**DESCRIPTION OF COURSE UNIT FOR DOCTORAL STUDIES AT VILNIUS UNIVERSITY**

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| **Scientific Area/eas, Field/ds of Science** | Medical and Health Sciences (M 000): Medicine (M 001) | | | |
| **Faculty, Institute, Department/Clinic** | Faculty of Medicine<br>Institute of Health Sciences<br>Department of Rehabilitation, Physical and Sports Medicine | | | |
| **Course unit title** (ECTS credits, hours) | **Assessment of Mobility Impairments**<br>9 credits (240 hours) | | | |
| **Study method** | **Lectures** | **Seminars** | **Consultations** | **Self-study** |
| Number of ECTS credits | - | - | 1 | 8 |
| **Method of the assessment** (in 10 point system) | **Exam** (in written form).<br>The written exam task consists of 4 open questions.<br>The value of the each question is 2.5 points. | | | |

## PURPOSE OF THE COURSE UNIT

To provide knowledge about the components of the mobility, the peculiarities of clinical biomechanics of the musculoskeletal system; to deepen the knowledge about movement disorders and its prevention, the change of movements in the genesis of the age; to introduce the mechanism of the movement control, techniques of the formation of movement skills; to develop the ability to assess functional condition of the musculoskeletal system and physical working capacity, to precisely select the methods of movement research.

## THE MAIN TOPICS OF COURSE UNIT

The concept and components of mobility (upper and lower limb mobility, functional mobility). Musculoskeletal system: structures and functions. Muscles: structure and function. Fibre types of skeletal muscles: I, IIa, IIb. Composition and structure of ligaments and tendons: collagenous, elastic tissues; attachment to the bones. Movements, factors affecting movements. Types of joint movements: passive/active/additional movements, stretching, manipulations. The center of gravity, the forces acting on the body. Biomechanics of fluids and tissues.

Basics of clinical biomechanics of musculoskeletal system. Muscle biomechanics. Muscle contraction force. Mechanical properties of muscles (tension, length, load, speed), its relationship. Muscle temperature, fatigue, pre-tension condition. The effect of physical training. Adaptation of the musculoskeletal system to physical activity: genotypic, phenotypic, long-term and rapid adaptation; adaptation of the circulatory and respiratory systems to physical activity; muscle deadaptation, disability and physical activity. Clinical biomechanics of joints. Disorders of the motion of biokinematic couples. Clinical biomechanics of articular cartilage, synovial fluid, meniscus, bones, ligaments and tendons, nerve tissue. Joint examination and special tests. Influence of static and dynamic loading on the joint. Facilitation and aggravation of movement.

Physical characteristics (speed, flexibility, endurance, strength, agility, balance) and its assessment methodologies. Factors affecting physical characteristics. Analysis of the influence of physical characteristics on movements.

Functional mobility. Components of functional mobility: balance, posture, gait. Balance: the concept, the identification and assessment of imbalances. Balance control mechanisms. Posture, its types. Assessment of posture disorders. Posture

control mechanisms. Spinal function. Position of head, upper extremities and chest during movements and balance control. Protection of soft tissues and vital organs during physiological movements and balance control. Gait analysis, its phases, parameters, factors affecting gait. Clinical biomechanics and assessment of gait disorders. Evaluation of torso, pelvis, shoulder line, upper limb movements during walking. Climbing up and down stairs, its phases. Lower limb functions during the run. Analysis of lower and upper limb movements to change body position from sitting to standing. Coordination: static, dynamic coordination, identification and evaluation of coordination disorders.

Methods of physical capacity evaluation. Determination of psychomotor response time. Nerve regulation of human movements. The role of the spinal cord in motion control. Muscle receptors, its role in muscle control. The role of the brainstem in posture and movement control. The role of the cerebellum in motion control. Assessment of the functional condition of the musculoskeletal system; the most common diseases affecting muscles, joints, bones; changes in the musculoskeletal system caused by diseases.

The most common skeletal system and soft tissue injuries (microtraumas, macrotraumas), its characteristics, prevalence and causes. Injury prevention. Recovery techniques. Relaxation. Physiology of stress and relaxation. Relaxation therapy. Specific relaxation techniques (pendulum movements, Mitchell technique, breathing exercises, soothing massage, rhythmic passive movements, visualization method, physical activity).

Physiological changes in the body. Changes in the musculoskeletal system and movements during the age genesis, peculiarities of physical activity at different ages. Basics of movement skills formation. Improving movement and function in the elderly. Physical activity at a young age. Principles of health promotion through physical activity (principles of the systematicity, accessibility, awareness, phasing, comprehensiveness, hygiene requirements). Movement in specific environmental conditions.

Musculoskeletal system research. Special research systems for testing and rehabilitation efficiency determination: in case of disorders of nervous and muscular functions (gait, balance, coordination, functional movement disorders). Methods of human movement research: electromyography (EMG), isokinetic dynamometry (determination of muscle strength and endurance, evaluation of muscle coordination), video, MTD analysis (for balance assessment). Aspects of new bioengineering and rehabilitation technologies use in medicine and biomechanical aspects of artificial organs. Peculiarities of clinical biomechanics of endoprostheses, implants, fixators, braces, its application.

## RECOMMENDED LITERATURE SOURCES


1. Joseph Hamill; Kathleen Knutzen; Timothy R Derrick. Biomechanical basis of human movement. Fifth, international edition. 2022. Philadelphia: Lippincott Williams and Wilkins. ISBN: 9781975169527 1975169522.
2. Joseph Muscolino. Kinesiology: The Skeletal System and Muscle Function. 3rd edition. 2016. Mosby. ISBN: 9780323396202.
3. James R. Morrow Jr., Dale P. Mood, James G. Disch, Minsoo Kang. Measurement and Evaluation in Human Performance. 5th edition. 2015. Human Kinetics. ISBN: 1450470432.

4. Thomas K. Uchida, Scott L Delp, David Delp. Biomechanics of Movement: The Science of Sports, Robotics, and Rehabilitation. 1st Edition. 2021. The MIT Press. ISBN: 9780262044202.
5. Sandrini, Giorgio; Homberg, Volker; Saltuari, Leopold; Smania, Nicola; Pedrocchi, Alessandra. Advanced Technologies for the Rehabilitation of Gait and Balance Disorders Springer; 1st ed. 2018. ISBN: 9783319727356.
6. Fell DW, Lunnen KY, Rauk RP. eds. Lifespan Neurorehabilitation: A Patient-Centered Approach from Examination to Interventions and Outcomes. First Edition. 2018. F.A. Davis Company. ISBN: ISBN: 0803646097.
7. Nicholas Stergiou. Biomechanics and Gait Analysis. 1st Edition. 2020. Academic Press. ISBN: 9780128133729.
8. Daunoraviciene K, Ziziene J, Pauk J, Juskeniene G, Raistenskis J. EMG Based Analysis of Gait Symmetry in Healthy Children. Sensors (Basel). 2021 Sep 6;21(17):5983. doi: 10.3390/s21175983.
9. Journal of NeuroEngineering and Rehabilitation: https://jneuroengrehab.biomedcentral.com/
10. Cochrane Database of Systematic Reviews: https://www.cochranelibrary.com/

**CONSULTING LECTURERS**

1. Coordinating lecturer: Aurelija Šidlauskienė (Assoc. Prof. Dr.).
2. Jurga Indriūnienė (Assist. Prof. Dr.).

**APPROVED:**

By Council of Doctoral School of Medicine and Health Sciences at Vilnius University: 29th of September 2022

Chairperson of the Board: Prof. Janina Tutkuvienė