maintenance at an appropriate level determines good health, good physical condition and well-being. They include five groups:

1. Morphological efficiency

- BMI (Body Mass Index),
- fat distribution,
- bone mineral density.

2. Musculoskeletal fitness

- muscle strength and endurance,
- flexibility.

3. Motor skills

- posture control (balance, coordination, mental control and neuromuscular speed)

4. Cardiorespiratory fitness

- submaximal exercise capacity and endurance,

- oxygen supply system,
- resynteza ATP,
- thermoregulatory processes,
- VO2max (maximum minute oxygen uptake).

5. Metabolic efficiency

- lipid metabolism,
- carbohydrate metabolism,
- the endocrine system (e.g. insulin).

12.3 Assessment of physical fitness of persons with intellectual disabilities

The assessment of individual components of physical fitness is important in each period of ontogeny. The results obtained allow, among other things, the use of appropriate forms of activity and modification of loads. The basis for the assessment of physical fitness are functional sphere tests. Their correct selection and execution are of key importance.

The assessment of physical fitness of people with disabilities, including intellectual disabilities, is a complex process and requires special attention and an individual approach. The choice of test, its difficulty, as well as the instruction must be adapted to the physical and cognitive abilities of a person with intellectual disabilities. Incorrect test selection may result in drop-out or incorrect results. The maximum commitment and motivation of the examined person is also important. It is worth focusing on the assessment of those parameters that are important in the daily functioning of a person with intellectual disabilities. The tests should be preceded by basic anthropometric measurements, measurement of height, body weight and calculation of the BMI index. Its value is obtained by converting the quotient of body weight to the square of the body height expressed in meters (kg/m2).

$$BMI = \frac{body\ weight\ [kg]}{body\ height\ [m]^2}$$

Next, the following should be assessed: coordination, balance, muscle strength and endurance, flexibility and cardiorespiratory capacity.

Due to the large diversity of the group of people with intellectual disabilities, there is no homogeneous, generally accepted procedure. Each person should be treated individually, with respect for their emotional state, cognitive abilities, temperament and personality. Ensuring maximum comfort and safety will allow the tested people to present their maximum capabilities. For this purpose, the subjects should be dressed in comfortable sports clothes, and the trials should be preceded by a short warm-up. Particular attention should be paid to safe, sports footwear, although it is not required in all trials. It is worth remembering that people with a more severe degree of disability are often emotionally very close to the caregiver and explaining important issues to them is also very important. Sometimes the involvement of the caregiver and their help in conducting the examination is very helpful. Among the recommended tests, you can choose:

1. The Eurofit Special test battery,

consisting of six attempts: explosive leg strength (standing broad jump test), arm strength (pushing a 2 kg ball test), abdominal muscle endurance (sit-up test), speed (25 meter run test), flexibility (sit and reach test), and balance (walk on a bench test) (Skowronski et al., 2009).

4. **The standing broad jump test**

This test assesses the explosive power of the lower limbs. The subject, standing with both legs in front of the line of rebound, performs a squat with a swing of the arms backwards and jumps as far as possible with a swing of the arms forward. The practitioner's feet are bare. Landing occurs with both legs without losing balance. Two trial jumps and two evaluated jumps are performed. The distance from the starting line to the point of contact of the posterior edge of the heel with the ground was measured. If the heels of the feet were not at the same level – the distance was measured from the point closer to the starting line. The measurement is made with an accuracy of cm.

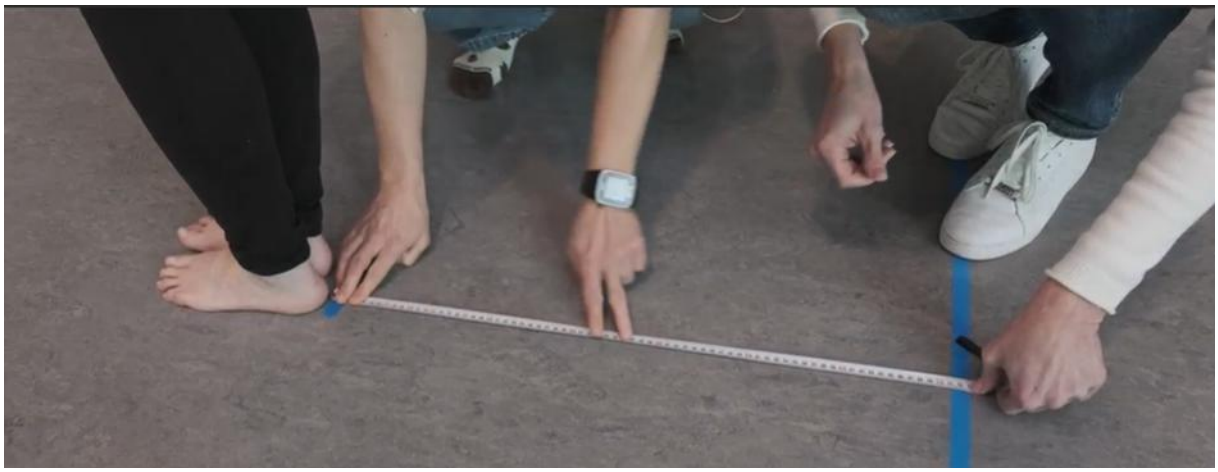

Figure 1 Measuring the result of the standing long jump test

2. **The sit-up test**

The test measures the endurance of the abdominal muscles and hip flexors. The patient lies with his back to his back, his lower limbs bent at the knee joints at an angle of about 90^0, his shoulders on the back of his neck. Then the patient bends the torso forward, touching the knees with the elbows and straightening the torso to the position of lying backwards. The exercise time is 30 seconds, only bends made according to the instructions are counted, the measurement is performed only once.

Figure 2 Performing a forward bend of the torso from lying backwards with the lower limbs bent

3. **The sit and reach test**

Flexibility measurement is carried out using a measuring table with a scaled top. The table top protrudes beyond the zero point – foot touches – 30 cm. The result is read with an accuracy of 1 cm. The test consists in leaning the torso from a straight position and slowly moving the fingers as far as possible along the bench, while keeping the lower limbs straight. The result is recorded at the moment of taking the stationary farthest position. The test is performed barefoot. The first bend is a trial, the second, performed after a short break, is evaluated. The result is the length of the bend measured in cm.

Figure 3 Flexibility measurement

5. **25 meter run test**

The test evaluates speed. The test is performed on a sports field or hall. The start and finish places should be clearly marked. The loud command "READY" is in force and then the starting signal is followed by a whistle. The run is performed from a high start, in sports shoes. Time measured with an accuracy of 0.01 s.

3. **Pushing a 2 kg ball test**

The test assesses upper limb strength and coordination. The thrust is performed with the stronger upper limb. The subject stands in a lunge with the lower limb opposite to the upper limb performing the thrust. The ball is rested on the palm of the hand, supported by the other hand. The subject dynamically straightens the upper limb with simultaneous forward movement of the torso so as to push the ball as far as possible. The ball is to be pushed, not thrown, the feet should be in constant contact with the ground, the line of throw must not be crossed. The distance is measured with an accuracy of 1 cm, from the place where the ball falls to the line of the designated throw. We make the attempt twice; we take into account the better result.

5. **Walk on a bench test**

The test assesses dynamic balance and is carried out on a gymnastic bench /test A/ and, if possible, the exerciser on an inverted bench /test B/.

Trial A – The subject stands without sports shoes in front of a line 2 m away from the edge of the bench, approaches the bench on his/her own, climbs on it and moves around it (without supporting himself or putting his feet on the floor).

Trial B – Is carried out when test A has been successful, according to the same rules, with the bench turned upside down; The transition is made on the narrow side of the skirting board.

The duration of the trial should not be longer than 30s.

The evaluation consists in awarding contractual points:

1 point – failure to perform the test attempt

2 points – approach to the bench

3 points – walking a 2 m section on the bench or with support along the entire bench

4 points – passage without support along the entire bench (attempt A)

5 points – walking a 2 m section on an inverted bench or with support along the entire bench

6 points – passage without support to the end of the inverted bench (attempt B)

Figure 4 Walking on a gymnastic bench in a high position (A trial, B trial)

2. Functional Reach Test

This test is used to assess dynamic equilibrium and the risk of falls. The subject stands sideways to the wall, the pelvis touches the wall, and the upper limb proximal to the wall is bent at the glenohumeral joint to 90^0. On the wall, the point where the selected finger is located is marked. We measure the distance at which the patient will lean forward, with the pelvis stabilized and the feet remaining stationary in contact with the ground. The test is performed twice, we record the better result, with an accuracy of 1 cm (Duncan et al., 1990).

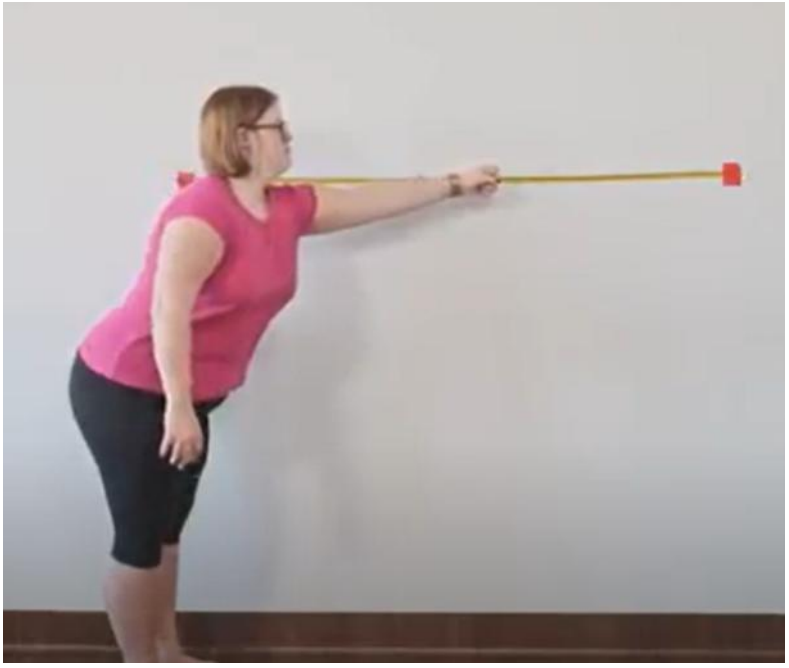

Figure 5 Performing the reach test

Interpretation of results:

Hand extension ≥ 25 cm – low risk of falls

Extending the arm from 15 to 25 cm – the risk of falls is doubled

Arm extension < 15cm – risk of falls increased fourfold

Inability to complete a task or reluctance to perform a task - the risk of falls increased eightfold (Bac et al., 2022)

3. Single Leg Stance test (SLS)

The test is used to assess static equilibrium. The test is performed on any limb chosen by the subject. The patient stands barefoot, one lower limb bent, raised (not supported by the other limb), upper limbs crossed on the chest. The test is performed with the eyes open, then with the eyes closed. In the open-eye test, the subject is asked to concentrate on one point on the wall at eye level. With the help of a stopwatch, we measure the time from the moment of lifting

the lower limb to the moment of: re-contact of the foot with the ground or support against the other limb, use of the upper limbs to maintain balance or open the eyes when trying with eyes closed. The attempt is also completed when the time of 45 seconds is exceeded. Each attempt is made twice, we record a better result (Oppewal & Hilgenkamp, 2020; Springer et al., 2007)

Table 1 Interpreting the Single-Leg Test (Bac et al., 2022):

AGE	ONE-KNIFE STANDING EYES OPEN [s]	STANDING ONE-KNIFE EYES CLOSED [s]
18 – 39	43,3	9,4
40 – 49	40,3	7,3
50 – 59	37,0	4,8
60 – 69	26,9	2,8
70 – 79	15,0	2,0
80 - 89	6,2	1,3

4. Hand Grip Strength Test (VIDEO 8)

The measurement is performed by squeezing a hand dynamometer. The test is performed in a standing position, the upper limb along the torso so that the arm and hand do not touch the body during the test, the other limb is lowered freely. The second attempt is performed after a short break, the better result is recorded, Measurements are made for both limbs. To see if the participant is squeezing with maximum effort, the test instructor must look at the contracting muscles of the arm and hand, phalanges, and facial expressions. To understand the task well, the participant can first squeeze a rubber ball (Oppewal & Hilgenkamp, 2020).

5. 30 Second Chair Stand Test (30CST, the 30 Second Sit to Stand Test).

It assesses the strength and endurance of the lower limbs. It is part of the Fullerton functional performance test battery and was originally intended to evaluate the elderly. However, it is also used by adults of all ages, including those with intellectual disabilities (Oppewal & Hilgenkamp, 2020).

The test is carried out on a chair of standard height, without armrests. The chair should be placed against the wall to avoid moving the chair. The subject sits in the middle of the chair, with their back straight and their feet shoulder-width apart. One foot can be extended in front of the other for better balance. The arms are crossed at the chest. Before starting the actual trial, you should demonstrate the performance of the test; Slowly at first, then quickly. Then the test subject should perform several trial repetitions.

Figure 6 Performing the 30-second Chair Stand Test

The task of the examined person is to get up from the chair as many times as possible within 30 seconds. Between each repetition, you should be fully seated in a chair. If the test subject has to use their hands to perform the test, they receive 0 points. Incorrectly performed reps are not counted. Standing up more than half the height at the end of 30 seconds counts as full performance. The number of repetitions below the average predicted for a given age group indicates a high risk of falling.

Table 2 Norms of the average number of repetitions for given age groups (https://www.physio-pedia.com)

age	Men	Women
60-64	14-19	12-17
60-64	12-18	11-16
70-74	12-17	10-15
75-79	11-17	10-15
80-84	10-15	9-14
85-89	8-14	8-13
90-94	7-12	4-11

6. **Five Times Sit to Stand Test**

The Five Times Sit to Stand Test (5x Sit-To-Stand Test) is commonly abbreviated as 5XSST. is used to assess the functional strength of the lower limbs, transitional movements, balance and risk of falling in the elderly.

During the trial, the time (accurate to the decimal part in seconds) is measured for which the subject is able to move from sitting to standing and back to sitting five times.

The test is carried out on a chair of standard height, for safety the chair should be placed with its back to the wall. The subject sits in the middle of the chair, with their back straight and their arms crossed over their chest. The task is to sit down and get up 5 times as quickly as possible. The timing begins when the "start" command is uttered and ends when the subject's buttocks touch the seat of the chair after the last repetition. If you are unable to complete five repetitions without assistance (e.g. upper limbs), you will fail the test, and the test will also end after 2 minutes (Whitney et al., 2005).

The shorter the time to perform the test, the better the test result. In addition, the results of age-matched norms are:

11.4 seconds for 60-69 age groups

12.6 seconds for 70-79 age groups

14.8 seconds for 80-89 age groups (Bohannon, 2006)

7. **6-minute walk test**

The 6-minute walk test is used to determine exercise tolerance.

The test is performed in a corridor of at least 30 meters. The corridor should be little frequented, straight, with a hard, flat surface, equipped with two posts at the beginning and at the end. Prepare a place for possible rest during the test, e.g. a chair. Along the route of the march there should be distance markers placed every 1 meter. Before taking the test, the patient should be rested. The test consists of walking the longest distance possible in 6 minutes. The subject may change pace depending on their abilities, and may also stop if they feel tired or shortness of breath. The subject must not run during the test. It is advisable to motivate the examined person. When interpreting the test result, we take into account the distance covered, arterial oxygen saturation, heart rate, blood pressure, shortness of breath and fatigue on a 10-point modified Borg scale (Nasuti et al., 2013).

In assessing physical fitness, it is important to systematically assess progress. Control tests should always be performed under the same conditions and in the same order.

When performing your tasks and conducting subsequent physical fitness tests, you should always remember about the basic principles of work ergonomics; about taking the correct positions, not unnecessarily burdening the skeletal and muscular system. You should also avoid helping and replacing a person with intellectual disabilities if it is not necessary – such action will allow them to show the maximum of their abilities and minimize the risk of excessive burdens for the person conducting the research.

People with intellectual disabilities generally have a lower level of physical fitness compared to their peers in the intellectual norm (Bossink et al., 2017; Hsieh et al., 2017a).

Delayed development of individual components of physical fitness may be directly related to factors causing disability, as well as to additional health problems more often co-occurring in this group.

12.4 Health status of people with intellectual disabilities and physical activity

People with intellectual disabilities are a very heterogeneous group of disorders with different etiology, clinical picture and course. There is no single, typical set of physical and mental characteristics for all people with intellectual disabilities, although there may be common features in certain groups. Intellectual development disorders are associated with a high

percentage of co-occurring mental, behavioural or neurodevelopmental disorders, with a higher incidence of certain conditions such as epilepsy, congenital defects and disorders of the gastrointestinal tract (duodenal stenosis, celiac disease), obesity, visual and hearing dysfunctions, thyroid disorders and sensory disturbances. Adults with intellectual disabilities are more likely than the general population to have mobility problems and take medications that can adversely affect health through side effects. In adults with intellectual disabilities, early mortality and multimorbidity are characterized by higher mortality compared to the general population. The onset of diseases in this group is much earlier, and the incidence of comorbidities at the age of 20–25 years is similar to that in the general population at the age of 50–54 years. Moreover, when faced with health problems, they have much more difficulty accessing the necessary support and appropriate healthcare (Cooper et al., 2015; de Winter et al., 2016; Hermans & Evenhuis, 2014).

Concomitant diseases may be a contraindication to certain physical activities, and this should be taken into account at the planning stage. Modification of the exercise plan should be especially considered when:

6. **Heart defects**

They are particularly common in the group of people with Down syndrome (found in almost half of children). The most common are the common atrioventricular canal and the opening in the interventricular and/or interatrial septum. Currently, in most cases, they can be effectively treated and do not significantly reduce physical activity in the later period. In case of doubt, it is worth consulting a cardiologist about the rehabilitation plan.

7. **Skeletal disorders**

In the context of planning physical activity, the occurrence of axial instability (AAI – atlanto – axial instability) is particularly important, which is found in 13% of children with Down syndrome. The diagnosis of AAI is mainly based on X-ray examination. With high instability, peripheral symptoms appear, most often of a neurological nature. The diagnosis of this abnormality is a contraindication to undertaking certain forms of movement, such as jumping, flipping or strength exercises in pairs. Activities associated with an uncontrolled risk of falling, such as skiing or horse riding, are dangerous. It is also worth being particularly careful when planning hippotherapy.

8. **Endocrine disorders**

Thyroid diseases (hypothyroidism, less often hyperthyroidism) and diabetes are more common than in the general population

9. **Immune disorders**

They cause greater susceptibility to infections, more frequent infections, as well as cancer and autoimmune diseases. It is worth remembering that proper physical activity affects the proper functioning of the immune system and reduces the risk of both viral and bacterial infections.

Moderate intensity efforts, preferably outdoors, are particularly recommended. Excessive fatigue should be avoided, as well as sudden changes in temperature.

10. **Ophthalmic disorders**

Hyperopia, myopia, astigmatism, strabismus and cataracts are more common. In some cases, ophthalmological diseases may be a contraindication to certain exercises. In the case of some eye defects and diseases, exercises causing sudden changes in pressure, i.e. jumps, strength exercises and exercises in which the head is low (bends, rolls), will be contraindicated. It is worth considering consulting an exercise program with an ophthalmologist. Some defects require proper supply of glasses. In people with intellectual disabilities, glasses may be damaged during everyday activities, especially during sports. For this reason, as well as for safety reasons, it is worth opting for sports goggles such as goggles.

11. **Hearing disorders**

In the group of people with intellectual disabilities, hearing disorders are more common. Several dozen percent of people with Down syndrome experience recurrent otitis, which results in hearing loss. Hearing disorders do not affect the selection of exercises but contribute to delayed speech development and deterioration of language skills. When implementing training programs, you must remember that people with hearing loss require alternative forms of communication and an individual approach.

12. **Growth disorders and abnormal body weight**

Some children with intellectual disabilities grow more slowly and reach a shorter height than their healthy peers. Abnormal body weight is also more often observed. A slower metabolism and problems in determining your nutritional needs can result in overweight or obesity. Among people with intellectual disabilities, you can also find people who are underweight or even extremely malnourished, which can be caused by disorders in swallowing and eating food, inability to take care of their needs and lack of proper care. In many situations, a dietary consultation may be useful. In the case of excessive body weight, aerobic efforts are important. You can offer walking, Nordic walking, swimming and exercises in the water, cycling (also on a tandem bike).

13. **Muscle tone disorders**

Muscle tone disorders are often observed in people with intellectual disabilities. People with Down syndrome are characterized by reduced muscle tone, hypermobility and increased joint laxity. In people with cerebral palsy, increased muscle tone predominates, which can cause limited locomotion and manipulation capabilities.

The overall prevalence of intellectual development disorders is slightly higher in men. In some societies, reduced social values and expectations towards women compared to men can negatively affect the accurate diagnosis and provision of appropriate support to women with intellectual disabilities. This makes it more difficult for them to achieve and show their range of

capabilities. Men and women also differ in the prevalence of certain behaviors and mental, behavioral, or neurodevelopmental disorders. Men are more likely to show hyperactivity and behavioural disorders, while women are more likely to show mood disorders and increased anxiety (also before new situations, challenges, physical activity) and it is worth taking this into account when planning physical activity (Cooper et al., 2015; Kosmol et al., 2021; van Timmeren et al., 2017; World Health Organization, 2022).

A decrease in intellectual potential and additional dysfunctions and problems affect the approach and the ability to undertake various activities. The results of the study clearly indicate that as a result of physiological and psychological factors, people with intellectual disabilities are characterized by a more passive lifestyle and less motivation to undertake regular physical activity. This is another factor that has a strong impact on physical fitness (Bossink et al., 2017; Hsieh et al., 2017b; Martin Ginis et al., 2021).

12.5 Determinants of physical activity

Currently, there are no global analyses of physical activity of people with disabilities, but the available data show that among people with intellectual disabilities as many as 58-89% do not meet the recommendations for physical activity (Hsieh et al., 2017b). Thus, they are more likely to suffer from serious health problems related to inactivity than the general population (Martin Ginis et al., 2021). Low levels of physical activity have long been recognised as a major risk factor for the development of major non-communicable diseases, including type 2 diabetes, coronary heart disease, stroke and some cancers, and are recognised as the fourth leading risk factor for mortality, with an estimated three million deaths per year worldwide (I. M. Lee et al., 2012). When engaging a person with an intellectual disability in physical activity, it may be useful to identify the factors that make it difficult or easier for them to participate.

Personal, social, financial, environmental, and family factors include low self-efficacy, lack of parental support, inadequate or unavailable accommodations, and lack of appropriate programs. The most commonly reported facilitators included high self-efficacy, enjoyment of PA, sufficient support from loved ones, social interaction with peers, attendance at school physical education classes, and tailored PA programs. Identifying the factors influencing physical activity are often crucial for engaging people with intellectual disabilities to change and maintain positive behaviours. The lack of information in this area hinders effective and long-term actions. In order to achieve optimal results, it is also necessary to cooperate in an interdisciplinary team including a physiotherapist, occupational therapist and often a cardiologist, neurologist, dietician and others. Understanding and support from loved ones: family, friends and caregivers is also important (Bossink et al., 2017, 2020; Jacinto et al., 2021).

12.6 The role of communication

In order to effectively include people with intellectual disabilities in physical activity programs, communication tailored to the individual needs of the recipient is necessary. When talking

about people with intellectual disabilities and addressing a person with intellectual disabilities, you should show great sensitivity and use language that emphasizes the value of all people as full members of our common society. If we are dealing with an adult and we are not in a close relationship, we should use the polite form "Ma'am, sir", even if this person addresses us by our first name. If the relationship is closer, of course, you can use a name or warmer forms, provided that it is comfortable for each person. In the first place, we always address the person with intellectual disability directly, respecting their autonomy, and not their caregiver.

In contact with a person with intellectual disabilities, special empathy is necessary. In this group, in addition to limitations in intellectual functioning, there are also limitations in adaptive behaviours in terms of conceptual, social and practical skills used in everyday life. People with intellectual disabilities may have problems with communication, interpersonal relationships, compliance with rules and the law, and responsibility for their behaviour. Problems in understanding or producing speech and language or in using language for communication purposes are more common. Older adults with intellectual development disorders may experience a faster onset of dementia or a decline in skills compared to the general population. It is important to remember that if a person with an intellectual disability does not make eye contact or does not respond to words, it does not mean that they do not listen to us or ignore us. Often, people with intellectual disabilities need more time to understand what is expected of them and make certain decisions, but this does not mean that they cannot do it.

Communication difficulties will depend largely on the degree of intellectual disability. In general, people with mild disabilities can communicate fluently, including about past, present and future events. Most are able to communicate their decisions about future goals, health care, and relationships (e.g., who they prefer to spend time with and how they prefer to spend time with). Most can also follow and follow instructions of up to 3 steps.

People with moderate intellectual disabilities are mostly able to communicate in short sentences and communicate their preferences for future goals, health care and relationships, but they will not always follow through on their statements. Most can follow instructions of up to two steps, so you need to use short and simple instructions when describing individual fitness tests.

Most people with severe intellectual disabilities are able to use communication strategies to indicate their preferences, including those regarding future goals, health care, and relationships in specific choices. Visual aids can be useful in communication. Most people in this group can follow the one-step instructions and stop the activity when requested.

People with profound intellectual disability are mostly able to convey information about their basic needs and preferences using non-verbal strategies, various forms of expression, gestures, smiles. Verbal communication using single words is rare. Most of them can perform very simple tasks, using hints and help (García et al., 2020; Smith et al., 2020; World Health Organization, 2022).

In communication with people with intellectual disabilities, it is worth thinking about the use of tools, techniques and strategies in the field of Augmentative and Alternative Communication (AAC)

This includes a variety of methods used to support communication among people with verbal communication difficulties. These methods can be used by all people who, due to congenital or acquired causes, temporarily or permanently, have problems with communication through speech. AAC works well in both adults and children.

In the acronym AAC, the first "A" *Augmentative* directly stands for enlargement, amplification. In this context, it is supporting communication: improving, adding, supplementing speech through sign language, images, boards, communicators containing signs. This makes the message more understandable to the listener.

The second "A" *Alternative* in AAC stands for Alternative Communication. It applies when a person cannot speak or when others do not understand their speech. In such situations, other ways of communication are needed.

Letter “C” means *Communication* (Crowe et al., 2022; Przybysz-Zaremba, 2020).

Speech disorders are more common in the group of people with intellectual disabilities compared to the general population. Unable to express their thoughts and needs, they are in a disadvantageous situation and their competences, potential and capabilities also in the field of physical activity may be misjudged by the environment. In addition, the inability to communicate can cause frustration and be a source of additional suffering.

Supportive and alternative communication can make it easier for people with intellectual disabilities to express their needs, preferences and opinions, also in terms of physical activity. Finding an effective way of communication also helps in establishing relationships with other people and increases the independence and independence of the person. It may also turn out that a given person has a much greater intellectual potential than initially estimated.

In your work, you can use, among other things:

25. Graphic information carriers – pictograms.

A pictogram can graphically represent a person, object or activity, or entire statements can be created from them. They can be used as communication signs, to create a daily schedule, an active board or an educational booklet. The most popular are:

6. PCS, Picture Communication Symbols

The PCS set includes around 5000 basic symbols, supplemented by additional symbols and country-specific symbols. For example, in the Polish version, these are images of Polish dishes, money, famous people. It is one of the most widely used symbol systems in the world, at the moment PCS symbols have been translated into 40 different languages. In PCS, each

symbol graphically represents a word or sentence organized in categories such as People, Food, Leisure....

Some symbols come in two versions adapted to the needs of people with different levels of understanding, which may be particularly important in communication with people with intellectual disabilities. The system can be available in the form of booklets, colourful stickers and computer programs such as Boardmaker™ or Speaking Dynamically™ Pro. These programs allow you to create educational materials that can be used directly or using a computer.

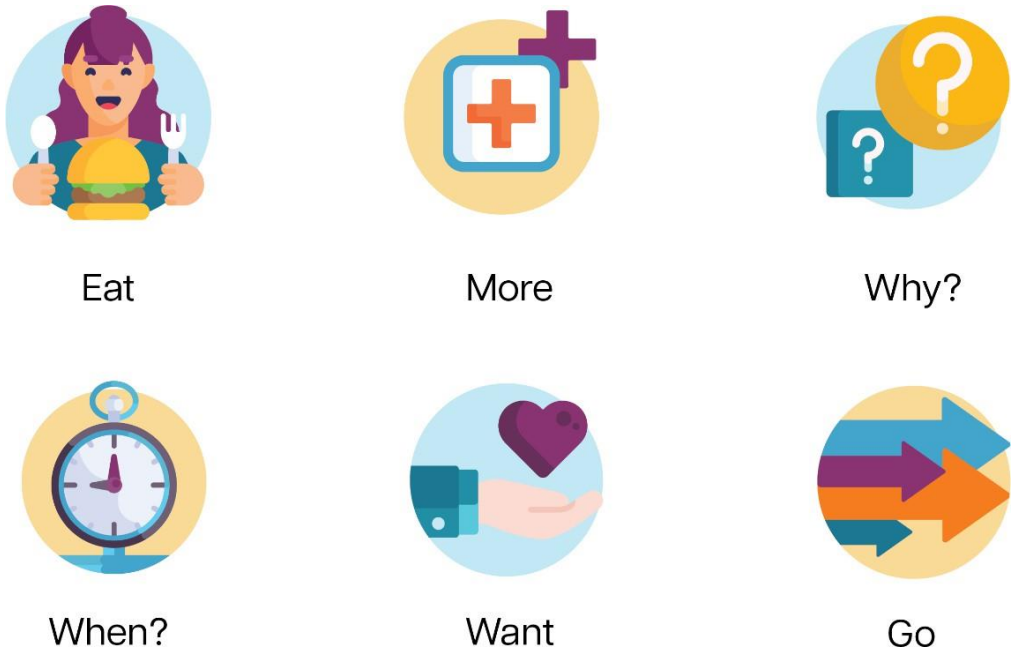

Figure 7 Example symbols (https://goboardmaker.com/)

14. PIC, Pictogram Ideogram Communication

These are white characters, made on a black background, often with a signature. The contrasting combination of two colours is to make it easier to understand the signs. This system allows people with verbal speech disorders to communicate, as well as people who communicate in completely different languages and cultures

15. Picturegrams – Picturegraphs, both black and white and colour.

16. Makaton® Language Program - a system of gestures and graphic symbols

The Makaton system combines graphic and manual signs. It was originally developed for adults with deaf and intellectual disabilities and was based on gestures. Currently, the system

is used by children and adults with the so-called "complex communication needs", including intellectual disability, Down syndrome, cerebral palsy, autism, after craniocerebral injury, stroke, as well as by caregivers, families and friends of these people. Each country that uses Makaton has its own completely different set of gestures, except for English-speaking countries that use the British version. For example, the Polish gestures of Makaton® differ significantly from the British version, they refer to Polish culture: language, religion, behaviour and customs. They also have an additional name KONi® - Communication of the Disabled.

Makaton®'s gestures are simple to perform, legible (you can guess the meaning of a given gesture) and iconic (easy to remember and reproduce).

Figure 8 Example graphic and manual signs (https://www.keenoxford.org/the-keen-blog/all-about-makaton)

Makaton®'s graphic signs are black and white line drawings, simple enough to be drawn by hand. They are especially useful for people who, due to certain motor dysfunctions, are unable to make the right gestures.

17. Bliss Communication System

It is a method of communication in which words are presented in the form of drawings. Symbols are in the form of simple geometric shapes, such as circles, lines, squares, arrows, etc. When another graphic element is added to a simple symbol, a new image is created that logically changes the meaning of the symbol. The advantage of the system is the fact that it allows you

to build longer statements and describe events and emotions. However, this method can be difficult to master for people with a lower level of intellectual development.

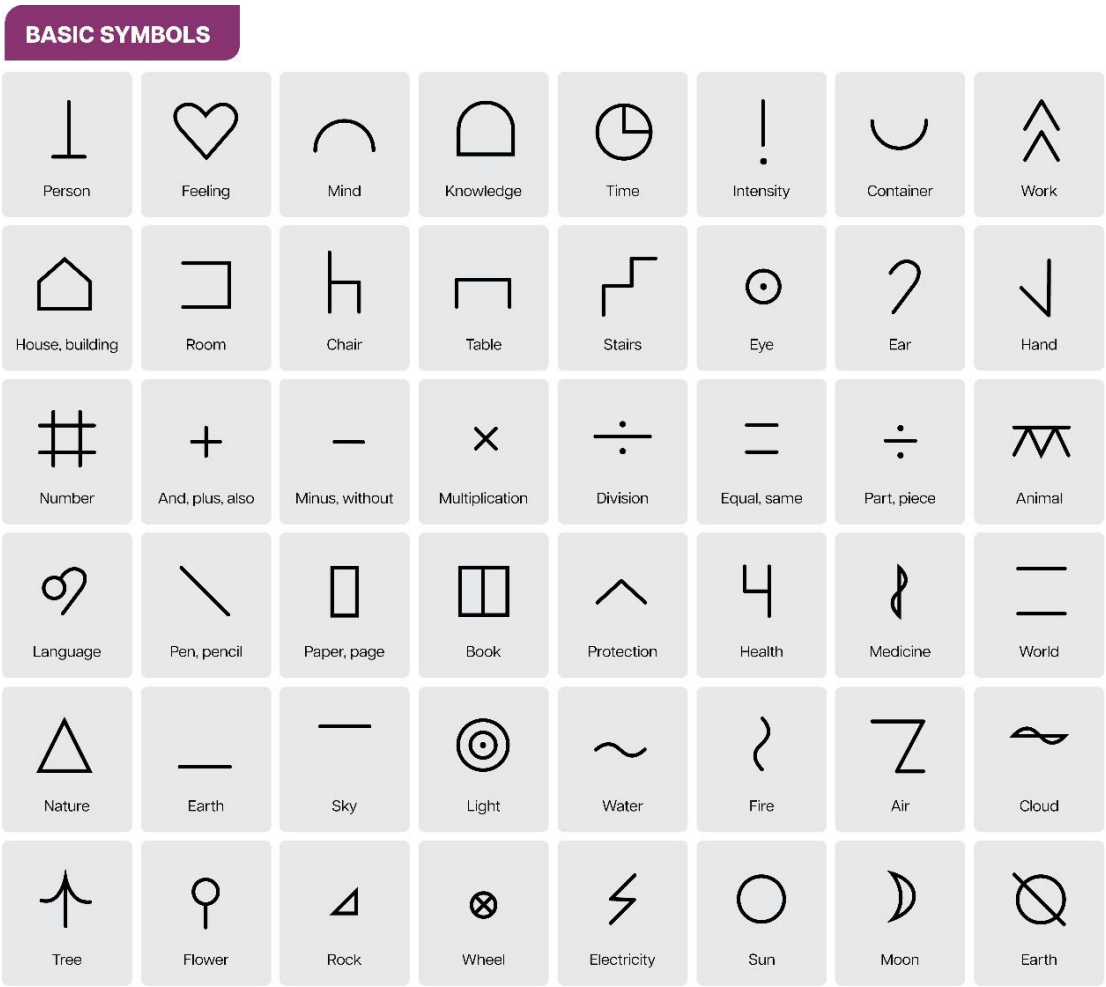

Figure 9 Bliss symbol examples (https://www.omniglot.com/writing/blissymbolics.htm)

Picture 18. Modern technologies in AAC

In recent years, there has been a sharp increase in the use of technology in education and support for people with intellectual and developmental disabilities. To support the communication process, specially prepared computer software and speech-assisted communication systems are used (e.g. applications on Apple™ devices, GoTalk9+, AMDi Tech/Plus 32, ablenet® BIGmack; Logan, Iacono and Trembath, most often behind a touch screen. The functionality of these technologies is increasing year by year, its availability is also increasing, while costs are decreasing. However, it should be remembered that people with disabilities are often in a disadvantaged financial situation and their access to modern technologies may be limited (Allen et al., 2017; Kaczmarek, 2021; Lang & McLay, 2023; Syriopoulou-Delli & Eleni, 2022).

Recommendations for intercultural communication:

- Adapt your communication style to the needs and preferences of the customer. Use simple language, visual aids, and specific examples for easy understanding.
- Take the time to build trust and customer relationships. Create a supportive and non-judgmental environment where they feel comfortable expressing themselves and discussing their goals.
- Practice active listening to understand the interests, motivations and concerns of the client and their loved ones related to undertaking a specific physical activity. Appreciate their enthusiasm and willingness to participate.
- Conduct a thorough assessment of the client's physical ability to undertake a specific sporting activity. If necessary, consider consulting with other health professionals, such as occupational therapists, special educators, cardiologists, or dietitians.
- Provide clear and simple instructions on safety measures and techniques for each activity. Emphasize the importance of following safety tips to prevent injuries and injuries.
- Develop a structured and gradual training program that enables the client to gradually build skills and confidence in their chosen discipline. Break down tasks into easy-to-follow steps and appreciate even small achievements. Appreciate effort, perseverance, and determination in pursuing your goals.
- Create an inclusive and supportive environment in the sports center. Encourage staff and other athletes to be patient, understanding, and respectful of people with disabilities.
- Involve family members or account managers in the planning and support process. Provide guidance and resources to help them understand the benefits and challenges of physical activity for people with intellectual disabilities.

12.7 Opportunities for physical activity

There is no evidence that physical activity is inadvisable in the group of people with disabilities. On the other hand, a positive effect of physical activity on cardiorespiratory fitness, muscle strength, functional skills and psychosocial well-being has been demonstrated in people with both physical and cognitive disabilities. Thanks to the growing awareness and openness of societies to the needs of people with intellectual disabilities, they have a chance to derive joy and satisfaction from participating in various sports disciplines. The rules and regulations of these disciplines are modeled on disciplines practiced by non-disabled people or modified to meet the needs of people with disabilities. In some cases, additional support in the form of appropriately modified and adapted equipment is also necessary.

People with intellectual disabilities can pursue their passions in disciplines such as:

- Team games
- Swimming
- Dance
- Judo
- Golf
- Tennis
- Powerlifting
- Horsemanship
- Athletics
- Cross-country skiing
- Alpine
- Sailing
- Sport and rock climbing
- Frisbee game

and many more.

An example of a sports discipline that seemingly seems to be intended for people with special physical and mental predispositions is sport climbing. It turns out that it can be successfully practiced by people with various forms of disability, including intellectual disabilities, bringing them a number of benefits in the area of physical fitness and mental health. This form of activity is used, among others, in the therapy of people with Down syndrome, autism spectrum, Asperger's syndrome, cerebral palsy, neurological diseases of various origins. For people with intellectual disabilities in many countries, various elements of climbing have been used for years as part of sports activities and rehabilitation camps. Sports competitions are also organized, as well as climbing events integrating various sports communities. Participation in such events not only improves overall physical fitness but also increases self-esteem and self-confidence (Bibro & Żarów, 2021; Liu et al., 2022).

Figure 10 Participants of climbing classes, Tarnów Academy, Poland

Special Olympics Mission

The largest sports and social organization in the world, associating people with intellectual disabilities, is the Special Olympics. The beginnings of the movement date back to the 60s of the twentieth century, when Eunice Kennedy Shriver, sister of President John Kennedy, was the initiator of the creation of an international sports organization for people with intellectual disabilities. The first day camps organized for young people showed how important physical activity and various forms of sports competition are for the development of people with intellectual disabilities. The 1st Special Olympics International Summer Games were held in 1968 in Chicago, and in 1977 in Colorado, athletes competed in winter sports for the first time during the Special Olympics World Winter Games. Initially, the movement developed in the United States and Canada, now it has its branches and representatives all over the world. From the very beginning, the Games were very popular, already in the first event 1000 athletes with intellectual disabilities took part. The last Special Olympics 2023 World Games, held in Berlin, Germany, saw 6,500 athletes compete, supported by 3,000 coaches, support staff and 9,000 volunteers. The organizer estimates that the individual events attracted a total of 330,000 spectators. Since then, more and more world-class events have been systematically held. Eunice Kennedy Shriver is a person who has undeniably contributed to the development of sport for people with intellectual disabilities, as well as to increasing public awareness of

intellectual disability, increasing knowledge in this area and increasing the rights of people with disabilities. Her huge contribution in this area has been appreciated and every year on September 22, EKS Day is celebrated in her honour.

Currently, the Special Olympics movement is:

- 227 National Programs in 177 countries
- 3.9 million players
- 7 Continental Offices, Washington, D.C. Headquarters
- Over 1 million family members
- over 500 thousand volunteers
- over 300 thousand trainers
- over 20 thousand sports competitions and events per year
- 32 winter and summer sports.

The mission of Special Olympics is to provide people with intellectual disabilities aged at least eight with a year-round series of training and sports competitions in a wide range of Olympic disciplines. The activities of Special Olympics focus on organizing training and sports competitions for people with intellectual disabilities. Through sport, players develop both physically and socially. They learn new skills, break their own barriers, become more courageous, open-minded and confident. In addition to sport, initiatives are also created to change public awareness of the potential, skills and needs of people with intellectual disabilities. The "Young Athletes" program is dedicated to younger people. It is a program supporting the physical and social development of children with intellectual disabilities aged 2-12. It includes sports games and activities, as well as preparation for disciplines such as basketball, football, cycling and swimming. Another program of the Special Olympics is the "Unified Sports" program. "This program connects approximately equal numbers of Special Olympics athletes with athletes with intellectually normal athletes (called partners) in sports teams during training and competitions. The age and fitness level of the athletes and partners are specified in detail depending on the discipline." The disciplines practised under the programme include, among others: basketball, badminton, indoor hockey, football, softball, table tennis, handball, tennis, volleyball. Joint training and participation in competitions support the development of physical fitness, allow you to gain new experiences and make new acquaintances and friendships.

A unique rehabilitation and training program of the Special Olympics is the Motor Activity Training Program (MATP). It is dedicated to people who cannot participate in official Special Olympics training and sports competitions due to physical disabilities coexisting with

intellectual disability, preventing them from participating in the sports offered as part of the Special Olympics, or inability to understand and comply with the rules of competition and sports regulations of the Special Olympics, e.g. due to a severe intellectual disability.

MATP refers to the sports disciplines practiced in the Special Olympics. Examples of competitions in official Special Olympics competitions for people with the lowest fitness are: in athletics – e.g. throwing a ball, long jump from a standstill, walking with an assist of 25 m; in swimming – 10 m with an assist.

The MATP program primarily emphasizes the benefits of systematic and consistent work between the therapist and the athlete. Unlike sports disciplines, there is no element of competition between participants and strict adherence to rules and regulations.

Special Olympics is not only about sporting activities, but also about building social environments that are welcoming to everyone, regardless of their level of ability. They provide support to teachers, trainers, volunteers, students, administrative staff, so that it is possible to create spaces where everyone feels valued and welcomed. Special Olympics financially supports initiatives around the world to implement projects that create an inclusive environment. They also support scientific research in this area.

On the website of the Special Olympics in your country, you can easily find addresses and contact details of regional offices. You can also get information about programs and projects implemented in your area and dedicated to people with intellectual disabilities (Special Olympics; Special Olympics).

12.8 Legal situation of persons with intellectual disabilities

In the case of people with intellectual disabilities, their legal situation may have an additional role in making decisions, including those concerning health and physical activity. The legal situation of adults with intellectual disabilities is often complicated. According to the provisions of Polish civil law, every person after reaching the age of 18 gains the ability to independently manage their own fate. Therefore, all decisions regarding the tests, research and activities to be carried out should be directly agreed with the client. Nevertheless, some adults with intellectual disabilities have difficulties in fully understanding the situation and may also have problems with unambiguous communication of their will. Therefore, it is worth taking into account the opinions of the guardian/parent in your actions. Most often, it is the caregivers/parents who know the person best, communicate with them most easily and know their needs and preferences best. Their help can be crucial both during the examination and in planning the improvement process.

In our practice, we can also deal with a completely incapacitated person. Such a decision can be made by the court in the case of a person with an intellectual disability who is unable to manage his or her own proceedings. The basis for incapacitation can always be only the good of the person who is to be incapacitated, and the reason for its ruling cannot be the need of

officials, family, economic situation or inability to communicate with a given person. The main effect of a ruling on total incapacitation is the loss of legal capacity. The competences of the guardian as the statutory representative of the ward are similar to the rights of the parents exercising parental authority, and it is they who must consent to all activities in the field of diagnostics and therapy. However, even in such a situation, you should always communicate with a person with an intellectual disability in the first place.

According to Polish law, an adult disabled person has full capacity to make decisions about himself. However, in reality, these individuals rarely live, most often relying on their parents and other family members to organize their daily activities. This means that they need parental consent to engage in m.in sporting activity. Parents and caregivers can adopt different attitudes. Through their overprotection and excessive care, as well as lack of faith in the abilities of the ward, they can limit their development. Supportive parents who are actively involved in the activities they undertake will be an encouragement and companionship, increasing the child's chances for development. Undoubtedly, effective communication and cooperation with people from your client's immediate environment will facilitate the planning and implementation of any sports or therapeutic program.

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13 HEALTHY AGING and MENTAL HEALTH IN ELDERLY

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The aging process of a human is complex and individual, occurring in biological, psychological, and social domains (Dziechciaż & Filip, 2014). Aging is the progressive deterioration at the cellular, tissue, and organ levels, leading to the loss of homeostasis, reduced adaptability to internal or external stimuli, and increased vulnerability to disease and death.

Health is defined not merely as the absence of disease or infirmity but as a state of complete physical, mental, and social well-being. The World Health Organization (WHO) broadly considers health, yet health assessments often focus on lifespan, pain control, functional abilities, and disability measures. These assessment criteria are insufficient to fully encompass important elements such as quality of life and patient satisfaction (Tsai et al., 2007).

In 1993, the World Health Organization (WHO) defined quality of life as "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns." (World Health Organization, 1993). Health-related quality of life typically refers to those aspects of quality of life that are influenced by a person's health status, reflecting the impact of disease and treatment on disability and daily functioning. Additionally, perceived health status reflects an individual's ability to lead a satisfying life (Ahmed and Andrich, 2015).

Quality of life plays an important role in symptom improvement, morbidity, rehabilitation, and patient care. Assessing patients' quality of life can lead to changes in treatment and care processes or demonstrate the effectiveness of a treatment. It also highlights potential problems that may affect healthy individuals in the future. Treatment is directed based on identified problems, and preventive measures are taken against possible issues. This approach prevents the oversight of problems in recovered individuals or those with long-term follow-up needs. Additionally, quality of life is an indicator of treatment success and has prognostic significance, thus it is recommended to be routinely assessed in clinical studies (Haraldstad et al., 2019).

With advancements in healthcare, the elderly population is increasing. By 2050, it is expected that the number of individuals over the age of 60 will reach 2 billion globally, accounting for 20% of the world's population. Decline in functionality and loss of independence are not inevitable consequences of aging (United Nations, 2013). Given the high prevalence and impact of chronic health issues among elderly patients, evidence-based interventions addressing these problems are becoming increasingly important to maximize quality of life. The primary aim of treatment in elderly individuals is to reduce mortality rates and healthcare utilization as well as to improve quality of life. Improvement in quality of life is associated with a decreased risk of developing chronic diseases and reducing complications from chronic

illnesses. Therefore, it is important to consider quality of life and its influencing factors in clinical practice (Eyıgör, 2009).

13.1 Factors Affecting Quality of Life in Elderly

As age increases, there is generally a decline in quality of life. Among the elderly population, the most common factors affecting quality of life include mobility issues and difficulties in performing daily living activities (Boston Working Group on Improving Health Care Outcomes Through Geriatric Rehabilitation, 1997). While the rates of anxiety and depression tend to decrease with age, mobility, self-care, pain, and usual activities tend to worsen as age progresses. Women's quality of life is generally lower than that of men, with higher pain scores. Factors such as living alone, lack of social support, low educational level, malnutrition, being underweight or overweight, alcohol and tobacco use contribute to a decrease in quality of life (Grund et al., 2020). Smoking, even without lung problems, leads to a decrease in exercise capacity, muscle fiber atrophy, and an increase in glycolytic capacity. This results in alterations in body composition, increased anxiety, and depression, which ultimately leads to a decrease in exercise capacity and quality of life (Pel-Littel, 2021).

During the aging process, impairments in sensory functions negatively affect quality of life. Aging brings about changes such as drooping eyelids, decreased tear production, presbyopia, slower adaptation to ambient light, and reduced contrast sensitivity. Hearing loss, particularly at high frequencies, can lead individuals to isolate themselves in social settings. A decrease in taste and smell can cause nutritional problems. Although the somatosensory system is less affected compared to vision, hearing, taste, and smell, there is a decrease in proprioceptive sense due to aging.

The reduction in quality of life due to impairments in vision is greater than that caused by impairments in hearing. Regular eye examinations should be conducted for elderly individuals, and treatments such as cataract surgery or vascular endothelial growth factor application should be administered when necessary (Assi et al., 2021; Chen et al.,2020; Cavazzana et al., 2018).

Malnutrition and swallowing disorders also significantly impact quality of life. Chewing function, nutritional status, and cognitive condition directly affect quality of life. Severe cognitive impairment can cause problems for individuals who need to use dentures. Having few teeth and being unable to use dentures can lead to chewing difficulties and dysphagia. Furthermore, cognitive impairment can result in difficulties with eating and accessing food, leading to malnutrition (Maresova et al., 2019).

Low educational level, marital status, depression, periodontal diseases, polypharmacy, smoking, denture use, and poor general health are associated with lower oral health-related quality of life. Additionally, factors such as tooth decay and lack of fillings are other risk factors that negatively affect quality of life (Baniasadi, 2021).

13.2 Visual Function Changes in Elderly

Aging brings about numerous physiological changes, among the decline in visual function. Presbyopia, cataracts, and dry eye are physiological changes, while glaucoma, age-related macular degeneration and vascular diseases are disorders of visual function that become more prevalent with age (Grossniklaus et al., 2013). The profound impact of visual impairments on quality of life, mobility and overall health is significant, and early detection, intervention and rehabilitation should be ensured (Knudtson et al., 2006).

Visual impairments significantly affect the quality of life of older adults. Poor vision can impede mobility, restrict social interactions, and contribute to feelings of isolation and depression. For instance, difficulty reading or recognizing faces can lead to a withdrawal from social activities, which in turn reduces overall well-being. Furthermore, visual impairments are closely associated with an increased risk of falls. Vision plays a crucial role in maintaining balance and navigating the environment. Visual impairments compromise these abilities, making everyday tasks potentially dangerous. Falls are a significant cause of injury and mortality in older individuals, frequently resulting in fractures, head injuries and subsequent loss of independence. These injuries are often associated with hospitalisation, long-term disability and even death. Addressing visual impairments is crucial for the prevention of falls, with the aim of reducing these risks and improving overall health outcomes (Knudtson et al., 2006; Popescu et al., 2011; Aartolahti et al., 2013).

Regular eye examinations are of paramount importance for the early detection and management of visual disorders. The implementation of medical treatments, surgical procedures, or vision rehabilitation at an early stage can prevent the deterioration of vision and enhance the quality of life. Many eye diseases are relatively straightforward to rehabilitate if detected early. For example, cataracts can be effectively treated with surgery, restoring clear vision. Glaucoma and diabetic retinopathy can be managed through the administration of medication and the implementation of lifestyle modifications, thus preventing further vision loss. Timely intervention can prevent the progression of these diseases and maintain visual function. Furthermore, eye examinations can also detect early signs of systemic diseases such as diabetes, hypertension, and neurodegenerative conditions, which are common in advanced age (Yap et al., 2019). These conditions frequently present with ocular manifestations before other symptoms become apparent, thereby facilitating early diagnosis and management. The prevention of complications associated with these systemic diseases enhances overall health and longevity (Edwards et al., 2022). It is of paramount importance to address visual impairments through regular screening, timely intervention, and comprehensive vision rehabilitation in order to improve the quality of life of the elderly population. The early detection and management of conditions can prevent severe vision loss and reduce morbidity and mortality rates by reducing the risk of falls (Aartolahti et al., 2013). Furthermore, ensuring good vision helps older people to maintain their independence and continue to contribute actively to society. Good vision is also crucial for the participation of the elderly population in planned physical rehabilitation programs. Effective rehabilitation often relies on the ability to perform exercises accurately, navigate environments safely, and follow instructions precisely. Clear

vision enhances their capacity to engage actively in physical therapy, allowing them to correctly execute movements, recognize spatial relationships, and monitor their progress, thus ensuring the efficiency and success of rehabilitation efforts (Gleeson et al., 2014). By prioritising eye health, we can enhance the well-being of older adults and extend their life expectancy, thereby fostering a healthier and more vibrant ageing population. It is significant to adopt a holistic approach to the rehabilitation of the elderly population. This comprehensive approach not only improves physical health but also supports mental and emotional well-being, creating a supportive environment for successful aging (Thompson et al., 2023).

13.3 Pain in Elderly

Pain in elderly individuals occurs in more than 50% of cases, although it varies across the general population. This situation imposes significant costs on the healthcare system. With the increasing elderly population, hospital admissions and healthcare costs are expected to rise. Chronic pain in elderly individuals can reduce mobility, leading to depression and anxiety, and can disrupt social relationships. Detecting pain in elderly individuals is also challenging; neuromuscular or cognitive impairments can cause communication difficulties, and patients may hide their pain. Pain should not be seen as a natural part of aging and should be managed with appropriate treatment methods to improve the quality of life for individuals (Schwan et al., 2019).

The presence of knee and back pain may indicate a risk of future dependency in daily living activities. Pain increases functional limitations, and functional limitations exacerbate pain. Individuals who are mildly dependent can become fully dependent if not assessed in a timely manner. Early assessment in elderly individuals is crucial to slow down the progression of dependency. Pain should not be perceived as a natural process of aging; it should be treated early, effectively, and with a personalized treatment plan to maintain functionality and quality of life (Maresova et al., 2019).

13.4 Falls in Elderly

Falls are common, especially among the elderly, and their significance increases with the growing elderly population. One-third of individuals over the age of 65 and half of those over 80 experiences at least one fall per year. Falls generally occur due to reduced muscle strength, walking, and vision problems. Falls are more frequent in women than in men. Besides female gender, a history of falls, lower extremity weakness, cognitive impairment, advanced age, balance disorders, use of psychotropic medications, history of stroke, arthritis, orthostatic hypotension, vision and hearing impairments, and anaemia are risk factors for falls (Dougles and Kiel, 2022). Falls can result in a wide range of outcomes from minor injuries to death. In addition to physical injuries, psychological effects are also observed; post-fall, fear of falling occurs in 3-92% of cases. Loss of confidence and social isolation develop, leading to a deterioration in quality of life. Seventy percent of falls can be identified and prevented beforehand. Therefore, individuals at risk should be identified, and necessary precautions should be taken to reduce mortality and morbidity before falls occur. It is recommended that

elderly individuals do not get out of bed immediately in the morning but sit on the edge of the bed for the first few minutes to prevent falls (Schoene et al., 2019).

13.5 Social Support and Education in Elderly

High social support, participation in cognitive activities, or group events are associated with better quality of life. To improve the quality of life in elderly individuals, strengthening mental activities and social relationships is necessary. It has been shown that elderly individuals with at least one friend have a higher quality of life compared to those without friends. Additionally, individuals living alone report more pain complaints compared to those living with their families. Heating problems and restrictive factors such as stairs in the home environment negatively affect quality of life. Eliminating elements that reduce the quality of life in the primary living area of elderly individuals is important for maintaining their independence and quality of life.

Low educational level causes two main problems for individuals: first, an increased burden of disease associated with low education level; second, decreased quality of life due to health problems. A correlation between low educational level and low quality of life has been identified (Mielck et al., 2013).

13.6 Measurement and Evaluation Methods in Geriatric Individuals

With advancing age, multiple chronic diseases, and geriatric syndromes (dementia, delirium, depression, incontinence, falls, polypharmacy, malnutrition, frailty, sarcopenia, pain) lead to a decrease and loss in the functional capacities of elderly individuals (Charlotte et al., 2015). Therefore, there is a need for a coordinated multidisciplinary assessment to clarify the diagnosis and management plans for elderly individuals. This need is met by Comprehensive Geriatric Assessment (CGA). CGA encompasses many areas. It includes the evaluation of physical symptoms, pain, and musculoskeletal symptoms, as well as balance and mobility. Continence, mood, cognitive functions, and sarcopenia are evaluated. Assessment of frailty and activities of daily living (ADL) is also important. In addition to hearing and vision functions, the nutritional status, management of multimorbidity, the condition of the caregiver, and the living environment are evaluated. Finally, the assessment of social support networks and future expectations is also part of the comprehensive geriatric assessment process.

1. **Evaluation of Balance and Mobility**

Approximately one-third of individuals over 65 years old and half of those over 80 years old experience at least one falls each year. Falls result in fractures in about 5% of cases (Racey et al., 2021). Additionally, falls are a significant problem that can lead to other medical complications such as dehydration, pneumonia, urinary retention, and infections, which can further confine the elderly to bed. Falls can occur for various reasons, including vision impairment, neurological or vestibular diseases, postural hypotension, muscle mass reduction, joint diseases, and foot disorders. Elderly adults with dementia fall 2-3 times more frequently

than cognitively healthy elderly adults, and 60-80% of those with dementia fall each year (Lamb et al., 2005).

In the assessment of balance and mobility, falls within the last six months are inquired about. Those who answer affirmatively should undergo balance and mobility scales. If there is a history of a single fall in the last six months, a Timed Up and Go test is performed. If there are multiple falls, further assessment is conducted.

Static Tests

***Romberg Test:** The individual is asked to stand with feet together, eyes open for 30 seconds, then with eyes closed. Excessive swaying, loss of balance, or stepping during the test indicates a positive result (Campbell, 2013).

***Tandem Romberg Test:** This test is similar to the Romberg Test but with feet positioned in a straight line, making balance disorders more noticeable. The individual stands with one foot's toe touching the heel of the other foot, arms at the sides, for 60 seconds. The average score from four measurements is recorded (Campbell, 2013).

***Single Leg Stance Test:** This test measures balance and static standing ability. The individual is asked to stand on one leg for 30 seconds while the other leg is in slight flexion. The test is terminated if the foot touches the ground, there is excessive swaying, or the individual jumps. The test is conducted on both lower extremities, and the average of five measurements is taken. Values below 30 seconds indicate impaired balance, below 10 seconds indicate balance disorder, and below 5 seconds indicate a high risk of falling (Vellas et al., 1997).

Dynamic Tests

***Tinetti Balance and Gait Test:** This test assesses the risk of falls in the elderly. It includes 13 items for balance and 9 items for gait, each scored from 0-1-2. The total score (balance + gait) is 35 (Tinetti, 1986).

***Timed Up and Go Test:** This test evaluates mobility, gait, and balance. The participant is asked to rise from a chair, walk 3 meters, turn around, walk back, and sit down again without using the armrests. The time taken is measured. Completing the test in more than 12 seconds indicates a risk of falling (Tinetti, 1986).

***Berg Balance Test:** This test evaluates balance and determines the risk of falling through 14 directives, with performance scored from 0-4. A total score of 0-20 indicates balance disorder, 21-40 indicates acceptable balance, and 41-56 indicates good balance (Gleeson et al., 2014).

***Six-Minute Walk Test:** This test evaluates walking patterns and speed over a 10-meter linear path. The time between 2 and 8 meters is recorded. Walking slower than 0.8 m/s is associated with sarcopenia, hospital admission, mortality, and fall risk (Andrews et al., 2023).

***30-Second Chair Stand Test:** This test evaluates lower extremity muscle strength and dynamic balance by counting the number of sit-to-stand repetitions in 30 seconds. The patient sits in a chair with a seat height of 44 cm, arms crossed over the chest and is asked to stand up and sit down without using their hands. Less than 10 repetitions in 30 seconds indicates lower extremity muscle weakness (Wilkison and Harper, 2021).

Performance-Based Tests

***Four Square Step Test:** This test evaluates the ability to step forward, backward, and sideways, and the stability during these movements. The time to complete the sequence without touching the poles is recorded. The individual stands facing square 2, and steps in the sequence 2-3-4-1-4-3-2-1 as quickly as possible without touching the poles. Completion in more than 15 seconds indicates a fall risk (Işık et al., 2015).

***Functional Reach Test:** This test measures how far an individual can reach forward without stepping. It assesses dynamic balance and is performed with three trials, taking the average of the last two. The individual stands against a wall with one arm extended at shoulder height and reaches forward as far as possible without taking a step. The difference between the start and end positions of the 3rd metacarpal is measured. A reach distance below 15 cm indicates an increased risk of falling (Lin et al., 2012).

***Falls Efficacy Scale:** This scale evaluates the perception of balance, stability during daily activities, and fear of falling. It consists of 10 items scored from 1 to 10. A score above 70 indicates a fear of falling. This detailed assessment framework ensures a comprehensive evaluation of balance and mobility in elderly individuals, allowing for early identification of fall risks and implementation of appropriate preventive measures (Tinetti et al., 1990).

2. **Evaluation of Mental Functions**

Mini Mental State Examination (MMSE)

The Mini-Mental State Examination (MMSE) is a standardized measure used to assess an individual's cognitive status. This test is widely used to detect cognitive impairments, monitor mental disorders, and identify changes in cognitive function, especially prevalent in the elderly population. The MMSE evaluates performance across various cognitive domains, including memory, attention, language, calculation skills, and spatial abilities. Administration of the Mini-Mental State Examination typically takes about 5 to 10 minutes. The MMSE is scored on a range of 30 points, with higher scores indicating better cognitive function. However, it is important to note that the MMSE alone is not sufficient for diagnosing dementia; additional tests and comprehensive evaluations are usually required. The Mini-Mental State Examination is used to measure cognitive impairment in older adults. It can be used to screen for cognitive impairment, estimate the severity of cognitive impairment at a specific point in time, track changes in cognitive function over time, and document a person's response to treatment. It assesses different subsets of cognitive status, such as attention, language, memory, orientation, and visuospatial competence. The MMSE is specific and takes about 10-15 minutes to administer. MMSE scores range from 0 to 30. Scores of 25 and above are

considered normal, scores below 10 indicate severe impairment, scores between 10 and 19 indicate moderate dementia, and scores between 19 and 24 suggest early-stage dementia.

Montreal Cognitive Assessment (MoCA)

The MoCA was developed as a quick screening test for mild cognitive impairment. The MoCA assesses various cognitive functions and is a popular screening tool used to determine the presence of cognitive impairment. It takes approximately ten minutes to complete and evaluates visuospatial abilities, attention, language, abstract reasoning, delayed recall, executive function, and orientation. The MoCA covers more domains than the MMSE and, as a result, has higher sensitivity and specificity. Cognitive assessments are quick, easy-to-use, and accurate methods to help diagnose, assess, and manage many cognitive disorders. The MoCA is useful in determining a patient's level of understanding and skill. The MoCA takes about 10 minutes to administer, and the highest possible score is 30, with scores of 21 and above considered normal.

Clock Drawing Test

This test quickly assesses visuospatial perception and skill levels. It is one of the tests impaired in the early stages of dementia. Its advantages include being quick and easy to administer with a high negative predictive value, while its disadvantages are subjective scoring and a high false-negative rate. The "clock drawing test" and the "three-item recall" method are quick and easy screening tests. If the patient can draw a complete clock and recall the three items stated, dementia is ruled out. These tests can be particularly useful in uneducated individuals and non-English speaking patients.

13.7 Therapeutic Approaches and Promotion of Healthy Ageing in Geriatric Individuals

Appropriate physiotherapeutic approaches for healthy aging include methods such as gymnastics exercises, music-dance therapy, and cognitive exercises. When determining these approaches, a balance should be maintained between the elderly individual's current clinical condition and physical activity level. When assessing the clinical condition of the elderly, physical and mental health should be checked to ensure there are no diseases or disorders.

Social discrimination based on chronological or assumed age is common in social life and is more pronounced in active living, resulting in the aging process becoming more severe. Viewing signs of aging and increasing illnesses as normal aging indicates a passive approach and acceptance. The goal should be active aging rather than normal aging, which requires an active individual life, healthy eating habits, and changes in social and community policies. Social isolation, feelings of loneliness, depression, and loss of peers can lead to physical inactivity and sedentary living in the elderly. Besides physiological changes, inactivity and self-limitation in daily life activities can negatively affect physical health. Physical activity levels should also be assessed for healthy aging.

Exercise aims to increase muscle strength and flexibility, improve cardiovascular and respiratory system functions, meet daily energy and motivation needs, enable socialization, and improve mood. Therefore, elderly adults can spend their elderly periods healthier and happier. Healthy aging is possible with good physical and mental health. To maintain and improve physical health, increase mobility, and prevent inactivity, calisthenic exercise approaches and light stretching exercises are recommended. Submaximal aerobic and calisthenic exercises can improve physical fitness, cognitive performance, and quality of life. It is recommended to be performed under the supervision of a physiotherapist for an average of 45-50 minutes, three days a week for four months. Gymnastic exercises have been shown to provide significant improvements, especially in immediate memory and learning functions (Picture 1).

Physical exercise improves spatial learning in healthy individuals and has a protective effect against cognitive decline that comes with aging. Individuals with higher levels of physical fitness can use their cognitive abilities more flexibly to meet environmental demands. It has been stated that regular physical exercise can reverse declines in cognitive processes. The increase in brain-derived neurotrophic factor (BDNF) with physical exercise is thought to be one of the main reasons for its positive effect on the cognitive characteristics of the elderly. BDNF is an important protein that positively affects structural and functional plasticity in the central nervous system and is vital for cognitive performance and adaptations in brain morphology (Kara, 2001; Tollanen, 2015; Neeper, 1995; Birinci et al., 2019).

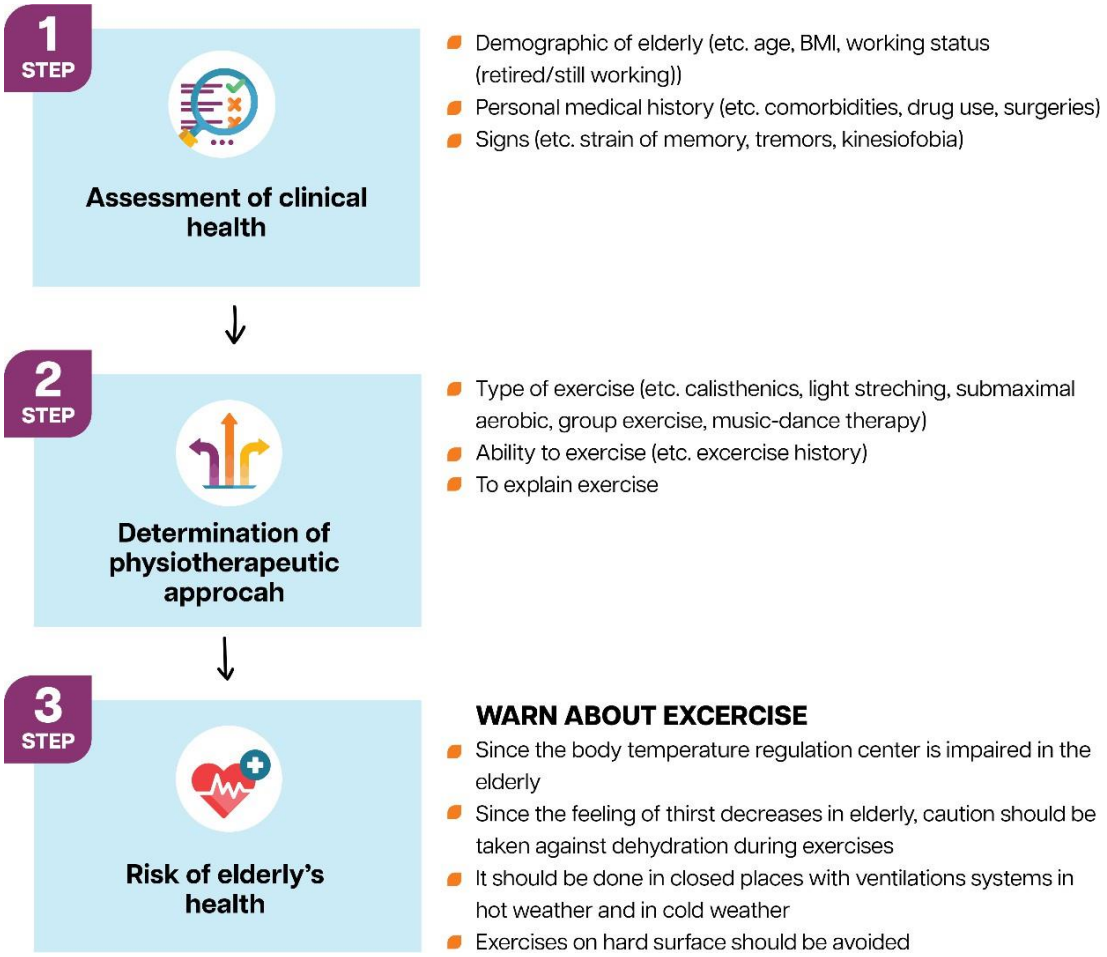

Figure 1 Considerations in physiotherapy and rehabilitation approaches in geriatric individuals.

Figure 1: Aging is a dynamic and irreversible physiological process occurring over time in the individual development of living organisms. Aging, a universal phenomenon from birth, according to most biologists, begins in the fourth decade of life and ends with death, the end of biological life. The human aging process is a complex and individual process occurring in biological, psychological, and social domains. Genetic code, along with external biological and psychosocial factors, is accepted as the fundamental etiological-pathological mechanism of aging. Biological factors include physical inactivity, improper nutrition, psychomotor load, acute and chronic medical conditions; psychosocial factors include environmental changes, isolation, loneliness, and lack of preparation for old age. Old age is defined as the final stage of the aging process resulting in death. Biologists and physicians define old age as the stage of life after maturity when there is a decline in body functions and various changes in systems and organs.

Old age can be considered from different perspectives: chronological (determined by age); biological (functional, determined by individual characteristics); legal (legal retirement age limit); economic (lack of activity, decrease in income); social (related to loss of prestige and social roles); psychological (determined by mental function studies). Changes in the

functioning of individual organs with age affect mood, attitude towards the environment, physical condition, and social activity, determining the place of the elderly in the family and society. However, psychosocial aging largely depends on how a person prepares for old age and shows its effect over time. It is claimed that the quality of our previous life determines the kind of person we will be in old age. Mental aging expresses human consciousness and its adaptation to the aging process. Acceptance of old age contributes to the feeling of happiness and life satisfaction, while it lacks causes feelings of loneliness and physical pain. Adapting to new situations becomes more difficult as one ages, leading to negative changes in cognitive and intellectual areas (Pedich, 2007; Kocemba, 2007; Szarota, 2004).

The assumption of various roles by the elderly in the social aging process is important for the continuity of social relationships and societal participation. Social aging expresses how a person perceives the aging process and how this shapes their relationship with society. Every individual living in society has defined roles, and with aging, some roles disappear, change, or new roles emerge. This situation is important for elderly individuals to adapt to new roles and show active social participation. Loss of health can reduce life satisfaction, leading to a loss of interest and feelings of loneliness. Retirement often brings significant lifestyle changes, which can result in social isolation and impoverishment.

One of the most important forms of active aging is contact with family, relatives, and neighbours, which leads to a sense of usefulness and dignity. Elderly individuals are in a natural environment where they expect spiritual, physical, or material support from their families. Social aging expresses how an individual perceives the aging process and their relationship with the society they live in. Everyone enters this process with an individual vision of old age, which is shaped by various factors such as closely observing older people, existing stereotypes about old age, and expectations from past experiences.

Disorders in functional capacity led to a decrease in quality of life. Globally, functional limitations are observed at a rate of about 15%. Some studies have shown that disability leads to deterioration in cognitive functions, adversely affecting the quality of life. Additionally, disability can lead to social isolation, causing depression and further worsening the quality of life. Participation in social activities contributes to the maintenance of mental and physical health, leading to an increase in the quality of life. Disability has been particularly associated with advanced age, being frail or overweight, weakness, depression, lack of exercise, health problems, and comorbid conditions. It is more frequently observed in lower socioeconomic levels compared to higher socioeconomic communities. It is more common in women than men, particularly showing a marked increase in those over the age of 80. Disability negatively affects independent living and leads to deterioration in the quality of life (Zhang et al., 2022).

Supporting healthy aging requires a balanced approach encompassing physical, cognitive, and emotional well-being for geriatric individuals. Exercises aiming to improve balance and coordination include tai chi, yoga, and balance exercises. These activities help elderly individuals move safely by reducing the risk of falls. Additionally, strengthening exercises increase muscle strength, contributing to maintaining independence and overall mobility. Cognitive exercises include activities such as puzzles, memory games, and social interactions

to maintain mental sharpness. Combining these elements provides a comprehensive approach to healthy aging. Signs such as persistent pain, excessive fatigue, or fainting during exercises indicate that the individual is exceeding their limits and require immediate consultation with a healthcare professional.

Optimal nutrition and physical activity play a crucial role in supporting healthy aging. Elderly individuals should be encouraged to follow a balanced and nutritionally rich diet regimen that includes various food items. Additionally, incorporating a variety of exercise methods such as aerobic exercises, resistance training, balance-enhancing exercises, and flexibility routines into their daily regimen is crucial. This comprehensive approach is effective in maintaining the physical and cognitive well-being of the elderly, reducing the onset and progression of various age-related health issues, and facilitating an active and happy lifestyle in the later years.

13.8 Exercise Approaches in Geriatric Individuals

1. Aerobic Exercises

At least 150 300 minutes of moderate-intensity aerobic physical activity or at least 75-150 minutes of vigorous-intensity aerobic physical activity or an equivalent combination of moderate-intensity and vigorous-intensity activity during the week is recommended for significant health benefits. Geriatric individuals should engage in at least 30 minutes of aerobic exercise (e.g. walking, swimming, water exercise and stationary cycling) most, if not every day.

2. Strength Exercises

For geriatric individuals, moderate or higher intensity muscle-strengthening activities involving all major muscle groups 2 or more days per week provide additional health benefits. Gradual increases in resistance are recommended in addition to strength training 2 to 3 days a week and a day of rest between training sessions. This helps geriatric individuals maintain bone and muscle strength. It is important to regularly increase the intensity (weight) of exercise to continue to strengthen muscles and bones.

3. Yoga

Yoga helps geriatric individuals to develop physically while maintaining body-mind integrity. In addition, thanks to yoga exercises performed in groups, communication with peers is provided. Chair yoga, restorative yoga and Hatha can be preferred for geriatric individuals. Yoga poses such as Mountain Pose, Butterfly Pose, Savasana, Cat-Cow Pose, Sphinx Pose, Legs on the Wall Pose, Child Pose are recommended. Geriatric individuals should be counselled and monitored during the exercises and progress in exercise. It is important to perform the exercises within the physical limits of the movement without causing any problems in the musculoskeletal system and without straining the functional level of the person.

4. Dance Therapy

Dance therapy may consist of dance-based movements including upper limb flexion, extension, forearm pronation and supination to music. In addition, rhythmic movements with arm swinging, stepping, lower limb movements and back and forth movements can be included to improve weight transfer and increase muscle strength around the knee, ankle, and hip. Warm-up and cool-down periods can be supplemented with stretching exercises and breathing exercises for the neck muscles, posterior-anterior shoulder capsule, trunk extensors, hamstring, and gastrocnemius muscles. Sessions lasting 45 minutes each are recommended to be performed at least once a week for at least six weeks. Research has shown that dance movement therapy improves parameters such as flexibility, muscle strength and endurance, balance, cardiovascular endurance, and cognitive function in elderly individuals (Picture 2-3).

Figure 2 Dance Theraphy

Figure 3 Dance Theraphy

5. Dual Task Training

Dual/task exercises can be performed in a healthy geriatric population. These exercises include activities that require the individual to perform two different tasks simultaneously. Such exercises can be used to cope with difficulties encountered during activities of daily living, maintain balance, reduce the risk of falls, and improve cognitive functions. Especially in older individuals, the simultaneous use of motor skills and cognitive functions is very important in daily life. Dual-task exercises may include activities such as talking while walking, maintaining balance while carrying an object, or performing more than one task at the same time (Pashler, 1994).

Individuals frequently encounter activities that require dual task performance in their daily lives. In situations requiring manual dexterity such as writing messages while walking, carrying plates while talking, taking notes while talking on the phone, taking money out of the wallet while calculating, cleaning while singing and cooking while chatting, motor function should be carried out simultaneously with an additional motor or cognitive function with minimal interaction. Due to the small number of functions involving a single motor task in daily life, it is necessary to evaluate the interaction between motor and cognitive function to accurately analyse the functional status in activities of daily living. When the literature is examined, it is seen that dual task method is used in studies investigating the interaction between motor and cognitive processes (O'Shea et al., 2002; Marchese et al., 2003).

Dual task training is applied by combining the exercises given in single task training with cognitive tasks:

- Recalling a sequence of numbers given with standing (semi-tandem and tandem)
- Standing on one foot and writing predetermined letters or words with the other foot
- Saying a number that comes before a number between 1-100 given with walking by narrowing the level of support (e.g. saying the number 24 if the researcher says 25)
- Making a simple addition with side walking
- Counting from 1 to 100 in increments of one with backward walking
- Throwing and holding a ball with one foot on the step and the other on the ground (Picture 4-5)
- Counting backwards from 100 by decreasing by one with forward reaching
- Saying a number that comes after a number between 1-100 given with side reaching (Weightman and McCulloch, 2014).

Figure 4 Dual Task Training

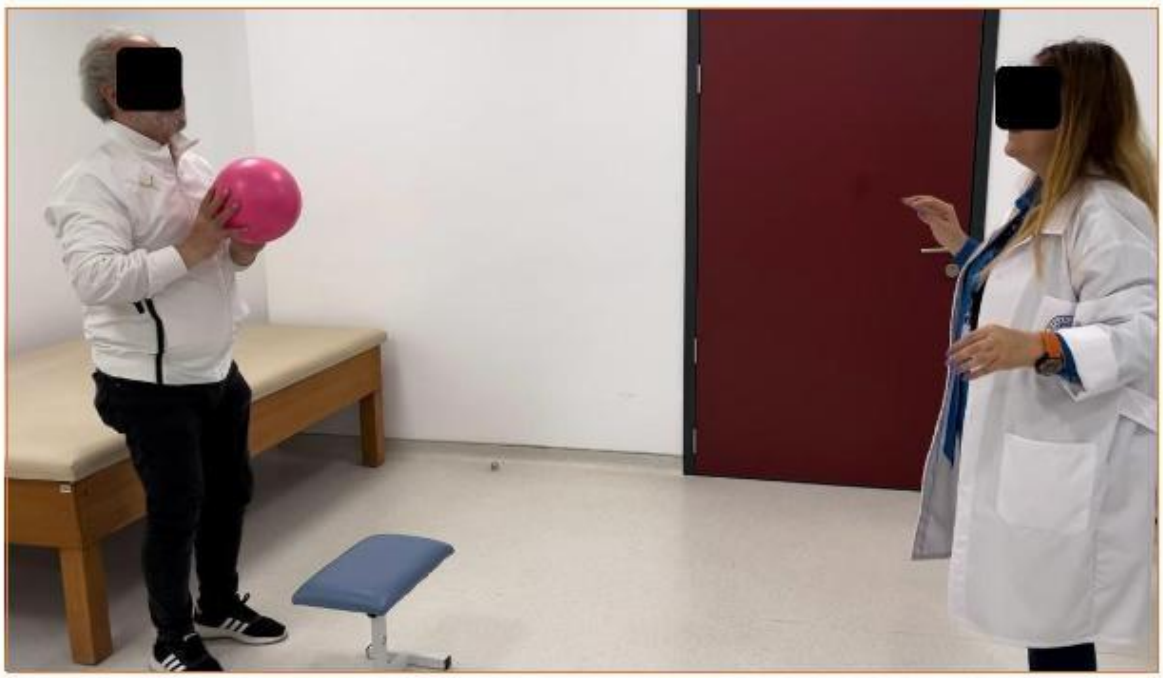

Figure 5 Dual Task Training

13.9 Exercises in Geriatric Rehabilitation

1. Balance and Coordination Exercises

Using mirrors during exercises provides benefits in terms of improved postural control and visual feedback to neurocognitive processes. Emphasising bilateral execution of exercises is crucial for systematic training of both upper and lower limbs. Initial difficulties in exercise performance are normal. It is essential to persevere with the exercise routine, recognising that the body's adaptation processes take time and that even trying one movement can provide significant physiological benefits (Picture 6).

Figure 6 Balance and Coordination Exercise

2. Sit-to-Stand Exercise

This exercise involves transition from a sitting to a standing position and targets lower limb muscle strength, balance, and co-ordination. It is also a basic skill for activities of daily living. Sit to stand exercise provides functional benefits. The exercise is as follows: sit upright on a chair with feet shoulder-width apart. Move towards the front of the chair. In this position, the feet are pulled back, ensuring that the heels are behind the knees. Hands can be held at the sides. Special techniques and variations can be included in the programme to improve balance and coordination during the exercise. To make the exercise more challenging, the exercise can be intensified by crossing the arms over the chest and leaning slightly forward from the hips. Then, move to a standing position with equal weight on both feet. The ankles, knees and hips should be completely in line. Then return to the sitting position. Also, rotational movements should be avoided during the exercise. A higher chair can be used to facilitate this exercise (Figure 7-8).

Figure 7 Sit to Stand Exercise

Figure 8 Sit to Stand Exercise

3. Chair Squats

Chair squat/squat exercise can be used in neuro-geriatric individuals. Neurological diseases such as stroke, Parkinson's disease, or multiple sclerosis, as well as ageing, can cause difficulties with muscle control, balance, and co-ordination. Therefore, exercises such as chair squats should be modified to suit the individual's specific needs and physical condition.

Depending on the individual's physical fitness, it is important to initially start with a smaller number of controlled chair squats. During this exercise the individual should be supported and kept safe with a support aid, balance bar or supervised by a physiotherapist. If a full squat is not possible, a more limited range of movement can be used (Picture 9-10).

Figure 9 Chair Squats

Figure 10 Chair Squats

4. Bridge Exercise

The bridge exercise is widely used in geriatric rehabilitation. In this exercise, the person lies on their back, lifts their hips off the bed and keeps their hips and knees bent while maintaining spinal alignment. The 'bridge' exercise encompasses a few benefits including strengthening core muscles, correcting posture, improving balance and coordination, and increasing core stabilisation. Neurological geriatric conditions often lead to physical limitations such as muscle weakness, imbalance, and coordination problems. Physiotherapists can create specific exercise programmes according to the individual needs of these patients and provide appropriate guidance.

Figure 11 Bridge Exercise

5. Ipsilateral-contralateral ROM exercises with metronome

Such exercises can be applied to neurologically elderly individuals but should be customised taking into account the health status and individual needs of the individual. Since the use of a metronome facilitates movement in a certain rhythm and tempo, moving with a metronome in these exercises can increase the coordination of the individual and make the movements more regular. Whether the exercises are performed ipsilaterally or contralaterally depends on the individual's specific health status, goals and physical abilities. The physiotherapist creates an exercise programme suitable for the needs of the individual.

Ipsilateral Exercises: Ipsilateral exercises refer to exercises in which both sides of the body work at the same time. An example of this is when the right or left upper and lower extremities perform a certain movement at the same time.

Contralateral Exercises: In contralateral exercises, the movement of one side is coordinated with the movement of the other side. Completing a movement with the left leg while the right arm is moving is an example of contralateral exercises.

Figure 12 Ipsilateral ROM exercises with metronome

Figure13 Contralateral ROM exercises with metronome

6. Hip Marches

The ‘Hip Walk’ exercise is generally considered a fitness routine suitable for the healthy aging process. This exercise is designed to strengthen the hip and lower limb muscles, increase coordination, and improve balance. The typical steps involved in the Hip Walk exercise are as follows:

- Stand in an upright position with your feet shoulder-width apart.

- Lift each leg upwards in turn, making a hip flexion movement.

- Slowly lower the legs to return to the starting position.

- Repeat the same movement with the other leg.

The Hip Walk exercise is effective in increasing lower limb muscle strength. However, the physiotherapist should consider the general health status, mobility, and special needs of the individual when prescribing this exercise (Figure 14).

Figure 14 Hip Marches

7. Standing Hip Abductions

This exercise aims to strengthen the hip abductor muscles and improve balance at the same time. During the standing hip abductor exercise, the feet should be positioned in an upright posture, either together or hip-width apart. The hip abduction movement is initiated by lifting one leg to the side. Care should be taken to maintain the knee extension position and the lifted leg should be kept in a high position for a short time. Lower the legs slowly to return to the starting position. The same sequence is repeated with the opposite leg. Care should be taken to avoid bending the trunk to the side during the movement (Figure 15).

Figure 15: Standing Hip Abduction

8. Stretching Exercises

Stretching exercises are beneficial for the geriatric population in terms of physical health and general well-being. Flexibility exercises give muscles and joints a greater range of movement, increase mobility, reduce muscle tension, relieve muscle pain, improve oxygenation of muscles by increasing blood circulation, support posture, prevent injuries and strengthen the connection between mind and body. By incorporating flexibility exercises into the daily routine, overall body health and well-being can be improved. Stretching exercises for the lumbar extensors, hamstrings, hip flexors and pectorals can be included in the programme (Figure 16-17).

Figure 16: Stretching Exercise

Figure 17 Stretching Exercise

9. Cognitive Exercises

As an example of cognitive exercises, Pegboard Box Exercise is widely used to improve cognitive functions in geriatric individuals. It is used to observe mental changes and cognitive performance in elderly individuals and aims to improve cognitive skills. The Box and Block Test is useful in the geriatric population as it assesses visual-motor coordination, planning, spatial perception and problem-solving abilities. For this exercise, coloured blocks and a box are usually used. The blocks can be of different colours and can be arranged in various ways. The individual's aim is to place the blocks in the box to create a specific pattern or arrangement. The pattern is usually provided through a model or picture and the older person is expected to arrange the blocks to fit this pattern (Figure 18).

Figure 18 Cognitive Exercise

Conclusion:

Physiotherapists design individualized exercises that enhance muscle mass and strength and provide flexibility for maintaining and improving the health of elderly individuals. Flexibility exercises optimize performance in daily activities by increasing joint range of motion and muscle flexibility. Balance and coordination exercises reduce the risk of falls and support safe movement. Rehabilitation programs aim to preserve and enhance the independence of elderly individuals and include functional movement analyses and improvement strategies that increase overall quality of life.

In treating musculoskeletal issues, physiotherapists apply exercise-based interventions for conditions such as osteoarthritis and use manual therapy and therapeutic exercises to

maintain joint health. Additionally, approaches such as group therapies provide social support and motivation, positively impacting individuals' psychosocial well-being.

Physiotherapists play a critical role in protecting and improving the health of older people through science-based approaches. These interventions are implemented through personalised treatment plans according to the specific needs of each individual. As a result, these holistic and individualised approaches make significant contributions to improving the quality of life of older people and promoting healthy ageing.

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14 INTERPROFESSIONAL COMMUNICATION IN EVALUATING GERIATRIC CLIENT'S FUNCTIONING ON A HOME VISIT

Mari Törne

14.1 Changes according to ageing

Aging in the human body happens gradually starting from an early childhood. It affects to the whole body from the cell level to the different structures of the body. If we think about the chronoligic age, officially people after the age of 65 years are said to be at the older age. But when we think about the biological age, physiologically people age in a different rhythm, if we think about the changes in the body and the functioning. There is also a psychologic age, which is based on how people act and feel (Stefanacci 2024).

Most age-related biologic functions reach their peak before age of 30. After that they gradually decline linearly. (Stefanacci 2024). The bones lose their density in ageing. The amount of calcium, which keeps the bones strong, decreases because the body absorbs less calcium and vitamin D from foods. (Stefanacci 2024). Bone density may decrease, and bone structure may deteriorate from as early as 35-40 years of age. Changes are more pronounced after age 50, especially with women. (Suominen and Suominen, 2022)

The amount of muscle tissue decreases as a person ages, while the muscle tissue that is lost is at least partly replaced by adipose tissue. (Suominen and Suominen 2022) Both, fast muscle fibers (type I) and slow fibers (type II) decrease. The connective tissue membranes between the muscle fibers thicken to some extent and fat accumulates in the muscle interstices. In sarcopenia muscle protein breakdown and synthesis are imbalanced leading to the loss of muscle mass and muscle function in old age, which in turn often leads to reduced functional capacity and quality of life. Decreased amount of physical activity and poor nutrition can cause sarcopenia. Regular physical activity can prevent sarcopenia. With aging, the tensile strength of the tendon decreases, because the tendons are almost exclusively composed of parallel collagen fibers. (Tilvis 2016.) Also, the muscle strength declines by about 1.5-2% per year after the age of 65 (Suominen and Suominen, 2022). The reaction time increases by about a quarter, due to anatomical and physiological changes in the central nervous system. (Tilvis 2016)

14.2 Functioning

Functional ability or functioning refers to a person's ability to cope with everyday life. Functioning can be considered in terms of physical functioning (e.g. getting outdoors, walking and coping with household chores), mental functioning (e.g. cognition and mood) and social functioning (e.g. loneliness and social isolation). (Pitkälä, Valvanne, Huusko, 2016) A gradual decline in functioning is seen first in the advanced activities of daily living (AADL), such as social participation and active physical activity. This is followed by problems with instrumental activities of daily living (IADLs), such as doing household chores, going to the shops, driving a car and using medicines and the telephone. Eventually, the basic activities of daily living (BADL), such as walking, bathing, getting out of bed and out of a chair, getting dressed, going to the toilet and eating, are affected. (Pitkälä, Valvanne, Huusko, 2016)

Functional impairment or deterioration in functioning is defined as a difficulty or need for assistance with activities of daily living that are necessary for independent living. A functional disability occurs when a person's mental or physical capacity is insufficient to meet the demands of the environment. The older person is an active player who reacts and adapts to their activity deficit and its consequences, e.g. by exercising, adapting their needs or using assistive devices. Another option is to modify participation, e.g. by obtaining outside help or modifying the environment to make it more functional. (Pitkälä, Valvanne, Huusko, 2016)

The more the capacity to function deteriorates, the more the older people are vulnerable to the effects of the environment. Living in a familiar environment allows the older people to be autonomous throughout life span. In a familiar environment, an older person develops compensatory and coping mechanisms as their functioning declines. An environment that is barrier-free, accessible and safe improves the elderly person's survival at home for longer. (Pitkälä, Valvanne, Huusko, 2016)

A dysfunction can occur slowly or as a sudden catastrophe. The incidence of slowly progressive functional impairment increases more rapidly with age than that of sudden onset functional impairment (Pitkälä, Valvanne, Huusko, 2016). Functional impairment or deterioration in functioning is influenced not only by a person's physical functioning, but also by psychological (e.g. cognition and mood) and social functioning (social activity, social networks), as well as by the physical environment and available aids. (Pitkälä, Valvanne, Huusko, 2016).

Several factors affect the development of disabilities. According to Verbrugge & Jette (1994), the extra-individual factors, like medical care and rehabilitation, medications, need of external supports and environment (built, physical, and social) can affect disabilities. The intra-individual factors affecting are lifestyle and behaviour changes and psychosocial resources. (Verbrugge and Jette, 1994) This shows that internal and environmental factors can speed up or slow down the onset of functional deficiencies (Pitkälä, Valvanne, Huusko, 2016).

Hospitalization is a major risk factor for older people for developing functional impairments. Around one third do not return to their pre-hospital level of functioning, even if the acute illness is successfully treated. Hospital care is often passive, with limited mobility and not necessarily adequate nutrition and fluid intake. Medications may contribute to the inactivity of the patient. Post-hospital factors, such as lack of follow-up rehabilitation, may predispose to reduced functional capacity. (Pitkälä, Valvanne, Huusko, 2016). To minimize functional impairments, unnecessary bed rest should be avoided, adequate food and drink intake, and constant critical review of the medication list should be completed. (Pitkälä, Valvanne, Huusko, 2016).

14.3 Assessment of functioning of an elderly person

Older people are usually willing to continue their lives at home as long as possible. Assessment of a person's ability to live independently at home is an important duty for health care professionals. (Schulman-Green et al 2006; Huang et al 2007.) Comprehensive geriatric assessment is a multidisciplinary process involving physical, mental, cognitive and socioenvironmental aspects of functioning. (Stefanacci, 2022). It should always have a holistic approach. (Ramani, Furmedge & Reddy 2014.) Determining functioning only in a hospital or institutional setting can give a wrong picture of an older person's ability to cope at home, unless the requirements and opportunities of their living environment are known and understood, and the views of relatives and friends are taken into account. (Pitkälä, Valvanne, Huusko, 2016) Assessment is difficult, however, as living independently involves multiple functional domains.

Interprofessional collaboration is defined within healthcare as an active and ongoing cooperation between professionals from different backgrounds and professional cultures working together in providing services for the healthcare users. (Schot, Tummers & Noordegraaf 2020)

The geriatric assessment is a multidisciplinary assessment. It aims to evaluate an older person's functional ability, physical and mental health, cognition, and socioenvironmental circumstances. It is usually initiated when the physician or family members identifies a potential problem. The geriatric assessment differs from a standard medical evaluation by emphasizing functional capacity and quality of life. Often, it is completed in a multidisciplinary team. (Bassem & Higgins 2011)

14.3.1 The short physical performance battery

The Short Physical Performance Battery (SPPB) is a well-established and reliable test for measuring the performance of the lower limbs of older people (Pavasini et al 2016). The SPPB tests balance, lower extremity strength, and functional capacity in older adults above the age of 65 years. It includes three different parts: walking, sit-to-stand and balance to assess functional mobility. (Physio-pedia) The SPPB score lower than 10 is predictive of all-cause mortality. The test may provide useful prognostic information about the risk of all-cause

mortality, but it also provides useful and reliable information about the geriatric client's ability to perform daily living activities. (Pavasini et al 2016)

The first part of this test battery is **Chair stand**, which measures the strength of the lower limbs. This ability is needed in daily living functions, like walking, dressing, cooking, to mention some of those. The test begins with single chair stand in which the person is sitting in a chair with the back resting on the backrest, arms crossed over the chest and feet firmly on the floor. If the person can complete the stand up once, we can move to repeated chair stand in which the person stand up from sitting position five times. If the person tries to stand up, but needs to take support from the knees, the test is not needed to continue (Figure 1).

Figure 1 chair stand test with arms on the side of the body. To be able the stand up, this person needs to take support also form the knees. (Picture by Törne M, 2024)

The repeated chair stand in which the person stands up from sitting position five times is then performed. The time is taken with watch. The person is asked to perform sit-to-stand movement as quickly as possible.

The results are scored as follows:

- Participant unable to complete 5 chair stands or completes stands in >60 sec: 0 points
- If chair stand time is 16.70 sec or more: 1 point
- If chair stand time is 13.70 to 16.69 sec: 2 points
- If chair stand time is 11.20 to 13.69 sec: 3 points
- If chair stand time is 11.19 sec or less: 4 points (Physiopedia)

For safety reasons it is important that the chair is placed against the wall. The physiotherapist is needed to stand very close to the person, if the balance is lost.

The second subtest in the SPPB is the balance, which has three parts: side-by-side-stand, semi-tandem stand and tandem stand. Balance is needed in almost all the daily living activities. The balance part is not performed, if the person is unable to stand independently in a stationary position without support or assistance. If the person with an assistive device can stand safely in a stationary position without support, testing can be done.

In side-by-side-stance the person stands with feet together for 10 seconds (picture 2).

Figure 2. Side-by-side stance with feet together. (Picture by Törne M, 2024)

The scoring for side-by-side stance is as follows:

- Held for 10 sec: 1 point
- Not held for 10 sec: 0 points
- Not attempted: 0 points
- If 0 points, end Balance Tests (Physiopedia)

If the person is unable to stand feet together without holding support from e.g. a chair or the feet do not stay together, the person gets 0 points, and the balance test part is not continued.

The second part is the semi-tandem stance, the person stands unsupported with the side of the heel of one foot touching the big toe of the other foot for 10 seconds (picture 3). The person may use the arms, bend the knees, or move the body to maintain balance, but they are not allowed to move their feet.

Figure 3. Semi-tandem stance. (Picture by Törne M, 2024)

The scoring for semi-tandem stance is as follows:

- Held for 10 sec: 1 point
- Not held for 10 sec: 0 points
- Not attempted: 0 points
- If 0 points, end Balance Tests (Physiopedia)

The last part of the balance test is the tandem stance (picture 4). The person is instructed to stand with the heel of one foot in front of and touching the toes of the other foot for 10 seconds. Again, in this test, the person may use their arms, bend their knees, or move their body to maintain the balance. The feet are not allowed to be moved.

Figure 4. Tandem stance. (Picture by Törne M, 2024)

The scoring for the tandem stance is as follows:

- Held for 10 sec: 2 points
- Held for 3 to 9.99 sec: 1 point
- Held for < than 3 sec: 0 points
- Not attempted: 0 points (Physiopedia)

The last part in SPPB is the walking test, which tests the gait speed. The participant walks on the line on the floor (3 or 4 meters) at a normal pace (picture 5). The time is recorded. The assistive device can be used. For safety, the physiotherapist should walk beside the person.

Figure 5. Walking speed. (Picture by Törne M, 2024)

The scoring for For 4-Meter Walk test is as follows:

- If time is more than 8.70 sec: 1 point
- If time is 6.21 to 8.70 sec: 2 points
- If time is 4.82 to 6.20 sec: 3 points
- If time is less than 4.82 sec: 4 points (Physiopedia)

14.3.2 The Barthel index

The Barthel Index for Activities of Daily Living is an ordinal scale which measures a person's ability to complete activities of daily living (ADL) (Physio-pedia). Barthel Index was created in 1965 to assess functional independence to perform 10 daily activities, and it has been mostly used with neurological diseases and the elderly (dos Santos Barros et al 2022). When the person gets very low score in Barthel Index, they are more likely to be dependent on caregivers and/or assistive devices. This is very valuable information, when we talk about functioning. The following ten daily living activities including basic mobility are measured with the Barthel index: Feeding, Bathing, Grooming, Dressing, Bowel, Bladder, Toilet use, Transfers bed-to- chair-and-back, Mobility on level surfaces, Stair negotiation. Any member of the multidisciplinary team can perform the Barthel Index. The Barthel Index is not meant to be used as the only assessment tool to see functioning of the person. It should be part of a complement of assessments to create a full picture of a person's functioning. (Physio-pedia).

When completing the Barthel Index, it is important to assess what the person actually does and how they complete the tasks instead of only asking the person their own opinion. To be able to see this, allow the person to complete the functional tasks as independently as possible without providing physical or verbal assistance. Make sure it is safe for the person. If they need assistive devices or aides, it can be allowed. Assistive devices can be used, and the test can still be scored as independent, but if the patient requires supervision they cannot be scored as independent. The examiner can also ask the patient, a family member, or other staff for information if needed. The Barthel Index is used as a part of a assessment to create a full picture of a patient's ability and rehabilitation potential. (Physio-pedia)

14.4 Interprofessional Communication

A term interprofessional collaboration is used in this learning module to describe cooperation between occupational groups representing different professions. The fluency of interprofessional communication between a physiotherapist and a nurse in assessing geriatric client's functioning to live at home independently is important. The situation of a geriatric client needs to be seen through a holistic approach. Culturally sensitive communication demonstrates understanding and respect for individuals and promotes patient and family satisfaction. (Brooks, Manias & Bloomer 2019)

Interprofessional collaboration is necessary to provide optimal and effective patient care and improve the quality of health care. It means that health care professionals with different specialties, different areas of expertise and work, and a different level of status all work together to provide high-quality, patient-oriented care. It also ensures that the patient benefits from the specific skills of each individual profession (Mahler et al 2014)

Interprofessional communication used in interprofessional collaboration must be working well to maintain the quality of care. Ineffective communication in healthcare results in different kinds of patient harm and adverse effects (Foronda et al. 2016, Hunter et al 2021). In addition to being able to communicate professionally with patients, families, communities, it is as important to be able to communicate with all professionals in health and other fields in a responsive and responsible manner. This supports the approach to the promotion and maintenance of health and the prevention and treatment of disease or disorder (Interprofessional Education Collaborative 2016)

A high quality, patient-centered care can be assured by culturally appropriate communication between health care professionals and with patients. In cross-cultural situations, cultural competency is very important for effective cooperation between health care professionals and their patients. (Hunter, Majd, Kowalski & Harnett. 2021)

14.5 The case - clinical reasoning

In the videos, the client called Martta Mäkinen and her functioning is assessed. Now you can get familiar with the case description and the test results:

Martta Mäkinen

88-yrs old lady living at home with the help of home care and home care nurse. No children, husband passed away 20 yrs ago. Her sister's daughter has helped going to the bank and grocery store. Her medical diagnosis are Type 2 Diabetes (insulin dependent), Myocardial infarction in 2015 and Hypertension for 30 yrs. She fell at home and was taken to hospital by ambulance 3 days ago. She was complaining about pain in the left shoulder. The x-rays showed no fractures, but she is having large hematoma in the shoulder and moving the arm seems painful. No acute ischemic changes seen in ECG. No cerebrovascular accident seen in head MRI. She was discharged from hospital yesterday and the doctor has given a referral to a physiotherapist for a home visit and evaluation of the ability to live at home independently.

Test results for Martta are as follows:

Short physical performance battery

1. Chair stand 0 points
2. Side-by-side-stand 0 points: the following balance tests were not needed to be done

3. Semi-tandem stand 0 points
4. Tandem stand 0 points
5. Walk test time 9,20 seconds = 1 point

For Barthel index her scoring was as seen in the picture 6.

Barthel Index of Activities of Daily Living

Instructions: Choose the scoring point for the statement that most closely corresponds to the patient's current level of ability for each of the following 10 items. Record actual, not potential, functioning. Information can be obtained from the patient's self-report, from a separate party who is familiar with the patient's abilities (such as a relative), or from observation. Refer to the Guidelines section on the following page for detailed information on scoring and interpretation.

The Barthel Index

Bowels
0 = incontinent (or needs to be given enemata)
1 = occasional accident (once/week)
2 = continent
Patient's Score: 2

Bladder
0 = incontinent, or catheterized and unable to manage
1 = occasional accident (max. once per 24 hours)
2 = continent (for over 7 days)
Patient's Score: 2

Grooming
0 = needs help with personal care
1 = independent face/hair/teeth/shaving (implements provided)
Patient's Score: 0

Toilet use
0 = dependent
1 = needs some help, but can do something alone
2 = independent (on and off, dressing, wiping)
Patient's Score: 1

Feeding
0 = unable
1 = needs help cutting, spreading butter, etc.
2 = independent (food provided within reach)
Patient's Score: 2

Transfer
0 = unable – no sitting balance
1 = major help (one or two people, physical), can sit
2 = minor help (verbal or physical)
3 = independent
Patient's Score: 3

Mobility
0 = immobile
1 = wheelchair independent, including corners, etc.
2 = walks with help of one person (verbal or physical)
3 = independent (but may use any aid, e.g., stick)
Patient's Score: 3

Dressing
0 = dependent
1 = needs help, but can do about half unaided
2 = independent (including buttons, zips, laces, etc.)
Patient's Score: 1

Stairs
0 = unable
1 = needs help (verbal, physical, carrying aid)
2 = independent up and down
Patient's Score: 1

Bathing
0 = dependent
1 = independent (or in shower)
Patient's Score: 0

Total Score: 15

(Collin et al., 1988)

Scoring:
Sum the patient's scores for each item. Total possible scores range from 0 – 20, with lower scores indicating increased disability. If used to measure improvement after rehabilitation, changes of more than two points in the total score reflect a probable genuine change, and change on one item from fully dependent to independent is also likely to be reliable.

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Figure 6 Martta's Barthel index (British Geriatric Society).

You could now make your own clinical reasoning for Martta's functioning and spend some time with thinking the following questions:

1. How you would describe Martta's functioning, if you consider the physical functioning?
2. In your opinion, is her still able to live at home independently?
3. What is the need for assistance and what kind of assistance she would need at home?

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15 BALANCE AND FALLS RISK ASSESSMENT IN AN OLDER PERSON WITH OSTEOPOROSIS AND AGGRESSIVE BEHAVIOUR

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15.1 Osteoporosis characteristics

Osteoporosis is a systemic bone disease accompanied by a decrease in bone mass and damage to the microstructure. It is the most common metabolic generalized bone disease worldwide, with its progression placing a large burden on both individual and social levels. (Shen, 2022; Dempster, 2011; Old 2015) Sporosis is characterized by low bone mass and poor bone tissue microarchitecture, resulting in increased risk of bone fracture. (Kanis, 2019)

The prevalence of osteoporosis is 18.3% (five continents) and the number of associated bone fractures is increasing worldwide. (Salari, 2021) Bone fractures resulting from the progression of the disease are estimated to account for nearly 9 million cases worldwide each year. (Pisani, 2016)

These bone fractures are pronounced factors of morbidity and mortality, despite the fact that effective medical and other therapeutic options would be provided to patients diagnosed in time. In many cases, adequate treatments do not occur, either because of lack of diagnosis, lack of patient cooperation, or lack of medical care. (Clynes, 2020)

Postmenopausal changes are the most common cause of osteoporosis. At the same time, more than 30% of the members of this group and more than half of the men and premenopausal women suffer from secondary osteoporosis. In such cases, the treatment of the underlying disease (see risk factors) is also essential in order to stop the deterioration of the condition. (Lewiecki, 2021) Picture 1 shows the traditional distribution of osteoporosis, based on Chitra's and LeBoff's article.

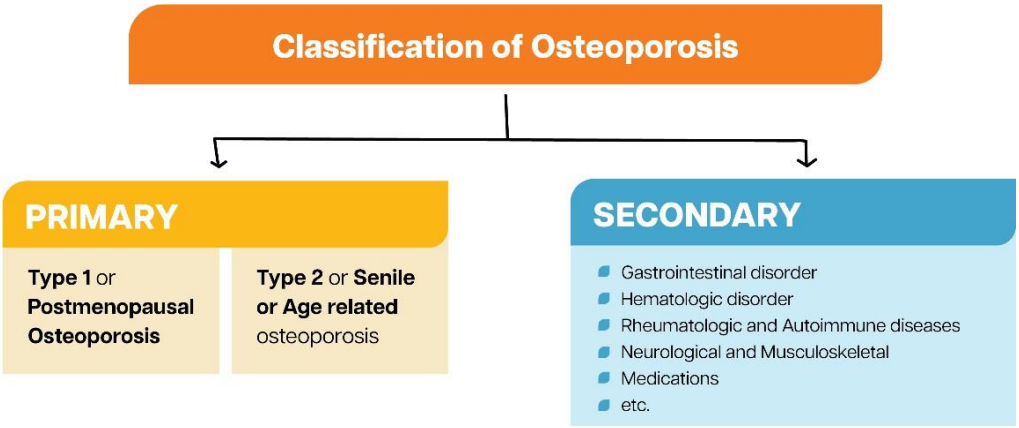


Figure 1. Osteoporosis allocation (based on Chitra, 2021 and LeBoff, 2022)

Osteoporosis may also be divided by the severity of bone involvement. Not only bone density has a direct role in the occurrence of fractures, although it is also important to know the structural resilience of bones, which is based on the results of bone density tests. (Shevroja, 2023) In many countries, the density characteristics of bone are routinely established by examining the DEXA (dual energy X-ray absorptiometry-DXA) of the hip and lumbar spine. The obtained standard deviation value can be a T-score value indicating a deviation from healthy young bone, or a Z-score indicating a deviation from the expected gender and age values. The latter is typically used in young people. (Kanis, 2019) More recently, the trabecular bone score (TBS) is also used to obtain an image of the bone strength in both primary and secondary osteoporosis. (Shevroja, 2023) Estimation of the trabecular structure has become a useful addition to traditional values. (Ganesan, 2024) However, it should be noted that research results and correlation analyses are primarily applicable to postmenopausal women, and premenopausal women should not apply the bone density criteria and guidelines.

There are four levels of severity that can be determined by measurement:

Table 1 Classification based on DEXA values according to World Health Organization Recommendation (Lewiecki, 2021)

1	T-score > -1.0 SD	normal (healthy bone)
2	T-score -1.0 and -2.5 SD	osteopenia (low bone mass)
3	T-score < -2.5 SD	osteoporosis

4	T-score < -2.5 SD and fragility fracture	severe osteoporosis

The course of osteoporosis appears in a variety of ways and is often associated with general symptoms (muscle tension, increasing pain upon exertion, percussion pain). In addition, you may have specific symptoms such as fracture pain in the bone, deformity and height loss due to these. Greasy pannicules and folds of skin may appear in the back area. The patient's posture also changes: thoracic kyphosis is increased, and there is a compensation cervical lordosis increase, and thus neck pain occurs. An increased thoracic curvature results in shoulder retraction and a rotten upper limb position. As the iliac crests and ribs approach, the functional efficiency of the diaphragm is reduced, dyspnoea and digestion problems may develop (hyatus hernia, meteroism). (Aibar-Almazan, 2022)

15.2 The role of risk factors in osteoporosis

Bone decomposition and construction throughout life, although the pace of this is changing, is ongoing. During remodelling (remodelling), the weight and mechanical resistance of the bone are adapted to the amount and extent of regular stress and other physical factors (such as direction of force). This remodelling of bones not only ensures the structural integrity of the bones, but also supports the balance of the body's mineral source (calcium, phosphorus). (Rowe, 2023) In osteoporosis, the speed of old bone breakdown (resorption) and new bone structure (formation) changes, thus the ratio of processes in relation to each other. The imbalance of remodelling leads to a decrease in the quantity of bone mass per unit, which leads to a decrease in the strength of the bones, thus increased bone fragility. (Appelman-Dijkstra, 2022) To prevent this, bones need basic mechanical stimuli and nutrient supply. Mechanical stresses are created by tendon-mediated muscle contractions, impact forces and gravity forces. (Hart, 2017)

In addition, many factors affect the implementation and control of the well-paced, properly-programmed remodelling processes. There are factors, such as age, gender, and other genetic factors, that cannot be influenced, that can cause the disease to develop. These should be considered as predictive factors, primarily by their effect on bone building processes. (Ralston, 2007) Osteoporosis is traditionally described as a female disease, but affects men. Salari et al believe that prevalence in their case is 11.7% (while in women this Picture is 23.1%). However, they are even more likely to find out the source of the problem only after the first fractures. (Volunteerly, 2017) The disease is often underestimated in men; therefore, the diagnosis and treatment of the disease is also delayed. Much of the more common fractures (approx. 40%) occur in male sex, and studies have shown that men are more likely to experience new fractures after fracture and a higher mortality rate due to complications. (Bandeira, 2022)

The role of genetic characteristics may also be important due to the influence of body characteristics on the osteoporosis process. Ectomorphic individuals with a low BMI index are more likely to develop the disease compared to those with average body weight. The risk classification determined in proportion to body weight is shown in Picture 2. (Yong, 2021)

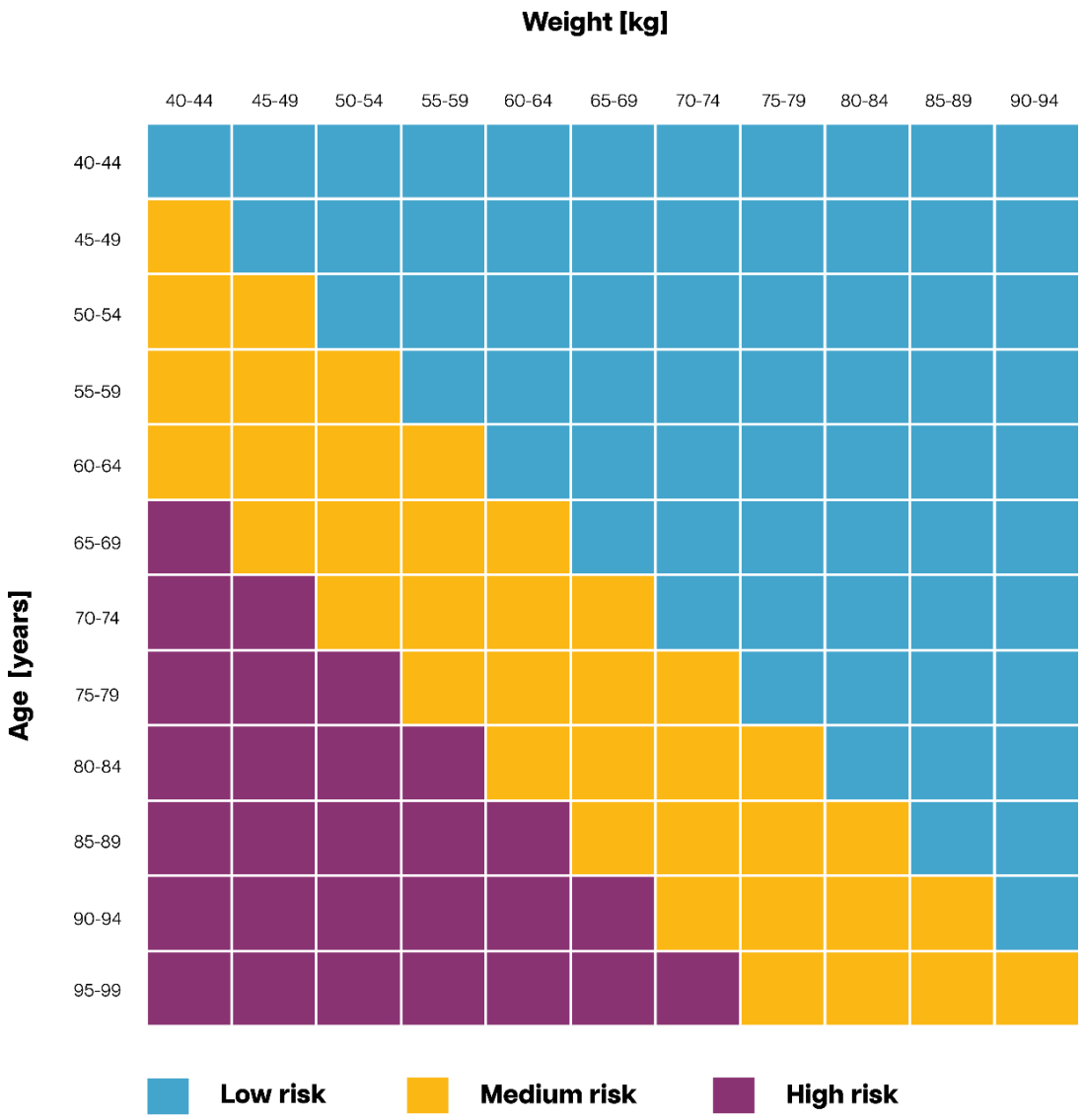


Figure 2 Body weight as risk factor for osteoporosis (Yong, 2021)

The role of lifestyle (influenceable) factors in the development or course of osteoporosis is significant. Regular smoking, drinking alcohol, and drinking large quantities of coffee (three or more) each day all negatively impact bone mass. Calcium and vitamin D consumption have long been a major concern among dietary habits, but in addition, the role of several trace elements in bone building processes (selenium, phosphorus, K2) has been prioritized. The consequences of eating disorders, malnutrition, or simply not paying attention have a negative long-term effect on bone building processes. (Bijelic, 2017; Hendrickx, 2015) Additional risk factors include long-term use of certain medications, as well as inflammatory diseases, endocrine, respiratory diseases, gastroenterological diseases. (LeBoff, 2022) Conditions to be

distinguished during the diagnosis of the disease include, but are not limited to,steomalacia, renal osteodystrophy, lymphoma, mastocytosis, osteonecrosis, infection, etc. (Ganesan, 2024; Porter, 2024)

15.3 Osteoporosis and Balance

Peace of mind is about holding the center of body weight above the support surface. The stability limit (safety boundary for body swing) depends on factors affecting the balance of individuals. Differences in any of these factors (including perception) lead to inadequate reactions and problems with balance. (Horse, 2009) Posture and balance are essential for the functional activities of daily living. Steadyness can be interpreted as a result of feedback based on somatosensory, visual, and vestibular information under intact conditions. (Pauelsen, 2020) Be able to support the body while standing, walking (vertical positions). This prerequisite is the central nervous system-controlled mechanisms of information from sensory systems, which control processes ensure that postural (postural) control is in place. This is the foundation of your ability to maintain balance. (Shanbhag, 2023) The complexity of balancing enables the fast and precise changes (via feedback) that are even needed to prevent falls. (Xing, 2023) The feedforward control also supports the responsiveness, with which the number of drops can be significantly reduced. (Pai, 2003) In addition to the previously mentioned nervous system structures and processes, the motor system also plays a significant role. The condition of the musculoskeletal system is also a significant factor in balance. Lower limb and trunk muscles weakening also affect ranges of motion, but due to loss of stability, unwanted excursions of movement are created in the trunk and extremities. Not only are they harmful to the joints, but they also negatively affect balance. Muscle imbalance results in less or no relaxation of overactive muscles that generate joint microdisposition. Altering arthrinematic movements may result in unwanted movements of the joints and variations in the range of motion, while tonic muscle antagonists are inhibited. Persistent evidence of this leads to slower uptake of propriocepceptive stimuli (sensomotor amnesia / pseudoparesis) and reduced response capabilities. As a result, deteriorating motion coordination occurs. (Varga, 2014)

The two forms of human body balancing are static balance and dynamic balance. Static balance is the ability to maintain a particular situation, while dynamic refers to a sustainable balance during movement. (Panjan, 2010)

Simpler and more complex tests are available to measure steady-state, and device measurements are also available. In everyday practice, complex or expensive tools are often not available, but it is worthwhile to determine as accurately as possible the ability to measure and develop.

Steadiness may be impaired by a variety of conditions or diseases. In addition to neurological conditions, sarcopenia is common, which affects the development of postural dysfunction regardless of gender and age. (Kim, 2020)

Muscle weakness and equilibrium disorder are common in osteoporotic patients. Steady-state changes in the uptake and processing of visual, vestibular, somatosensory stimuli also associated with normal aging occur. In addition to slowing reactions, the balance of osteoporosis patients is affected by changing postures and decreased activity. These cause a decrease in muscle strength in the trunk and lower extremities. Muscle balance deteriorates, kyphotic posture makes self-care activities more difficult (stem movements, walking speed, and walking stairs are reduced). A bent posture also causes the center of body weight to be placed forward, thus getting closer to the edge of the support surface, leading to a more unstable equilibrium position. (Hsu, 2014.; Gunay, 2020)

It may further increase the deterioration of the condition, presumably the pain has a negative effect on propriocepation and thus the ability to maintain balance. (Efstathiou, 2022) In an older age, good posture control and good balance are also limited by impairment of cognitive function. As well as slowing down reactions, they are characterised by larger swings while standing, and difficulty in carrying out dual tasks can also be observed in their case. (Liu, 2020)

15.4 Fall in osteoporosis

It is estimated that about one third (28-35%) of those over the age of 65 will fall at least once a year, and this rate increases with age. (Kalache, 2007)

Falls affect all age groups, but people over the age of 65 are particularly at risk, as they have the highest rate of bone fractures. Most of the fractures in the older age group (about 90%) are caused by falls. (Komisar, 2021) The resulting complications can be life-threatening for this age group. (James, 2017) The resulting complications can be life-threatening for this age group. (Sawers, 2018)

The background of falls has been investigated by many studies, which have concluded that falls should be thought of as multifactorial events. (Lockhart, 2005) These external influences may even depend on factors such as the customs and characteristics of each nation. There are significant differences between Western European countries in terms of the incidence of elderly falls and related impacts. (Haagsma, 2020)

From a biomechanical point of view, a fall can be characterized as a disruption of dynamic balance and the inadequacy of its restoration. (Nagano, 2022; Xing, 2023) From now on, an important role can be attributed to the nature of the fall and the activation of the defence mechanisms. (Yang, 2020) Due to the variability of fall characteristics (environmental and personal) and consequences, the methods used to estimate fall risk are also broad and varied. In addition to locomotor status, perceptual ability, the individual's coordination level and existing illnesses are also important.

Of the latter, a significant risk factor is, for example, osteoporosis and high or fluctuating blood pressure. Osteoporosis is often associated with immobility, weakness, and previous fall which increases the risk of falling.

Falls are the most common cause of injuries in the elderly, however, they do not require all fall care, approximately one in five cases lead to breakage. (Scheffer, 2008) Individuals who have fallen several times in response to better reactions and have a lower rate of serious injury. Improving reaction time and practicing how to fall can help prevent serious injury in the future in the prevention of falls. Motor learning allows patients with osteoporosis to adopt a good fall strategy when a good series of motion becomes automatic. (Phelan, 2015) Others, after a fall, even if they do not suffer a fracture, often develop fear of falling, which results in their movement becoming more limited. (Kolpashnikova, 2023)

The development of a fall is determined by the characteristics, abilities, and effects of the environment, such as extrinsic, intrinsic, and situational factors.

Examples of personal characteristics include age-related changes, lower education or solitude, cognitive impairment, sensory loss, changes in balance, walking or strength, illnesses, behaviour. Environmental factors include healthcare, medical treatment, footwear, supportive devices, home/neighbourhood characteristics, drugs, medications, caregiver support. In addition, comorbidities such as diabetes, stroke, depression, Parkinson's disease. (Phelan, 2015; Xu, 2022) Dizziness (dizziness and vertigo) are very common symptoms in the history of falling. The incidence of dizziness increases with age and is slightly more common in women. Dizziness causes a feeling of general uncertainty to affect the temporary inability or weakening of balance maintenance. The most common appearance is from lying to sitting or performing tasks that involve head backwards. (Join, 2004) In case of secondary osteoporosis, the underlying disease may also contribute to the fall, such as stroke or diabetes mellitus. Neuropathy in connection with diabetes increases the risk of falling due to loss of sensation in the leg. (Repeated, 2021)

Falls associated with fracture occur most often from standing height, especially common in case of side drop (5.7 times the risk). However, hand dimming may reduce the risk of hip fracture. Hip protection supports prevention by reducing the chance of breakage by 2.2-fold. (Yang, 2020)

15.5 Bone fractures in osteoporosis

Bone fracture due to osteoporosis can cause vulnerability and even death to the elderly. In patients with multiple vertebral fractures, the risk of mortality increases by approximately 2.4-4.4-fold. (Jalava, 2003) Bone fracture occurs more frequently even at ages over 50. By 2040, it is estimated that approximately 300 million people with high risk of fractures will be among osteoporotic individuals aged 50 years and older. (This year, 2015)

In the elderly, fractures of the vertebral, hip and forearm bones are most common, and other bones may of course be affected. (Clynes, 2020) Due to advances in care, a decrease in mortality from osteoporosis is typical, but the resulting deterioration in quality of life and disability remains a problem. (Shen, 2022) The functional condition prior to fracture significantly affects the events of the subsequent period, the release of the injury. (Dempster, 2011)

In osteoporosis, fracture is due to fragility of the bone, but the strength of the bone can also play a role, as injury with a healthier bone structure can occur with increased force. (Mostly, 2016) In patients with osteoporosis, the fracture also develops a force that would not lead to injury in healthy individuals due to weakening of the bones. Therefore, in case of advanced severe osteoporosis, normal daily physical exertion is sufficient for the fracture (bending, walking, lifting light objects).

Isolated vertebral fracture can often be hidden for long periods of time, because damage to the microstructure of bone tissue and loss of bone mass does not always have specific complaints, and pain from degenerative diseases is already common among elderly patients, which is attributed to the symptoms occurring (local pain, which increases its load, sensitivity to pressure, protective muscle spasm). Mechanical and functional conditions varying as a result of breakage may cause fracture of adjacent vertebrae. Vertebral fractures are most commonly referred to as lesions, but the most important decision for the treating physician in terms of treatment is that based on the height decrease, a mild (20-25%), moderate (25-40%), or severe (≥40%) vertebrae fracture occurred. The pain usually subsides (in 4-6 weeks) and resolves within a maximum of 12 weeks, but it can also become chronic. Over time, patients may experience increased back kyphosis, chest subsidence, causing compression of internal organs and loss of appetite. In addition, sleep disturbances, self-care disorder, resulting in immobility and depression may occur. (Griffith, 2015)

While it should be emphasized due to the incidence of vertebrae involvement, the most severe is the damage caused by hip fractures. Complications that occur after a fracture (such as bronchopneumonia, deep vein thrombosis, urinary tract infections, ulcers) can cause the body to continue to break down or have fatal consequences. The risk of mortality in the period immediately following the fracture (mainly in the acute hospital period) is extremely high, then gradually reduced. This effect can last for up to 10 years by causing other chronic comorbidities to worsen. In addition, morbidity data are high in disability, vulnerability, especially in fractures of the vertebrae and hip. In the latter case, approximately half of the affected patients are unable to mobilize independently, and the high proportion of elderly patients who cannot continue to live independently after fracture. (Clynes, 2020)

In men with osteoporosis, the secondary form is more common than in women. (Vilaca, 2022) Men usually have fewer bone fractures because the prevalence of osteoporosis is also lower and their bone density is 8-10% higher than women, and their bone size is often higher. Androgen decrease is slower in men, usually after the age of 70. (Herrera, 2012) Observations have shown that men are less cooperative in drug use. (Sing, 2023)

The estimation of the risk of fracture in bones can be performed by numerous examinations and tests, but the FRAX complex questionnaire method is recommended by WHO to help determine the 10-year risk of severe fractures. This is one of the most common methods used in clinical practice. Imaging procedures are essential in diagnosing the disease and thinking about complications, but it may even be possible to integrate the results of these in the future using artificial intelligence. (El Miedany, 2020)

Patient Test Method

There is currently no approved test method in Europe that can clearly identify the presence of the risk of bone fracture in patients with osteoporosis. (Kanis, 2019)

The detection of predisposing (predisponating) factors that negatively affect the disease is important in addition to the present complaints, therefore special attention should be paid to the knowledge of variable, assistive parameters and factors during the performance of the study steps. The person's knowledge and attitude will affect his/her disease, life and the success of the collaboration. It's particularly important to win a patient in collaboration, so it's always good to behave as an equal party, a decision-making, a person who wants to know. In the case of osteoporosis patients, in addition to assessing the general condition, the risk of falling may also be an important aspect.

Algorithms and descriptions can be used for the test procedure. These aim to provide a navigating thread for a very diverse study. As you can see in the table below (Table 2), it is worth thinking about and, if possible, conducting the study based on a complex system of considerations.

Table 2 Fragility in elderly (early identification and treatment) (URL1)

Categories of Assessment for Patients Evaluated at Fall and Injury Risk.[50] **See Appendix B for accompanying details and Suggested Management.** See also the *BC Guideline: Frailty in Older Adults – Early Identification and Management*

History

1. Fall history

Functional review

2. Physical activity and endurance
3. Limitations in activities of daily living (ADLs)
4. Access and use of adaptive equipment

Medical review

5. Co-morbidities and risk factors
6. Medication review
7. Nutrition and hydration
8. Continence/rushing to the bathroom
9. Vitamin D intake

Social and environmental review

10. Substance use
11. Environmental and home hazards
12. Living alone and social isolation

Physical exam

Functional review

13. Mobility
14. Feet and footwear

Medical review

15. Visual acuity
16. Orthostatic/postural hypotension
17. Other system examination

A number of questionnaires are available to help with the assessment, which aim to give as complete a picture as possible of the client's condition from various aspects.

15.6 Adoption of medical history

Osteoporosis examination, as with any other medical condition, should be started with a medical history. Thorough, prudent questions can provide you with a lot of useful information about the individual's condition.

When estimating the risk of falling, it is worth taking into account the patient's age and personal characteristics, recording information on previous falls/falls history, medication habits, other medical conditions, balance abilities, activity level, physical and coordination abilities, reactivity, sensory (especially visual) adequacy and even cognitive function if possible.

Foot function (specifically in the case of polyneuropathy in diabetes mellitus) and environmental characteristics also play an important role in the development of falls.

Decreased feelings (no sensory feedback) and weakened muscles cause low leg function. (Alam, 2017) The shortening role of the anterior tibial extremity, the insufficiency of adaptation at the time of soiling, all promotes entanglement or proliferation of the leg in the soil, threshold, bench, which may be a direct cause of falls.

In determining the way forward, all the information gathered should be assessed at an individual level and used to make a decision. Since taking such a detailed medical history can take a lot of time from professionals, and despite your attention, important information may be missed, it may be worth writing a list of important areas in advance. It is very helpful to know that many questionnaires have already been completed to assist in the assessment. They are designed to give you a more complete picture of the client's condition from different aspects. Some are simpler, quicker to complete, and longer, more complex, and some include physical exams and tests. Many of them support the study with a scoring and evaluation system that can also be used to estimate a patient's risk of falling. Some of these are listed below:

- Staying Independent Checklist
- Morse Fall Scale (MFS)
- Prisma-7 questionnaire
- Fracture Risk Assessment tool
- Outpatient Falls Questionnaire
- The Activities-specific Balance Confidence (ABC) Scale
- Fall Risk Assessment Tool (FRAT)
- Self-rated Fall Risk Questionnaire (FRQ)

- Fullerton Advanced Balance scale (FAB)
- Tilburg Frailty Indicator (TFI)
- The Johns Hopkins Fall Risk Assessment Tool
- Canadian Study of Health and Aging (CSHA) Clinical Frailty Scale
- PreFIT Falls Risk Assessment Quick Reference Guide

In case of long-term cooperation, a questionnaire to measure quality of life may also be collected, for example, using the Qualeffo-31 osteoporosis specific quality of life questionnaire (van Schoor, 2006; Huang, 2006).

15.7 Physical examination

After the medical history and completion of the questionnaires, the observation examination follows, during which the form and symmetry of structures and structures must be as expected. It is also important to perform a posture and weight line examination due to changes in patient posture. In addition to measuring the necessary characteristics, such as height, weight, extent of kyphosis (with a kifometer, or wall-occiput, or rib-hip blade distance measurement), chest excursion, limb length, circumference, etc., it is also worth referring to the range of motion of certain segments. This can be done with centimeter tape, goniometer, inclinometer. You can get a picture of your muscles during traditional muscle strength and stretch tests. Other studies, such as functional tests, can be used, which are more complex, often in combination with other talents. For example: Sharman test, plank posture tests, Trunk Stability Test (TST), Unilateral Hip Bridge Endurance Test (UHBE).

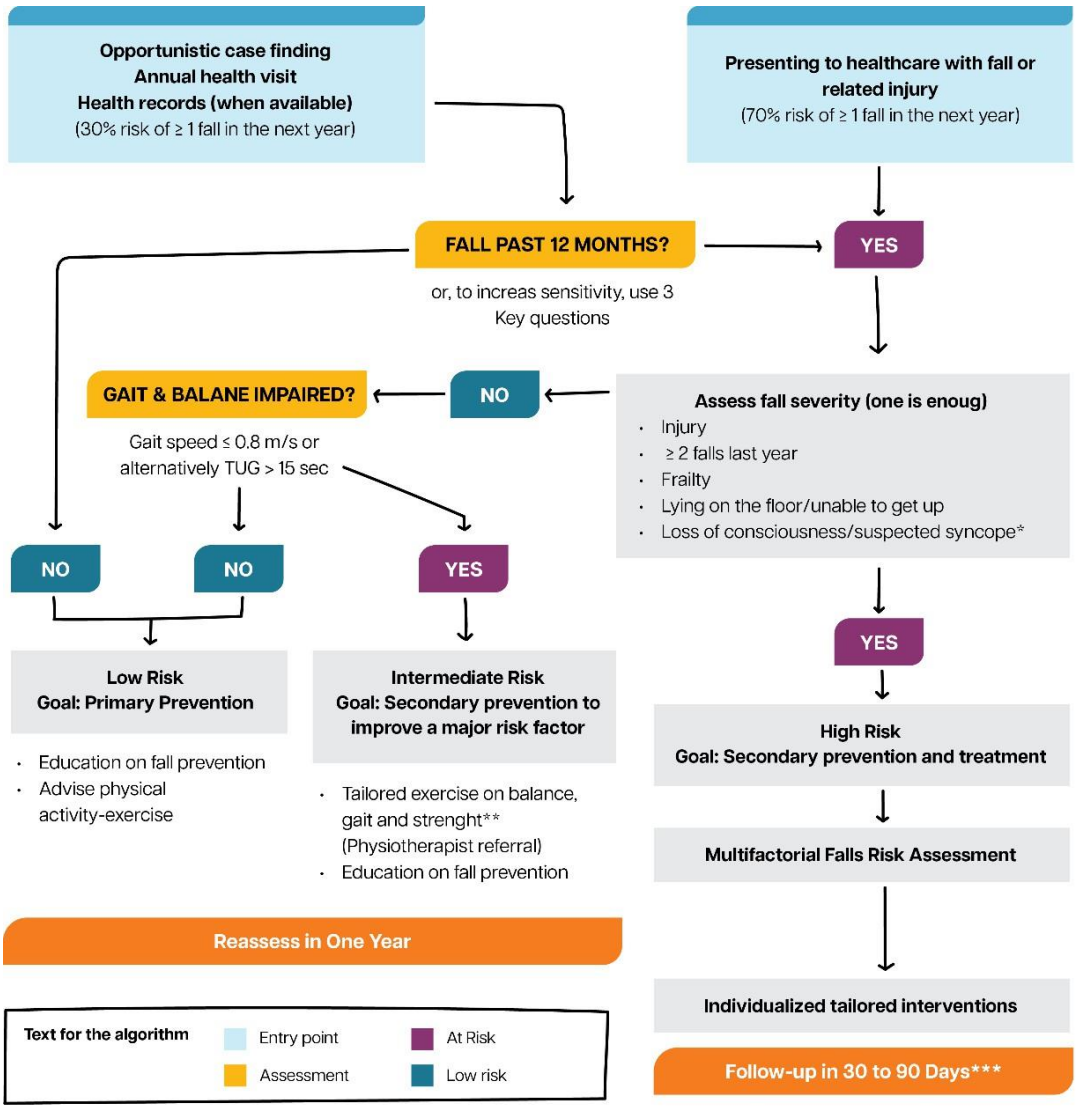
The physical examination scales combined with the questionnaire have also been compiled to determine the functional status of the patient and/or to determine the risk of falls. For example, the Fall Risk Factors STEADI study, in addition to a 12-point questionnaire, is also responsible for balancing testing to assess the risk. A variety of tests can be performed to determine balance, which can be static or dynamic balance tests. Simple, rapid tests (e.g., vertebrae test, 4-step steady state test, multidirectional access test or modified version, Modified - Physical Performance Test Multidirectional Reach, etc.) or Classifications (Functional Balance Grades), or multiple scales (e.g., Berg Balance Scale, Tinetti Balance Scale) are known. There are also more accurate studies, but the need for these tools is also more significant (for example: Clinical Test of Sensory Interaction and Balance)

This diversity allows for the most favourable, adequate examination of the patient's condition, but it is often difficult to choose, as it may not be possible to select the most appropriate ones for the purpose. In addition, it can be considered whether the conditions are appropriate, how fast, easy to perform, or evaluate the test, or if the examiner has the necessary experience to guide the implementation.

Of course, other tests can be performed as needed. This may include, for example, an examination of the reaction time, lower extremity motor Coordination Test (LEMOCOT) of the lower limb, and an analysis of the proper functioning of the foot and eyes.

The purpose of these studies is to estimate the risk of falling and breaking patients. A summary of the medical and physiotherapy test results may lead to the most accurate results. For example, classification may be aided by the algorithm below (Picture 3) which is designed to support decision making. The authors suggest asking three key questions about the fall: Has fallen in the past year?, Feel unsteady when standing or walking?, Worries about falling?

A single listed factor is sufficient for the classification of the high-risk group. Injury, two or more falls within the past year, bone fragility, tendency to faint, loss of consciousness, inability to get up from the ground. (Montero-Odasso, 2022)



Notes: 3 Key Questions (3KQ) any positive answer to a) Has fallen in the past year? b) Feels unsteady when standing or walking? c) Worries about falling? promts to "fall severity" step. **Fall severity:** fall with injuries (severe enough to consult a physician), laying on the ground with no capacity to fet up, or visit to the emergency room, or loss of consciousness/suspected syncope. **Frailty:** Commonly used frailty assessment tools include the Frailty Phenotype and the Clinical Frailty Scale.
*Syncope suspicion should trigger syncope evaluation/management. **Exercises on balance/leg strength should be recommended for the intermediate group. Evidence shows that challenging balance exercises are more effective for fall prevention. In several settings, this intermediate group is referred to a physiotherapist. ***High risk individuals with falls can deteriorate rapidly, and close follow up is recommended and should be guided on the frequency of consequent health service utilization. **TUG:** Timed and go test

Figure 3 Fall prevention and management in elderly (Montero-Odasso, 2022)

Grouping continues to be a diverse group of patients within a category. It is an important task of the physiotherapist to identify as much as possible the client's capabilities for development. Therefore, it is recommended to perform several tests from which the patient's general physical condition, coordination and balance can be obtained, etc.

The following are examples of these.

The anamnesis should usually cover issues related to body height. The difference in height can be analyzed with respect to the changes that take place over the course of 1 year (a decrease in body height of more than 0.5 cm means a risk of fracture, a decrease in body height of more than 1 cm means a risk of fracture) Another option is to calculate the **Historical Height Loss (HHL)**, during which a 5 cm decrease compared to peak height increases the risk of falling eightfold. (Moayyeri, 2008; Hillier, 2012)

Additional options for identifying hidden vertebral fractures and postural deterioration:

Wall-to-occiput distance (WOD):

Because postural compensatory changes may be present, it is important to measure the upper back. During the examination, the patient stands close to the wall so that: his back and heels rest against the wall, his head looks forward. The examiner measures the distance between the wall and the occipital protuberance.

A WOD greater than 5 cm indicates a vertebral fracture of the thoracic spine and an increase in kyphosis. (Antonelli, 2007)

The average distance over the 3 trials was used to categorize the participants into 3 groups according to severity of kyphosis, including mild (≤5.0 cm), moderate (5.1–8.0 cm), and severe (>8.0 cm).

Another method for estimating the size of kyphosis is the rib-pelvis distance: during the examination, the vertical distance between the lower edge of the eleventh rib and the upper surface of the iliac crest is measured in the armpit line. Two finger widths or less means a positive test. (Wiyanad, 2018)

Vertebral fractures of the lumbar spine can cause postural changes and compensations.

The distance between the ribs and the pelvis (iliocostal distance) can be easily measured. During the measurement: positioned behind the patient, after palpating the lower ribs and the iliac crest, determine the vertical distance in the midline of the armpit (with a centimeter tape or finger width).

An RPD smaller than 2 fingers or 3.6 cm indicates a vertebral fracture in the lumbar spine.

The test can also be used for follow-up to identify changes in posture. (Abe, 2008)

Postural control examine: Pull test (retropulsion test)

Response to sudden, strong posterior displacement produced by pull on shoulders, while patient erect with eyes open and feet slightly apart.

Assessment:

0 = Normal.

1 = Retropulsion but recovers unaided.

2 = Absence of postural response; would fall if not caught

by examiner.

3 = Very unstable, tends to lose balance spontaneously.

4 = Unable to stand without assistance

(Nonnekes, 2015)

Static balance: The 4-step balance test

In this balance test, the patient must hold four different, increasingly difficult positions for 10 seconds while standing.

The examiner can help you take the body position and then start the examination. If the patient can maintain the position without losing balance, the test is passed. You can extend your arms or move your body to keep your balance, but don't move your legs. If the test fails, it must be stopped. Patients may not use assistive devices.

Start the test with "Done, start." phrases and ends after 10 seconds when you say "Stop".

Static balance: Modified Romberg Test

With this test, we can get a general picture of the patient's static balance ability on different surfaces. In the standing position of the patient, the legs are placed 10 cm apart and the opposite elbows are held with their hands. In this case, the person focuses on a target 1-2 m away and tries to maintain his balance. The test is performed for 15 seconds or until the loss of balance occurs (falling, stepping to the side, jumping, turning, etc.), and the examiner measures the elapsed time in seconds. If the subject can hold the position for 15 seconds, the test is "passed". If the test subject is unable to hold the position for 15 seconds, he may make another trial. The test takes place in four steps under the conditions stated below.

Steps: 1. Open eyes/solid surface, 15 sec 2. Closed eyes/solid surface, 15 sec 3. Open eyes/suitable surface, 20 sec 4. Closed eyes/suitable surface 20 sec.

In addition to the "passed" or "failed" categories of the test, it also provides the opportunity to record the exact time, which is also suitable for measuring progress later in life. (Agrawal, 2011) (URL1)

Static balance and postural control: Functional reach test

The client is asked to stand next to the wall (without touching it) and extend their arms forward at shoulder height. In the case of clenched fists, the measurement is made at the 3rd metacarpal head. The patient should be asked to reach forward as far as possible without coming out. Then the horizontal distance between the starting point and the end point gives

the result. You can make three attempts, and the average of the last two counts in the measurement.

Assessment:

- 25 cm or more distance - low risk of falling
- Between 15-25 cm - 2x higher fall risk compared to normal
- 15cm or less - 4x higher fall risk compared to normal
- unwilling to reach - 8x greater fall risk

Other factors may also need to be taken into account in the evaluation: e.g. hip joint, ankle joint range of motion, core muscle strength. (Duncan, 1990)

Dynamic balance: Alternative step test

Several versions of this test are performed with the patient in a standing position.

In the original test, an 18 cm, 40 cm deep and 60 cm wide step was used. At the beginning of the test, the participant stands facing the stairs with a double leg support and without walking aids. The participant should be asked to place the entire left and right leg alternately on the step as quickly as possible, 8 times on each leg. Each successful step requires the entire foot to be placed on the step and returned to the floor.

Rating: Performance for more than 10 seconds increases the risk of falling. (Tiedemann, 2018)

Dynamic balance: Timed up and go

The speed of the task is informative, but also the quality of the movement. E.g. evaluation of the Tinetti balance scale gives a clue: movement is continuous, firm (free of sway and instability), steps are symmetrical, heel placement is accurate, no trunk sway, joint positions are correct (no knee or trunk flexion or other), no gait aids, if present use them well.

An indication is given if the completion of the task is 12 seconds or more, while performance above 15 seconds indicates an explicit risk. (URL1)

Dynamic balance: Four square step test

During the test, the klines must move in pre-numbered squares created with the help of two sticks in a specific order (2, 3, 4, 1, 4, 3, 2, 1). The goal is to enter each square as quickly as

possible with both feet. The patient can try the test before the measurement, then perform it twice, and the better result is evaluated.

Timing begins when the first foot touches the floor in square 2 and ends when the last foot touches the floor in square 1.

For the elderly, a result longer than 15 seconds increases the risk of falling. (Moore, 2017)

Measurement of physical condition: 5 sit to stand test

During the examination, the client sits on a chair with a back, from which he stands up and sits down as quickly as possible for 5 seconds. All this with arms crossed over his chest and without his back or legs resting on the chair. The measurement starts at the start word indicated by the client and ends with the last bottom touch. If help or support is needed to perform the test, the test stops.

Assessment: The age matched norms score are 11.4 seconds for 60-69 years age groups and 12.6 seconds and 14.8 seconds for 70-79 and 80-89 years of age group, respectively. (Melo, 2019) (Bohannon, 2006)

In another version of the test, it is necessary to perform the task of sitting down and standing up for 30 seconds, and the evaluation is based on this. (URL1)

Functional test: Pick-up-weight test

During the test, the tested person has to reach down for a bag containing a 5 kg weight and lift it up. The bag (the handle of which is 50 cm from the ground) must be lifted with one hand and placed on the table. Performance assessment: able or unable to complete the task. (Tiedemann,2008)

15.8 Physiotherapy Program

The treatment recommendations and guidelines differ slightly, but each programmer agrees that lifestyle modification is necessary due to the prevention approach at any stage of the disease. In some countries, there are pre-assembled complex programs that provide a variety of useful, understandable information about the characteristics of the disease, its consequences, treatment and prevention options, including Steadi - Older Adult Fall Prevention mentioned above, online, and accessible to patients from home.

Longer to shorter program books and brochures are also available for reference, such as the Australian Osteoporotic Refracture Prevention Services. It is useful for patients to not only get information from the internet, but also their doctor and physiotherapist to guide the therapeutic program and answer any questions they currently have.

Whether the patient receives medication or not, it is worth giving everyone a training program, informing them of the risk factors and what they can do to slow down the progression of the

disease themselves. In addition to the role of dietary habits and, if necessary, dietary supplements, smoking and alcohol cessation, as well as regular follow-up with existing underlying diseases and adherence to medical recommendations are important considerations.

The physiotherapist may be responsible for teaching adequate exercises or for encouraging proper physical activity. In the event of a motion program for patients with osteoporosis, the use of combination methods is recommended based on previously described influencers and disease-induced lesions.

Thus, it is worth setting a goal to develop the following areas and skills:

- muscle strength (primarily core, extremities)
- endurance,
- balance and coordination,
- joint mobility, muscle flexibility
- improve posture
- respiratory exercises and relaxation
- trunk and pelvis stabilization exercises
- reaction time, responsiveness, fall engineering development

Exercises should be minimized, especially in relation to balance improvement. To do this, the use of posts, handrails, or physiotherapist must always be ready to maintain trust and safety. Development should always be carried out with difficult and complex tasks that match the state of the client. In terms of balance improvement, it is best to start with retentional, small, stretchy tasks on a stable support surface first. Visual control can then be taken in a safe environment. Another possibility for improvement is the use of unstable surfaces, reduction of the support surface, or the performance of certain musculoskeletal tasks associated with the situation.

Bone is a reactive tissue, so resistance training exercises can be performed to maintain and increase bone resilience. These exercises also support normalization of weight management. In terms of its effect on bone density, different combinations of exercises appear to be sufficiently effective against individuals who do not engage in regular physical activity. Slowing down weight loss of bone density is likely to be easier in early postmenopausal periods than in late periods. (Kemmler, 2020)

In a professional-led program, it may also be beneficial to conduct group exercises, prior assessment of abilities, and taking into account patient safety. (LeBoff, 2022) Besides weight-

bearing, conditioning machine workouts, jogging, walking, yoga, pilates can also be a useful form of exercise. Physical activity as early as half an hour a day can be beneficial in improving health. (Herrera, 2012) The bone reacts best to forms of load that are at least medium-loaded, dynamic, and characterized by a short load duration. The magnitude of the load is primarily determined by the degree of reaction to the ground (the magnitude of a collision) or the degree of muscle strength. (Weaver, 2016) Based on literature recommendations, it seems that 2-3 repetitions (or 1RM 50-80% intensity) of their 5-8 repetitions per core muscle group per week are beneficial for strength training. (Rodrigez, 2022)

To slow down the rate of bone mass weight loss, it is worth considering as an additional task in any physiotherapy development. The exercise types associated with the above-mentioned stresses, whether it is stress tasks performed in a closed kinematic chain, not only the lower extremity, but also create spinal compression, thereby inducing the bone-building processes of the vertebrae. However, in many cases, spinal stress should be reduced using stabilization techniques prior to this type of training method because unintended movements or excessive loading can create harmful forces.

It is worthwhile to mark the activities requiring active participation and cooperation of the patient as a common goal. Your training program should not only report lifestyle advice but also understand the purpose of some types of exercise in the area of physiotherapy, learn how to do them correctly.

In order to reduce the risk of falls, the treatment of possible underlying diseases and the development of individual motor skills are effective ways to reduce risk. In addition to these intrinsic factors, the review of extrinsic factors – restructuring or efficient use of the environment – also help reduce the chance of falling. These environmental modifications can be quite simple, such as wearing suitable, safe footwear that does not slip or fall out, or removing or securing loose, moving or wavy carpets. (Falaschi, 2021)

It would be essential to make the rooms clear and use additional equipment where necessary, for example: installation of handles, spa chair, toilet height placement. (Salari 2022) Certain additional measures and recommendations may be useful for elderly persons, but these fall-offs do not affect the occurrence but may affect the severity of complications and their outcome: e.g. the elderly person wears an alarm (watch/cup) or a mobile phone during the day to get help as soon as possible.

Regular balance and combinations of strength and stamina-enhancing exercises improve the physical performance of the elderly, but also support daily activity drive, cognitive function and quality of life. (Gschwind, 2013) This impact can be enhanced by exercises in the group. (Sherrington, 2017)

It is always very important to use a method adapted to the patient's condition. In the event of confirmed loss of vertebrae (and femur) stock, the patient may be worked under a lower load (e.g. sitting on a stable/unstable surface) and avoiding larger, faster dynamic exercises. Beginning with advanced osteoporosis (increased risk of fracture, severe osteoporosis), it is necessary to maintain the range of motion (ADL) necessary primarily for daily function with

regard to the movement of the trunk, extreme movements are contraindicated due to the risk of fracture of the bones (vertebrae, ribs). Based on individual judgment, tasks performed in the prone position can be performed on a soft surface, and in case of deterioration, it is necessary to leave this position. In advanced cases, flexion, rotation of the trunk, exercises with weight should be carried out with caution and with little or no weight, as movements performed with normal range of motion may now lead to breakage. In such cases, manual physiotherapy techniques (mainly manual therapy and deep soft tissue treatments) should also be avoided, as these also have simple or complex forces on bone stock with reduced structure. Individuals who had few previous movements, permanent immobilization, or previous fracture were particularly at risk.

A motorised learning program aimed at improving posture is also recommended for clients to consciously and actively set and maintain body sites. Quality motion is always important in physiotherapy, but in osteoporotic patients, it plays a special role in supporting the normal distribution of loads to ensure even loading of structures.

The previously described principles of physiotherapy for diagnosed osteoporosis are included, but the most important is prevention, by maximizing peak bone mass in youth and then maintaining it as long as possible during aging. At any stage of life, it is worthwhile to make efforts for the health of the bones according to age, including persistent and regular physical activity.

15.9 COMMUNICATION

In this lesson you will learn *how to communicate with a low educated elderly man who shows elements of provocative and aggressive behaviour*. We will show how to establish a relationship with an elderly person, how to behave with them when they are provocative or aggressive, which communication methods can help the physiotherapist to carry out the examination or treatment. The rules of communication with a person with low education (restricted code, redundancy, feedback). How to anticipate, recognise and manage tantrums.

The number and proportion of older people in society is increasing. However, there is no common definition of who is considered older. From this perspective, age is not the most important factor for people living in developing countries, but rather the loss of previous social roles or the decline in active participation in community life (WHO; 2018). In Western culture, people over the age of 60 or 65 are usually considered old. In health surveys, the minimum age of old age is increasingly set at 65. This age coincides with the retirement age in some countries. However, old age cannot be considered as a single age stage; subgroups are usually distinguished, such as young elderly (65-74), middle-aged (75-84) and elderly (over 85) (Zizza et al., 2009), because the different age subgroups may have different characteristics. In fact, it is not possible to treat the elderly as a single homogeneous group, rather the diseases of old age can homogenise them, for example sensory impairment, dementia, etc. Advancing age in itself increases rather than reduces differences between individuals.

15.10 ASPECTS OF COMMUNICATION WITH OLDER PEOPLE

We should evaluate the aspects of communication with older people in the light of the above considerations. Below we describe communication problems and possible solutions that may apply to larger groups of older people but are not typical of all older people. The following problems can make it difficult to properly assess and treat older people:

- polymorbidity is common, i.e. several somatic diseases and mental disorders may be present at the same time, which makes diagnosis and treatment much more difficult.
- with increasing age, cognitive and sensory problems become more common, making communication more difficult.
- some conditions can cause language difficulties, such as stroke or Parkinson's disease.
- the level of health awareness may be generally lower among the elderly, due to possible lower education and poorer access to information.
- the level of social support may be lower due to the prevalence of loneliness, which can cause problems in many areas.
- many older people may have financial problems, which may influence decisions about recommended treatments and lifestyle changes, among other things.
- some older people may find it more difficult to access treatment due to mobility difficulties and limitations.
- ageism: discrimination against older people. Stereotypes and prejudices about old age can make it difficult to care for older people. Such a stereotype might be that older people always present their complaints in a long and complicated way, that they only go to the physiotherapist to talk, that all older people already have some kind of mental decline so that they do not understand the physiotherapist's explanations, and so on. These ideas can be significant barriers to the physiotherapist-patient relationship.
- trying to hide symptoms. Older people often feel ashamed of their complaints and symptoms and may try to hide them. There may be several reasons for this, for example, the social perception of certain symptoms is very negative, or the need to meet social expectations, or the fact that the patient does not want to lose their job. They may be afraid of being admitted to hospital or a nursing home, but there may also be cultural reasons.
- infantilisation, i.e. treating an adult like a child. This sadly common communication error can manifest itself, for example, in the childish tone of voice used by health professionals,

oversimplified communication, lack of adequate patient information, and exclusion of the patient from decisions about their own treatment and future.

- we can talk about triadic communication not only in the case of child patients, as many elderly people are accompanied to the health care facility, e.g. to the physiotherapist, because they need help or because they are worried about them. In a situation where a relative or companion is present in addition to the patient, the physiotherapist may have specific communication difficulties. It can sometimes be difficult to structure a conversation that is going in different directions, to manage different levels of concern and expectations, and to manage the emotional dynamic between patient and carer. (Pilling, 2020; Tarbuck, 2016)

How should a physiotherapist communicate with older people? Because the problems are complex, so are the solutions.

Creating the right environment

- in the waiting room and examination room, there should be chairs that are easy for older people to sit on and get up from. Chairs with straight backs and armrests can be more useful than reclining chairs.
- there should be handrails in the waiting room, examination room and toilets
- there should be adequate lighting in the examination room, and we should minimise background noise; this can help communication with older people with sight and hearing loss.

Longer consultations

Consultation, examination and treatment of older people may take longer than usual. They may find it more difficult to move around, they may be slower to get dressed and undressed, and due to their multiple illnesses, their complaints and symptoms may be more severe than, for example, a middle-aged patient.

Establishing a partnership

The first step in building a partnership is the right approach! Avoid using titles such as 'uncle' and 'aunt'. Ask the patient what they would like to be called. Adults with capacity are subject to the same legislation and therefore the same communication recommendations, regardless of their age. Therefore, if an older person's capacity has not been restricted by law, he or she has the same right to information and participation in decisions about his or her own treatment as anyone else.

Symptomatic communication

As some older people try to hide their complaints and symptoms, the physiotherapist must actively seek to uncover those problems that the patient may not have talked about. This can be facilitated by creating a trusting atmosphere and by the physiotherapist asking specific questions about the most common problems experienced by older people.

Communicative aspects of sensory problems

If the physiotherapist is unaware that the patient has these hearing or vision problems, it is best to ask at the beginning of the session. In the case of hearing loss, it can help if the physiotherapist looks at the patient, leans in a little closer, speaks at a sufficient volume (but never shout!), with clear pronunciation, at a normal, usual pace or a little slower than that. It is worth supplementing your speech with non-verbal signs and visual aids (e.g. pictures, demonstration tools) to help understanding. As much information as possible should be given in writing. In the case of visual impairment, always ask the patient to use their glasses. In the case of sensory impairment, it is particularly important to check that the patient has understood what has been said.

Appropriate level of assistance

Independence is important to many older people, so the physiotherapist should avoid over-care. The easiest way to do this is to ask the older person how much help they need. At the same time, the physical therapist should not hesitate to offer help if he sees that the older person needs it.

Respect cultural differences

Older people's health behaviours and attitudes to illness may be different from those of the younger generation. They may tend to regard many symptoms as a natural part of ageing. There may also be differences in treatment, for example, we may cling to treatments that seem tried and tested but are now considered outdated or even wrong. The physiotherapist should ask questions about all this.

Appropriate assessment of depression and suicide risk in old age

The risk of suicide is extremely high in old age, the physiotherapist needs to be aware if the patient is experiencing symptoms of depression, and if there is any indication that there is a risk of suicide, appropriate steps need to be taken, professional help should be sought and referral to a specialist should be made.

(Pilling, 2020., Tamparo & Lindh, 2017., Tarbuck, 2016., Pék, 2004.)

15.11 ASPECTS OF COMMUNICATING WITH AN AGGRESSIVE PATIENT

Anyone who has recently visited a healthcare facility - even as a patient - has almost certainly encountered a patient who behaves in an impulsive and sometimes downright aggressive manner. This phenomenon has become very common and is a growing problem for healthcare workers. Research and scientific articles published on the subject agree that healthcare workers are often unprepared to deal with such situations. When aggression and provocative behaviour in an elderly person is combined with a low, limited communication code, a very complex and complicated communication situation arises.

It is important to check what may be behind the provocative behaviour, as knowing this will help us to resolve the situation appropriately. *Pushy, aggressive behaviour can have several causes:* for some it is in their nature and habitus, for others it is the accepted behaviour associated with their position, while in some cases it is the result of illness and a vulnerable situation. Aggressive behaviour can be triggered by fear, insecurity, anxiety, frustration, pain or even communication difficulties - for example, differences in the level of communication between the physiotherapist and the patient. Of course, the patient's alcohol consumption or possible mental illness does not make the situation any easier for the physiotherapist. Dissatisfaction with the situation can often be a legitimate reason for aggressive behaviour - for example, failure of previous treatment, long waiting times, lack of information - but also the patient's lack of self-confidence and insecurity, which he tries to attribute to the seemingly vulnerable health professional. In this situation, it is important not to 'put on the gloves' as this will only exacerbate the argument, but a dispassionate, objective attitude may also further anger the patient if he is looking for an excuse to engage in a verbal duel. (Pilling, 2020.)

Some suggestions for the physiotherapist to overcome communication problems with a provocative or aggressive patient.

The carer's view of the conflict situation. A healthcare worker should start from the basic position that *temper management is also part of their job.* It is almost natural for a healthcare worker to come into contact with tense, nervous people again and again, as they deal with sick people who experience strong emotions on a daily basis. It is therefore worthwhile approaching the tense, irritable patient or their relatives with *a professional and helpful attitude*. If you take all the anger on yourself and react hostilely, you yourself will experience a lot of tension. On the other hand, those who try to help the patient calm down in this situation help both the patient and themselves.

Escalation techniques

- it is important to maintain *a calm and professional demeanour*, even in the face of provocation. Avoid mirroring the patient's aggression. A calm tone is often the key to resolving the situation (if we remain calm ourselves, this usually has an effect on the other party and helps to reduce their tension).

- basic courtesy and small, attentive gestures (e.g. offering the patient a seat) can also help reduce tension.
- practicing *active listening*, *acknowledging the patient's feelings and concerns without judgement*, is very helpful. Active listening means trying to understand the speaker's message and the feelings associated with it. In practice, this means listening quietly, maintaining appropriate eye contact, adopting an open posture, and encouraging the speaker with comments at appropriate points (indirect agreement: I see, I understand; open-ended questions). If we have the opportunity, it is worth letting them talk about their complaints, give their opinion, which we can confirm and accept.
- it is especially important *not to interrupt the speaker*. Do not interject with counterarguments, even if we feel that we strongly disagree with something the patient has to say.
- *keep your distance!* Being too close to someone can increase their tension. (On the other hand, it can also be dangerous because it makes it easier for them to reach us). Therefore, keep a sufficient distance (at least 1-2 metres) from people who are tense and angry.
- *set clear and calm boundaries for acceptable behaviour.* Explain how the patient's behaviour is interfering with the examination. Express your frustration but try to maintain a calm environment and make the patient understand the importance of this. Instruct the patient to maintain a civilised tone if the language is rude or offensive to others.

Communication strategies

- Use clear, concise language and avoid medical jargon. Repeat key information as necessary.
- Keep your speech focused on the reason and purpose of the examination and its benefit to the patient's health.
- If possible, offer the patient choices to help them regain a sense of control.
- Only one person should speak to the patient at a time! For a person in a narrowed state of consciousness, stimuli coming from many directions are difficult to process and threatening, which increases their tension. Even if there are several people in the room, only one person should speak to the victim at a time.

Anticipating and recognising tantrums

- Pay attention to the *patient's non-verbal cues*. Look for clenched fists, increased muscle tension or changes in facial expression.

- Look for rising volume, changes in tone, verbal threats or insults as *possible signs of an impending outburst.*
- *What to avoid*: telling the patient to calm down; using a superior, commanding tone; criticising and belittling the patient; ignoring the patient's problems, questioning the legitimacy of their feelings, trivialising them.

Treating tantrums

- If a tantrum occurs, calmly explain that you will not be able to continue the examination until the patient regains his or her composure.
- Suggest a short break to allow the patient to rest in a private room, if available.
- If the situation escalates, seek help from a colleague or security staff for your own safety and that of the patient.

4 steps for dealing with a tantrum

Stage 1: Ignore. Ignore the first hurtful word or sharp phrase and remain calm and polite. This can often be a solution in itself. If you still want to respond, give short, neutral answers.

Stage 2: Assertive responses without confrontation. In a conflict situation, expressing your understanding by mirroring the patient's feelings ("I can see that he is very tense!") or trying to identify the reason ("What made him so angry?") reduces the level of tension and we can move closer to a solution. It is important to note that understanding does not mean agreement, but at the same time attention and empathy are central to working with the patient. Expressing regret ("I'm sorry you had to wait so long") is often a magic word, let's add a short, objective statement of our own position with a concise explanation (really just 1-2 sentences!). "I'm sorry you had to wait so long. I couldn't see you earlier because a patient with a serious condition needed more time to be seen.) In our communication we should always try to work towards a solution and cooperation.

Level 3: Assertive responses with confrontation. An objective description of the situation, stopping verbal aggression, redirecting the conversation in a constructive direction.

Stage 4: Getting out of the situation. If someone feels unsafe, leave the room and seek help.

By following these tips, the physiotherapist can create a less confrontational environment and possibly complete the examination or treatment. Remember that calmness, setting boundaries and clear communication are crucial when dealing with a provocative or aggressive patient.

(Pilling, 2020, Hills & Joyce, 2013, Beech & Leather, 2006)

15.12 COMMUNICATING WITH A PATIENT WITH LIMITED EDUCATION

Appropriate verbal code. Use simple, short sentences and familiar words. Avoid complex medical terminology and complicated explanations that require background knowledge.

Redundancy. Repeat key information in different ways to ensure understanding. In addition to verbal information, provide other forms of information such as pictures, diagrams and demonstrations,

Feedback. Encourage the patient to ask questions and give feedback during the examination.

Congruence. Ensure that your verbal and non-verbal communication is consistent.

(Pilling, 2020, Pease & Pease, 2017)

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APPENDICES

APPENDIX 1

APPENDIX 1 – MOVEMENT DEVELOPMENT MILESTONES			
Age (years)	**Fine Motor Skills**	**Hand-eye Skills**	**Gross Motor Skills**
4	7. holds the **pencil between fingers** (no longer holding the pencil in fist, but with the help of fingers) 8. **drawing becomes recognizable**, drawing a person with three body parts or two-to-four-part person (head, torso, limbs) - the proportions are not yet exact, the Picture is mostly one-dimensional, a line indicates the limbs and torso sometimes, but it is already recognizable - the head is better first, then the body 9. **likes to color** 10. copies cross, square 11. cuts paper in half 12. dresses no buttons 13. ties single knot	14. **ball throwing:** with an overhead throw 15. **ball handling:** catches bounced ball +lateral dominance is largely established, handedness becomes clear	16. **static balance**: standing on one foot for approx. 6 seconds (between 4-8 seconds) and for 2 seconds on tiptoes – reducing the support surface makes it difficult to maintain balance 17. **dynamic balance**: jumping, running, climbing stairs - gladly solves more difficult tasks that require skill 18. hops on one foot (approx. 2-3 times), climbs up and down climbing frames, slides 19. jumping forward approx. 30-60 cm, jumping from a height of 70-80 cm, jumping forward with a pair of feet continuously, long; gallops 20. jumping forward on one leg 3-5 jumps or 1 meter long 21. walking: walks in a line with legs in front of each other, can carry a glass full of

			water without spilling 22. walking backward in line 23. running: can turn sharply, can stop suddenly 24. walking down the stairs with alternate legs without holding on - can even walk on longer stairs at 8-10 steps with alternate legs; the steepness and unusual height of the stairs still disturbing, in which case they can still come down with a back step
5	25. **tripod pencil grasp** 26. **dresses** and **undresses** without assistance - unbuttons and buttons medium-size buttons 27. **colours** between lines 28. **draws person** with at least three body parts (mostly between 5-10) 29. **"quasi" writing** - pretending to write 30. **copies** triangle and square and other geometric **shapes** 31. **cuts** out a circle	32. **ball throwing** with trunk rotation: rotation of the trunk is already strongly engaged: the ball is over the shoulder, the elbow extension is still dominant during the throw, stepping forward with the same foot as the throwing arm during the throw 33. **ball handling**: can throw a tennis ball 1-2 meters into the bin (spinal rotation is already activated); can now mostly catch a large ball, hip and knee flexion to make a soft catch 34. can kick not only the stationary ball but also the rolling ball	35. **static balance:** standing on one foot for 8 to 10 seconds 36. **dynamic balance:** 37. walking, running, jumping 38. walking on a beam, feet in front of each other 39. walking on tip toes 40. walking backward (heel-toe) 41. jumping forward from a standing position at a distance of cca. 70-80 cm 42. can turn backwards 180° by jumping up from a standing position 43. jumping backwards with even feet 6 times in a row 44. bunny hopping, frog jumping

		+lateral dominance is established, stabilized	45. skipping with alternating feet 46. hopping 8 to 10 times on one foot 47. jumping over an object and landing with both feet together 48. galloping, leaping 49. leaping in place 50. jumping up and down 51. more precariously jumping forwards and backwards on even feet 52. jumping forwards and upwards from one leg 53. somersaulting without leaning sideways 54. swinging, climbing
6	55. **builds**, plays with Legos, puts together puzzles 56. can **eat properly** with a knife and fork 57. while drawing, the **writing movements** already appear – perhaps they already try to write 58. depiction is detailed 59. draws a 12- to 14-part person 60. **keeps the line** when coloring 61. **ties shoes**	62. sense of the ball continues to develop, **throwing** enters the mature phase 63. already throws from a standing one leg forward (transverse lunge), the trunk also turns before throwing, the momentum of the arm movement during the throw is supplemented by the forward rotation of the trunk 64. throws a small ball into a paper basket from a distance of up to 3-4 meters	67. difficult walking, running and jumping situations: walks skillfully along the beam with his feet in front of each other, it is capable of crossing even half a meter while walking - e.g. over a puddle 68. good at running and jumping, runs well on uneven ground, steep slopes and stairs, jumps, runs away, jumps over small ditches, tree trunks (obstacles) 69. **static balance:**

		65. skillfully throws at the target from a distance of 2 meters 66. **catching the ball** also develops, the eye follows the movement of the incoming ball well, the hand position and arm movement changes according to the flight of the ball, when it comes into contact with the ball, it slows down its momentum by letting go of the arm +lateral dominance develops, so the hand on the dominant side is more skillful	a. standing on one leg with eyes open: 10-15 seconds; with eyes closed for 6-10 seconds (optimally, the trunk does not swing out too much and the arms do not mow significantly) 70. **dynamic balance:** a. can walk on the line with good balance even over longer distances - this can be tested with a 3-4 meter long taped line b. jump over a rope 25 cm high c. double-legged forward jump approx. 1 meter away d. jumping forward on one leg fast and long e. jumping on the spot on one leg 6-7 times continuously 71. likes to try/practice various forms of exercise: hopscotch, jumping rope, roller skating, cycling a. can master the complex movements of sports movements - able to complete a 45-60 minute playful sports session b. can learn the basics of most sports movements: soccer, bicycle, roller skating, swimming, skiing, etc. - understands and follows rules
7	72. skilled in **craft techniques**:		77. moves persistently and skillfully: soccer,

	painting, drawing, cutting, gluing, paper folding, plastic molding 73. helps with simple **housework**: peeling, chopping, stirring, cutting dough, sweeping, wiping 74. movement coordination is becoming more and more skillful, can solve tasks that require fine motor skills 75. he depicts events in **drawing**, human drawing includes at least 6 body parts 76. drawings develop, differentiate, show details - e.g. pocket on the dress arcs, loops, waves - elements of writing movements appear		bicycle, running, bouncing a ball 78. complex movements, proper balance and coordination are assumed
7	81. skilled in **craft techniques**: painting, drawing, cutting, gluing, paper folding, plastic molding 82. helps with simple **housework**: peeling, chopping, stirring, cutting dough, sweeping, wiping 83. movement coordination is becoming more and more skillful, can solve tasks that require fine motor skills 84. he depicts events in **drawing**, human drawing includes at least 6 body parts		86. moves persistently and skillfully: soccer, bicycle, running, bouncing a ball 87. complex movements, proper balance and coordination are assumed

	85. drawings develop, differentiate, show details - e.g. pocket on the dress arcs, loops, waves - elements of writing movements appear		

Table 1: Motor skills and movement developmental milestones from age 4 to age 7

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About the Mov-e project

MOV-E aims to create a free, accessible opportunity for the self- development of physiotherapists, students of physiotherapy and other people who deal with people with musculoskeletal disorders. Due to the increasing migration and differentiation of societies, we want to increase the competences of physiotherapists not only as specialists in manual therapy, but as people responsible for emotional, psychological and social wellbeing of the patient.

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or Fundacja Rozwoju Systemu Edukacji. Neither the European Union nor the granting authority can be held responsible for them.

Co-funded by the European Union