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Editor-in-Chief ▪ **AKOS KOLLER**

SPRINT SPORTS RESEARCH INTERNATIONAL

SPEED 2026 – Scientific Conference, focusing on Return-to-Sport with a Health Conscious and Digital Approach

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Editorial

Welcome to the SPRINT supplement containing the Program and Abstracts of the **SPEED 2026 – Scientific Conference, focusing on Return-to-Sport with a Health Conscious and Digital Approach.**

Safe and successful participation in sport is a core objective of sports medicine. In recent years, clinical guidelines have advanced considerably, offering recommendations on physical activity limits for patients with various disease conditions. Despite this progress, important gaps remain, particularly regarding the precise definition of exercise intensity, duration, and modality in return-to-sport scenarios.

Concurrently, digital and artificial intelligence-based technologies have become increasingly prominent in the monitoring of physiological responses during exercise and sport. Many of these tools were initially developed for military applications or elite athletes but are now widely accessible to patients and recreationally active individuals. Continuous physiological feedback is routinely available not only to athletes, but also to patients, parents, and coaches. This rapid expansion has created a growing expectation that data derived from digital tools should be incorporated into everyday medical decision-making. However, many healthcare professionals are not yet adequately equipped to interpret and contextualize these complex datasets. Consequently, patients often attempt to draw medical conclusions independently from large volumes of digital and AI-generated information, which may pose clinical risks.

The SPEED 2026 – Scientific Conference, focusing on Return-to-Sport with a Health Conscious and Digital Approach was conceived to address these challenges. It provides an interdisciplinary forum for physicians, healthcare professionals, researchers, and sports scientists to discuss prevention and intervention strategies aimed at improving the safety and quality of return-to-sport and physical activity following disease. In parallel, the meeting encourages critical evaluation of digital and AI-based technologies that have the potential to collect valid physiological data and transform them into clinically meaningful, evidence-based insights. The 2026 scientific program focuses on two major disease areas of relevance to sports medicine: cardiology and neurology.

The SPEED 2026 Conference is organized by the Medical Committee of the Hungarian Football Association in collaboration with Széchenyi István University in Győr, an institution with a strong emphasis on technological innovation.

In addition to plenary sessions, the conference highlights the work of young researchers by moderated poster presentations. All these contributions reflect emerging scientific perspectives in sport-related research. *SPRINT – Sports Research International* supports these efforts by publishing the abstracts in the present supplement.

It is our hope that this conference and the accompanying supplement will foster interdisciplinary dialogue and contribute to the development of safer, more precise, and digitally informed return-to-sport practices.

We wish you a successful conference!

Budapest, January 6, 2026

Akos KOLLER
Editor-in-chief
SPRINT-Sports Research International

Zsolt SZELID
President of the conference
SPEED 2026

SPEED 2026 – Scientific Conference, focusing on Return-to-Sport with a Health Conscious and Digital Approach

SCIENTIFIC PROGRAM OF THE CONFERENCE

FRIDAY, JANUARY 23

08:50–09:00 WELCOME

Prof. Dr. Béla Merkely, Rector
Semmelweis University
Dr. Zsolt Szelid, Associate Professor of Medicine, Head of Department
Széchenyi István University, Department of Sports Medicine and Digital Health

09:00–10:50 KEYNOTE SESSION

Nutrition and sport
Prof. Dr. Nicole Avena, Professor of Medicine
Princeton University

Return to play monitoring in football
Dr. Evert Verhagen, Chief Scientific Advisor
Union of European Football Associations (UEFA)

Etiologies of sport-related sudden cardiac death
Dr. Castelletti Silvia, Chair, ESC EAPC Sports Cardiology Section
European Association of Preventive Cardiology, Sports Cardiology Section

How AI and digital cardiology will transform cardiac athlete management
Dr. Jorstad Harald, Associate Professor of Medicine, Head of Department, AMC Sports Cardiology
Amsterdam UMC, Department of Sports Cardiology

Quantified self, virtual human twins - where is data taking us in medicine?
Dr. Zoltán Lantos, Associate Professor of Medicine, Head of Department,
Semmelweis University, Faculty of Health Sciences, Department of Virtual Health Guide Methodology

Roundtable

10:50–11:20 COFFEE BREAK

11:20–12:50 SPORT AND HEART DISEASE

Sports and cardiovascular disease
Dr. Zsolt Szelid, Associate Professor of Medicine, Head of Department
Széchenyi István University Department of Sports Medicine and Digital Health

Physical activity following myocardial infarction
Dr. Attila Simon, Senior Physician, Chair
Balatonfüred Heart Center

Cardiomyopathies and sport activity
Prof. Dr. Hajnalka Vágó, Professor of Medicine, Head of Department
Semmelweis University Heart and Vascular Center, Department of Sports Medicine

Coronary CT as an effective tool in cardiovascular prevention
Dr. Ádám Jermendy, Assistant Professor
Semmelweis University Heart and Vascular Center

Basic life support education in youth sport
Prof. Dr. Endre Zima, Professor of Medicine, Chair
Semmelweis University Institute of Anesthesiology and Perioperative Care

Roundtable

12:50–14:20 LUNCH BREAK AND POSTER SESSIONS

14:20–15:30 SPORT & RISK FACTORS

Diabetes and sport
Dr. Nóra Homoródi, Assistant Professor, Head of Department
University of Debrecen, Clinical Center, Institute of Cardiology, Department of Cardiac Rehabilitation

Obesity and physical activity
Dr. Zsolt Sárszegi, Associate Professor, Head of Department
University of Pécs, Cardiology Clinic, Department of Sports Cardiology

Body composition monitoring - DEXA
Dr. Attila Matkovits, radiologist
Unimedical Center Győr

Return-to-sport considerations in women
Dr. Ágnes Stefanovits, obstetrician-gynecologist, athletics coach
University of Pécs, Department of Prevention and Perinatal Medicine

Roundtable

15:30–16:40 DIGITAL PREVENTION AND MONITORING OF CARDIOLOGICAL DISEASES

ECG and AI
Dr. Gábor Orbán, resident cardiologist, PhD student
Semmelweis University Heart and Vascular Center

AI in cardiology
Prof. Dr. Szilvia Nagy, Professor in Information Science
Széchenyi István University Department of Telecommunications

Are smartwatches reliable?
Dr. Ferenc Suhai, PhD, Senior cardiologist, Head of MRI Laboratory
Semmelweis University Heart and Vascular Center

Digital ECG at the Semmelweis University and the global perspective
Dr. Péter Vámosi, cardiologist, Chair
Semmelweis University HSZI

Roundtable

16:40–17:00 COFFEE BREAK

17:00–17:40 EVALUATION OF STRESS TESTS

Evaluation of cardiopulmonary stress tests
Prof. Dr. János Porszász, Professor of Medicine, Past Director of CPET Core Laboratory
The Lundquist Institute for Biomedical Innovation at Harbor-UCLA Medical Center

Smart devices and AI solutions in performance diagnostics
Dr. Gabriella P. Szabó, Associate Professor of Medicine, Chair
National Institute of Sports Medicine, Department of Athletic Performance

Roundtable

17:40–18:50 PHYSICAL ACTIVITY AND TELEMEDICINE PRACTICE IN ARRHYTHMIA AND HEART FAILURE

Supraventricular arrhythmias and sport
Prof. Dr. László Gellér, Professor of Medicine, Vice-Director
Semmelweis University Heart and Vascular Center

Ventricular arrhythmias and sport
Prof. Dr. Tamás Szili-Török, Professor of Medicine, Chair
University of Szeged, Cardiology Center

Heart failure and telemedicine
Dr. Annamária Kosztin, Associate Professor
Semmelweis University Heart and Vascular Center

Regional practice of telemedicine in heart failure patients
Dr. Gergely Nagy PhD, Associate Professor, Head of Department
B.-A.-Z. County Central Hospital and University Teaching Hospital, Cardiology Department

Roundtable

19:00 DINNER

SATURDAY, JANUARY 24

08:30–09:30 MONITORING AND REHABILITATION OF PHYSICAL ACTIVITY AFTER NEUROLOGY CONDITIONS

Current practice in rehabilitation after stroke and brain injury
Dr. Zoltán Dénes, Associate Professor, Head of Department
Semmelweis University, Department of Physical Medicine and Rehabilitation

AI-based neuro-motion analysis in rehabilitation and sports performance analysis
Dr. László Grand, Associate Professor
Pázmány Péter University

Returning to sports activities after neurology conditions – the significance of primitive reflexes triggered by stress and their rehabilitation options
Dr. Erzsébet Stephens-Sarlós, Assistant Professor
Széchenyi István University

Cycling controlled by functional electrical stimulation for the rehabilitation and competitive sports of patients with spinal cord injuries
Dr. József Laczkó, Associate Professor
HUN-REN Wigner Research Centre for Physics

Roundtable

09:30–10:45 MONITORING AND REHABILITATION OF PHYSICAL ACTIVITY AFTER NEUROLOGY CONDITIONS II.

Robotic and virtual rehabilitation in medicine
Dr. József Tollár, Associate Professor
University of Pécs, Faculty of Health Sciences and
Széchenyi István University

Posture monitoring with raster stereography
Dr. Szilvia Boros, Associate Professor
Széchenyi István University

Movement and neurology – digital options in stroke detection
Dr. Péter Árvai, Clinical Specialist
University of Debrecen

Space technology in neuro- and cardiac rehabilitation
Szilvia Kóra, PhD student
University of Pécs, Faculty of Health Sciences, Doctoral School of Health Sciences and
Kaposi Mór Teaching Hospital

Roundtable

10:45–11:15 COFFEE BREAK

11:15-13:00 SAFE AND DIGITAL PROFESSIONAL SPORTS

Data-based analysis in soccer
Dr. Gábor Schuth, Strength and conditioning coach, Hungarian National Football Team
Hungarian Football Association

Balancing between exercise and rest, the daily use of the WHOOP band
Dr. Sándor Sáfár, PhD, Associate Professor
Hungarian University of Sports Science

Use of NORT Complex in sport
Prof. Dr. József Topál, Scientific Advisor
HUN-REN Natural Sciences Research Center

The use of digital avatar in athletes
Dr. Nóra Sydó, Assistant Professor
Semmelweis University Heart and Vascular Center

Digital monitoring of athlete selection and prediction of success in the ETO FC system
Dr. Lili Kósa, Assistant Professor
Széchenyi István University

Roundtable

13:00–14:30 LUNCH BREAK AND POSTER SESSIONS

14:30–15:30 SPORT IN YOUNG PATIENTS – WHAT IS POSSIBLE AND HOW CAN WE MONITOR IT? ONLINE STREAM

Diabetic children and sport activities
Dr. Márk Svébis, Specialist in diabetology
Semmelweis University Department of Internal Medicine and Oncology

Sports in children with heart disease
Dr. Beáta Gyömörei, Pediatric cardiologist, Senior physician
MRE Bethesda Children's Hospital Budapest

Digital tools in follow up
Dr. Zsolt Szelid, Associate Professor of Medicine, Head of Department
Széchenyi University Department of Sports Medicine and Digital Health

Pain relief in children: applications in VR technology
Dr. Domonkos Tinka, Resident Pediatrician, Petz Aladár University Teaching Hospital Győr and
PhD student in Doctoral School of Regional and Economic Sciences, Széchenyi István University

15:30 WRITTEN TEST EXAM FOR MEDICAL DOCTORS (OFTEX)

Scientific Committee:

Zsolt Szelid, Széchenyi István University of Győr (Chair of the Committee)
Lóránd Erőss, Semmelweis University
Hajnalka Vágó, Semmelweis University
Attila Simon, National Institute for Cardiovascular Rehabilitation
Ákos Koller, Hungarian University of Sports Science
Péter Torzsa, Semmelweis University
Emese Mezősi, University of Pécs
Tamás Szili-Török, University of Szeged
Imre Boncz, University of Pécs
Sándor Szántó, University of Debrecen
Róbert Halmosi, University of Pécs
Zoltán Lantos, Semmelweis University
Tibor Mintál, University of Pécs
Nóra Homoródi, University of Debrecen
Szilvia Boros, Széchenyi István University of Győr
Gergely Ágoston, University of Szeged
Péter Prukner, Széchenyi István University of Győr

Organizing Committee:

Ákos Koller, Hungarian University of Sports Science
Zsolt Szelid, Széchenyi István University of Győr
Nóra Homoródi, University of Debrecen
József Tollár, University of Pécs & Széchenyi István University of Győr
Szilvia Nagy, Széchenyi István University of Győr
Béla Debreczeni, Hungarian University of Sports Science
Katalin Vámos, Convention Kft.
Ádám Vajda, Convention Kft., Technical information: avajda@convention.hu

Moderated Poster Sessions: Abstracts

Exercise Motivation and Well-Being Among Users of Artificial Intelligence-Assisted Fitness Applications

Judit Emma Boda-Ujlaky[1], Erzsébet Printz-Markó[1], Zoltán Alföldi[1], Ágota Lénárt[1], Róbert Járai[1], Edmond Girasek[1]

[1]Széchenyi István University, Győr, Hungary

According to self-determination theory (Deci and Ryan, 2017), our motivation and well-being are highest when an activity satisfies our three basic human motivations: our need for relatedness, competence, and autonomy. Previous research has focused primarily on the sense of competence, gamification effects, and self-monitoring. In our research, we seek to answer the question of how the motivation and well-being of people who exercise in their free time using AI-assisted fitness apps differ from those who exercise in traditional gyms, but we focus on social relationships during exercise.

In addition to demographic variables, we examine the amount, intensity, and location (outdoors/indoors; gym/home) az exercise, and the nature of social relationships during training (alone/with a personal trainer/in a group/in a team). We also administered the PALMS (Leisure-Time Physical Activity Motivation Scale) and the PERMA Well-Being Profile Questionnaire. The former is used to assess different forms of exercise motivation, while the latter is used to assess different characteristics of general psychological well-being. Our hypothesis is that the motivation of users of AI apps or other non-AI-assisted training (e.g., YouTube videos) does not differ from that of those who choose gym training, but their well-being shows a different profile due to the lack of social relationships, so they are characterized by lower overall psychological well-being.

The data was collected online using the Qualtrics platform, and we reached participants using the snowball method. The data is processed using the R program with multivariate statistical procedures. According to our preliminary results, the use of AI-based fitness applications is not yet widespread in Hungary. The majority of people who exercise in their free time do so outdoors, alone, at home with a subscription app, or in a gym in a group (typically women). They typically engage in moderate-intensity exercise, predominantly for health and relaxation purposes, with social motives playing only a moderate role.

Beyond Training: Determinants of Nutrition Knowledge Among Hungarian Athletes

Réka Erika Kovács[1], Szilvia Boros[1], István Karsai[2], Gusztáv József Tornóczky[3]

[1]Department of Health Management and Psychology, Faculty of Health and Sport Sciences, Széchenyi István University, Győr, Hungary

[2]Physical Education and Exercise Centre, Medical School, University of Pécs, Pécs, Hungary

[3]Institute of Health Promotion and Sport Sciences, Faculty of Education and Psychology, ELTE Eötvös Lóránd University, Budapest, Hungary

Background: Nutrition knowledge is a key determinant of athletes' performance, recovery, and overall health. Despite its recognised importance, limited empirical data exist regarding the sport nutrition literacy of Hungarian athletes across different performance levels. This study aimed to address this gap by evaluating nutrition knowledge and identifying its sociodemographic, sport-related, and perceptual predictors in a sample of Hungarian athletes.

Methods: A total of 1,335 athletes (132 elite and 1,203 recreational; 54.3% male; mean age = 22.74 ± 8.11 years) completed the Hungarian Abridged Nutrition for Sport Knowledge Questionnaire (ANSKQ-HU). Additional variables included education level, sport type, weekly training hours, perceived importance of healthy eating, and accessibility to nutrition information sources. Statistical analyses comprised Kruskal–Wallis H-tests, Mann–Whitney U tests, MANCOVA, and Kendall's tau correlations to examine group differences and associations.

Results: Overall, 63.37% of athletes fell into the poor knowledge category (<50%), demonstrating substantial gaps in sport-specific nutrition literacy. No meaningful differences were observed across gender, sport level, or prior exposure to nutrition education, suggesting that current educational efforts may be insufficient or inconsistently delivered. Education level emerged as a significant determinant of nutrition knowledge: participants with secondary or higher education outperformed those with only primary education on both the fundamentals of nutrition, energy requirements of physical activity, and prohibited substances (FEP) subscale and total ANSKQ-HU scores, with medium effect sizes ($d = 0.31–0.35$). Age and weekly training hours showed weak but significant correlations with FEP and total scores ($p < 0.01$). Athletes who perceived healthy eating as highly important scored consistently higher on both FEP ($\chi^2 = 30.840$, $p < 0.001$, $\eta^2 = 0.022$) and total knowledge ($\chi^2 = 22.612$, $p < 0.001$, $\eta^2 = 0.015$). Access to multiple nutrition information sources and professional dietitian

support significantly improved MPE (micronutrients and performance-enhancing sports nutrition) and UM (utilization of macronutrients) subscale scores.

Conclusion: The findings underscore the urgent need for structured, evidence-based nutrition education for Hungarian athletes. Integrating qualified dietitians and reliable educational resources into training environments may enhance athletes' nutrition knowledge and thereby support optimal performance and health outcomes.

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Climate Anxiety as a Psychological Burden: Links To Mental Health, Eating Behaviors, And Physical Activity In University Students

Fanni Küplen[1]

[1]Széchenyi István University of Győr, Győr, Hungary

This research is part of the international AppHuman Protocol Climate Change Study, conducted with a Hungarian sample. It examines the psychological and behavioral effects of climate change-related perceptions and concerns among university students aged 18–30. We aim to explore the associations between climate anxiety and anxiety, depression levels, eating disorders, such as orthorexia nervosa, compulsive exercise, and commitment to a sustainable, healthy lifestyle. The study is carried out with ethical approval on the Qualtrics online platform and uses 23 measurement instruments, including those that assess the variables listed above.

The analyses will be conducted using descriptive statistics, correlations, regression models, and structural equation modeling (SEM). We expect that higher climate anxiety will be associated with both health-impairing behaviors (e.g., orthorexia symptoms, problematic exercise) and potentially adaptive, health-promoting responses, which may have important implications for prevention and for supporting sustainable health behaviors.

Keywords: Climate anxiety; eating disorder; Health behavior; Physical activity; University students

The Discreet Beauty of Epidemiological Causality – The Relationship Between Sport and Breast Cancer

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[3]Department of Mathematics and Computational Sciences, Széchenyi István University, Győr, Hungary

Introduction: The correlation between chocolate consumption and Nobel laureates is a well-known example of misleading statistical association. Similar overinterpretations appear in studies linking breast cancer incidence or survival to lifestyle factors such as diet or physical activity. Our aim was to critically analyse the literature on sport and breast cancer, focusing on study design, methodological limitations, and how scientific enthusiasm may develop into overconfidence.

Methods: A structured PubMed search was performed using the keywords breast cancer, physical activity, exercise, sport, and diet. Three thematic blocks, each with six representative publications, were analysed: (1) established prognostic and predictive factors (TNM stage, nodal status, receptor profile, BMI); (2) lifestyle factors often mentioned but supported by limited evidence (diet, psychological constructs, wellness-derived claims); (3) rarely examined yet potentially relevant factors (social status, geography, ethnicity, access to care). Both original studies and relevant reviews were included, and meta-analyses were used as higher-level reference points. Methodological quality, cohort structure, activity assessment, and confounder handling were evaluated.

Results: Breast cancer heterogeneity, non-standardized and self-reported activity measures, and incomplete control of key confounders (parity, oral contraceptive use, BMI, menopausal status, genetic predisposition) substantially limit interpretation. Long observational periods overlap with major therapeutic and screening changes, reducing comparability. Even high-quality studies often fail to separate prognostic from predictive factors, and correlations are frequently presented as causative. Lifestyle studies are especially vulnerable to self-selection, recall and survivorship bias, and socioeconomic confounding.

Conclusion: While the overall health benefits of physical activity are clear, its precise, measurable impact on breast cancer incidence or survival is unproven and often overstated. Epidemiological findings must be interpreted cautiously: not every association constitutes evidence. Individualized, age- and condition-specific recommendations are preferable to broad lifestyle claims, and medical practice should resist mass-media simplifications and the elevation of hypotheses into "truths" without adequate proof.

Redefining Human Limits: Cardiovascular Risks and Knowledge Gaps Surrounding Performance Enhancing Drug Use and "The Enhanced Games"

Vencel Juhász[1, 2], Mani Eftekhari[3], Rohith Ryali[3], Atta Taseh[3], Soheil Ashkani-Esfahani[3], Gergő Merkely[3, 4, 5]

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[3]Foot & Ankle Research and Innovation Laboratory (FARIL), Dep. of Orthopedic Surgery, MGB, Harvard, Boston, MA, USA

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[5]Department of Orthopedic Surgery, Budapest, Hungary

Background: Pharmacological and technological performance enhancement—including anabolic-androgenic steroids, stimulants, erythropoiesis-modifying agents, peptides, and gene-based interventions—reshapes how the limits of human performance are understood. The Enhanced Games, the first sporting event to openly permit the use of performance-enhancing drugs (PEDs), challenge traditional norms of competitive sport. The inaugural competition will be held in May 2025 in Las Vegas (USA). Only FDA-approved agents may be used, off-label, both during preparation and competition. Meanwhile, PEDs are becoming increasingly common in the general population for aesthetic, recreational, or non-competitive purposes. Their cardiovascular (CV) adverse effects, however, remain insufficiently characterized.

Objectives: To summarize the evidence regarding the CV effects of major PED classes and to outline the potential implications associated with the Enhanced Games and population-level off-label PED use.

Methods: A literature review was conducted with particular attention to study quality, sample size, and population characteristics. Data from cardiac imaging, biomarker analyses, and observational studies were integrated.

Results: Reported PED-related CV effects range from physiologic-appearing reversible adaptation to clearly maladaptive changes, including hypertension, diffuse myocardial fibrosis, ventricular chamber dilation, endothelial dysfunction, autonomic instability, increased arrhythmia burden, and elevated sudden cardiac death risk. Most available data, however, originate from small samples of male amateur bodybuilders, limiting clinical relevance and generalizability. Evidence strength varies by substance: anabolic steroids consistently demonstrate pathological imaging findings, whereas other PED classes are supported by limited or low-quality data. Similar CV patterns are observed in recreational users, indicating that risk is not confined to elite sport. The Enhanced Games may offer a unique—though ethically complex—opportunity to characterize CV and non-CV effects in a structured manner. Rigorous, regular screening of athletes, long-term follow-up, and transparent dissemination of findings will be essential.

Conclusions: The Enhanced Games and the expanding off-label use of PEDs highlight the urgent need for high-quality CV research. Current evidence does not adequately represent the diversity of users or the full spectrum of substances. Defining the limits of CV adaptation and identifying early markers of myocardial stress will be crucial for evidence-based prevention, risk assessment, and monitoring strategies in PED-using populations.

Examination of the Effectiveness of High-Intensity Technological Rehabilitation in Patients with Subacute Stroke

Nándor Prontvai[1, 2], József Tollár[1, 2, 3]

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[3]Széchenyi István University, Digital Development Center, Győr, Hungary

Introduction: Technological rehabilitation shows significant progress in international and domestic rehabilitation in the movement and development of stroke patients, however, direct comparative studies are still limited. High-intensity therapies already used in athletes have been shown to be effective in the care of neurological patients according to the literature.

Methods: In our research, we conducted a prospective, randomized clinical trial (n=33), where we divided the study subjects equally. (C-Mill VR+, robotic gait therapy (ROB), Exergaming, virtual reality therapy (EX), Agility training (AG)). All treatments were performed at high intensity, which was determined in frequency and time units. The treatment time was one hour each time. The therapy was performed five times a week for 3 weeks. Before and after three weeks of treatment, we assessed the patients' subjective quality of life (mRS, BI, FIM, SE-ADL), balance and postural instability (BBS, BESTest, FES, PEP), and gait and performance (6mWT, 10mWT, X-Sens 3D).

Results: High-intensity therapies resulted in improvements in patients' quality of life, balance, postural instability, and gait outcomes in all groups ($p < 0.05$). On average, endurance improved by 104–177% and balance scores by 36–53%. The improvement in gait speed and balance ability was particularly noticeable in the ROB group compared to its own and the other groups studied ($p < 0.001$). The detected results of the ROB and EX groups resulted in significant improvements in gait speed, step length, and balance-related gait indicators, compared to agility therapy ($p < 0.001$).

Conclusion: Our subjective and objective study results suggest that technology-supported, high-intensity rehabilitation methods represent a promising alternative to traditional therapies, especially in the short-term improvement of gait and balance.

Integration of Objective Human Kinesiology Examinations into the Rehabilitation of Neurological Patients

Blanka Törő[1, 2], József Tollár[1, 2, 3]

[1]Faculty of Health Sciences, University of Pécs, Doctoral School of Health Sciences, Pécs, Hungary

[2]Somogy County Kaposi Mór Teaching Hospital, Kaposvár, Hungary

[3]Széchenyi István University, Digital Development Center, Győr, Hungary

Introduction: One of the most significant symptoms of neurological disorders is impaired coordination and balance. When the nervous system is affected, trunk control and posture will vary depending on the specific disease and the individual's underlying health condition. Objective human kinesiological assessments are necessary to detect the physiological parameters of patients. This allows for the monitoring and adaptation of rehabilitation treatments tailored to the individual and the disease. In sports, these tests are part of everyday selection and performance evaluation in Hungary and abroad.

Materials and methods: In our research, we analyzed coordination, balance, and gait patterns caused by different neurological conditions by detecting objective biomechanical variables. We compared the data of the patient groups with themselves and with each other, and monitored the changes after rehabilitation. Our research is a randomized, stratified sampling, controlled clinical study conducted at the neurorehabilitation unit of the Somogy County Kaposi Mór Teaching Hospital. Under laboratory conditions, we examined postural instability using a dynamic posturograph (TecnoBody ProKin), gait pattern using 3D motion analysis (Xsens), and muscle contractions using dynamometry (Kinvent) The preferred patient groups were those with Parkinson's disease, stroke, multiple sclerosis, and vertigo. A total of 100 people were included in the study (n=100), who were monitored continuously before and after the start of their rehabilitation.

Results: In our research, we were able to successfully detect various instabilities caused by the given conditions. During posturometric measurements, shifts in the center of body mass (COP) and trunk sway during static and dynamic standing tests became clearly visible. We used 3D motion analysis to analyze gait in real time, including stride length, stride width, and the main phases of gait. Using dynamometry, we were able to determine the main lower and upper limb muscle strengths and their asymmetries as percentages. The symptoms characteristic of the examined conditions, such as lagging of the affected side or involvement of the vestibular system, were clearly observable in the measurements of all three devices. The tests allow us to monitor the progress, deterioration, and changes in patients.

Summary: Objective human kinesiology tests can facilitate the work of therapists and physicians in rehabilitation, as we can provide them with much more accurate results about the current condition of patients and changes therein. The tests used in training and sports science can be integrated into rehabilitation and provide accurate monitoring for doctors and therapists.

Keywords: 3D motion analysis, posturometry, dynamometry

Sleep Quality and Recovery Monitoring in Youth Swimmers: The Role of Artificial Intelligence (AI) and Big Data in Sport Science Decision-Making

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Background: Sleep is a key determinant of recovery of athletes, influencing performance, injury risk, and mental well-being (Fullagar et al., 2015). Sleep deprivation impairs reaction time, cognitive functioning, hormonal balance, and increases susceptibility to injury (Charest & Grandner, 2020). For youth athletes undergoing growth and maturation, optimal sleep is essential for adaptation (Takács et al., 2025). Athletes sleeping <8 hours have a 1.7-fold higher injury risk compared to those achieving ≥8 hours. Sleep extension interventions show notable performance benefits; Stanford swimmers improved sprint, reaction, and turn times (Mah, 2016). Despite these findings, no Hungarian study has examined wearable-based sleep and recovery monitoring in youth swimmers. Recent reviews highlight AI as a crucial tool in sport science for detecting patterns beyond human observation (Mateus et al., 2025).

Aim: To evaluate the suitability of the Oura Ring for monitoring sleep quality and recovery in youth swimmers under real training conditions, and to determine whether AI-based analysis can identify individual recovery patterns and responses to load.

Methods: The study uses the latest-generation Oura Ring, validated for measuring sleep architecture, heart rate variability (HRV), and recovery indicators. Physiological big data collected across the training cycle will be analyzed using AI methods such as individualized trend modeling and clustering.

Results and Conclusions: We expect improvements in total sleep time, sleep efficiency, and sleep latency following targeted feedback, with inter-athlete variability influenced by adaptability, training design, and competition schedules. Meaningful associations are anticipated between sleep quality and recovery markers. HRV, resting heart rate, and temperature trends are expected to be most informative during taper, supporting individualized training decisions. Integrating Oura-based monitoring by AI into preparation may enable evidence-based optimization of performance, reduce injury and illness risk, and support long-term athlete development.

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Exoskeleton-Assisted Gait Therapy in the Rehabilitation of Neurological Patients

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Introduction: Neurological gait disorders—such as spinal cord injury, cerebellar ataxia, spastic paraparesis, and stroke—substantially limit mobility, functional capacity, and quality of life. High-intensity, repetitive, task-specific training is essential for promoting activity-dependent neuroplasticity, yet conventional therapy often falls short in terms of achievable repetition volume and consistency. Robot-assisted gait training using lower-limb exoskeletons offers high-dose, reproducible gait cycles that may enhance gait automatization and functional recovery. This study aimed to evaluate the feasibility and functional outcomes of the Ekso Bionics EksoNR exoskeleton in neurorehabilitation.

Methods: A prospective longitudinal study was conducted between June 2024 and February 2025 involving five patients with heterogeneous neurological gait impairments (2 spinal cord injury, 1 spastic paraparesis, 1 cerebellar ataxia, 1 stroke). Each participant completed a 15-session exoskeleton-based intervention. Outcomes included 6MWT, FIM, Barthel Index, EQ-5D-5L, WHO-QoL, TUG, Tinetti, BBS, and WISCI II. Robotic metrics (step count, step length, walking distance, walking time) were also recorded. Pre–post changes were analyzed using paired t-tests or Wilcoxon tests ($p=0.05$).

Results: All robotic performance metrics improved significantly. Step count increased from 751.8±253.59 to 3408±872.4 ($p<0.001$), with significant gains in walking distance ($p=0.002$) and step length ($p=0.003$). Walking time increased from 22.4±4.5 to 60.4±8.9 minutes ($p<0.001$). The 6MWT showed significant improvement ($p=0.017$). TUG scores improved but did not consistently reach statistical significance. Balance measures improved based on BBS ($p=0.006$) and Tinetti ($p=0.001$). FIM, Barthel Index, EQ-5D-5L, and WHO-QoL scores trended positively, though not all reached significance. WISCI II showed no significant change, likely due to the small sample size.

Conclusions: EksoNR-assisted gait training is feasible, safe, and effective for neurorehabilitation in patients with diverse neurological gait disorders. Significant improvements were found in objective gait parameters, cardiovascular endurance, and balance measures. Although not all clinical outcomes reached statistical significance, functional gains were observed in all participants. Larger controlled studies are needed to confirm these findings.

Keywords: Spinal cord injury, Ataxia, Stroke, Spastic paraparesis, Gait impairment, Ekso Bionics, Robotic gait training

Stereo Camera Calibration for Sport fields

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The rapid advancement of digital technologies is creating new opportunities in the spatial analysis of team sports, particularly in the precise tracking of players and the game object. In this context, a real-time motion tracking system composed of multiple stereo cameras has been developed, capable of covering sports fields of various sizes and accurately determining the three-dimensional position of athletes and the ball.

Compared to sensor-based approaches, optical motion tracking does not require any equipment to be attached to the athletes, does not influence their movement, and can accurately track all players and the game object simultaneously with high spatial resolution. Unlike sensor-based solutions, it does not suffer from signal loss during collisions or intense physical contact and does not restrict natural athlete movement. As a result, optical systems are especially suitable for analyzing fast and dynamic team sports.

During the development of the system, methods were established for optimal camera placement, synchronization, and geometric calibration, enabling accurate spatial reconstruction of the field and consistent data processing within a unified coordinate system. Challenges inherent in multi-camera environments—such as aligning data from different viewpoints, merging depth information, and reducing noise—were addressed using modern fusion algorithms.

The implemented software architecture ensures real-time processing of image and depth data from the cameras, providing continuous, stable, and precise tracking of player and ball movement. The system is also capable of analyzing motion-derived patterns, offering valuable foundations for coaching decision support, performance evaluation, or sports science research.

The resulting solution enables reliable, high-precision multi-camera tracking on sports fields and contributes to the advancement of modern sports analytics technologies.

High-Intensity Virtual Reality and Technology-Assisted Rehabilitation In Parkinson's Disease: Results of a Randomized Controlled Multimodal Program

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Background: Parkinson's disease (PD) is a progressive neurodegenerative disorder associated with substantial impairments in motor function, balance and health-related quality of life. Technology-based complementary therapies, such as virtual reality (VR), telerehabilitation (TR), sensor-based robot-assisted rehabilitation and rheoencephalography (REO), may increase training intensity, improve adherence, and enable physiologically informed, personalized rehabilitation.

Methods: We conducted a randomized controlled trial including 100 persons with idiopathic PD, assigned to four high-intensity training arms: VR-based exergaming, high-intensity cycling, C-Mill robot-assisted gait/balance training and agility-focused functional training. Interventions lasted 14 weeks (2×35–45 min/week) at high cardiovascular load. Outcome measures covered physiology (heart rate, blood pressure, Borg RPE), posturography (CoP sway, stability indices), motor function (FIM, TUG, 10MWT, 6MWT, BBS, DGI, UPDRS-III, WMFT) and health-related quality of life (PDQ-39, EQ-5D). A dedicated VR/TR platform combined clinic-based immersive and screen-based VR (Unity-based games, Kinect, C-Mill VR+) with a home VR system (HomeKit) providing 3D motion analysis, remote monitoring and real-time feedback. A 14-week VR-exergame subprogram (n = 25) specifically targeted agility, reaction time and cognitive–motor integration.

Results: High-intensity multimodal rehabilitation produced significant gains in gait speed (+0.3-0.5 m/s), FIM (+25-30 points) and fine motor performance (UPDRS-III, TUG, 10MWT, WMFT) across groups. Balance and mobility (BBS, DGI, BESTest) improved markedly, with TR (C-Mill VR+) and Agility training showing the largest effects. VR and exergaming (14 weeks, n = 25) enhanced agility, reaction time and motivation, and were associated with increased neuroplasticity markers, including BDNF elevation and improved cognitive-motor integration. VR-based tasks such as "coin collection", "obstacle avoidance", squatting and balance games increased upper- and lower-limb range of motion and strength (shoulder, elbow, wrist, hip, knee, ankle), improved CoP control and reduced estimated fall risk by optimizing proprioceptive feedback. The HomeKit VR-TR system enabled high-frequency home training with real-time feedback and offline data analysis, while reducing burden on the health care system and supporting cognitive and emotional rehabilitation, especially in patients with cognitive deficits. Robot-assisted C-Mill training improved step length, balance and reaction readiness, and reduced freezing-of-gait episodes, while maintaining cardiovascular safety (RPE 14-15, heart rate/blood pressure within target zone, no adverse events).

Conclusions: This high-intensity, VR- and technology-assisted multimodal program is safe and yields clinically meaningful improvements in gait, balance, upper- and lower-limb function and quality of life in PD. VR and exergaming appear particularly effective for enhancing agility, reaction time, motivation and neuroplasticity, while integrated TR and REO-based monitoring support the development of future 4D biofeedback-driven, predictive neurorehabilitation protocols.

"Pulses, Pixels, Preferences" – Student Needs in the Development of Digital Health and Sports Analytics in Higher Education

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The rapid development of the sports and health technology sector is creating an increasing demand for the processing of data generated during human movement, lifestyle, physiological functioning, and healthcare. AI solutions can support this process. We would like to reflect this approach in education, so we are launching a new interdisciplinary course entitled Digital Human Data Analysis within the Master's program in Artificial Intelligence Informatics, specializing in health technology and sports science. Our poster presents the concept of this course, which is based on the integrated analysis and use of clinical data sources, measurement data from wearable sensors, and sports performance monitoring systems.

As part of the course development, a focus group study has been launched among students to explore their expectations and attitudes regarding the course content, learning methodology, and assessment methods. The focus group aims to map students' perceptions of innovative learning experiences, device usage experiences, and data-driven sports and health development applications, at the intersection of educational development and market needs. The results and guidelines of the focus group will be available for the conference. The study used a mixed methodology, integrating quantitative and qualitative elements. The research was based on a Google Forms questionnaire, which measured student attitudes using Likert scale questions, while the qualitative part was based on open-ended questions and in-depth focus group interviews. This approach allowed for the exploration of expectations at both statistical and content levels.

Our goal is to demonstrate a training model that presents the available human health and performance data related to the development of AI applications and the possibilities for analyzing them, with a direct link to the world of sports and digital health innovations. Our poster contributes to technology-focused educational development and initiates a dialogue on the training framework for the future AI-based utilization of human data. Students clearly want more practice-oriented, data-driven, and innovative courses. Teaching digital health and sports analytics can be effective if it builds on scientific methods, modern technologies, and real data analysis. Based on our findings, there is a need for a comprehensive, modular course that integrates AI tools, data protection knowledge, and practical applications, contributing to students' competitiveness in the future labor market.

Stimulus Expectancies and Performance: Implications for Sport Psychology

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This cross-sectional study explored how individual differences in expectations about various potential sports-performance-enhancing agents affect outcomes. It also introduced a new visual tool for assessing stimulus-based expectancies. A total of 435 adults (58.5% female) completed demographic questions and responded to six image-based items (pill, powder, drink, chocolate bar, injection, electrical stimulation), indicating whether each stimulus was expected to improve performance. Responses were recorded as dichotomous (yes/no).

The findings revealed that mixing high- and low-expectancy individuals reduces measurable expectancy effects, a critical concern in sport science, where responses of athletes who respond to placebos and those who do not are averaged. This combination can conceal genuine psychological effects on placebo-induced performance, suggesting that many placebo effects in sport are underestimated.

Furthermore, confirmatory factor analysis supported a robust unidimensional structure for the newly developed Stimulus Expectancy Assessment Tool (SEAT), with excellent model fit (CFI = 0.974, TLI = 0.952, RMSEA = 0.086, SRMR = 0.032) and strong internal consistency ($\alpha = 0.84$). The latent factor explained an average of 48% of the variance in expectancy.

These results hold important implications for sport psychology. Expectancy, an established component of placebo effects, may meaningfully influence actual performance, perceived exertion, recovery, and motivation. By identifying athletes with high/low stimulus-specific expectancies, practitioners can better tailor psychological interventions, enhance placebo-responsive training strategies, and avoid misinterpreting performance data that inadvertently mixes responders and non-responders. The SEAT provides a practical method for screening expectancy profiles and refining both research and applied sport performance practices.

Real-World Comparison of FFR and QFR: New Perspectives on the Functional Assessment of Coronary Stenoses

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Background/Objectives: Quantitative Flow Reserve (QFR) has a class I/B recommendation in the 2024 guidelines of the European Society of Cardiology, along with Fractional Flow Reserve (FFR), for the functional assessment of chronic coronary stenoses. The diagnostic value of QFR with respect to the gold standard FFR in real-world settings is not well described, and neither are the factors influencing the bias of QFR versus FFR well understood. The learning curve associated with QFR calculation has not been thoroughly investigated. Hence, we sought to evaluate the association between the QFR and FFR, to investigate the influence of clinical parameters on both values and their difference, and to analyze the learning curve associated with QFR measurement in a real-world setting.

Methods: All patients who underwent FFR and QFR measurements in 2023 at our tertiary-care center were included. QFR calculation was performed by examiner with no prior experience in QFR calculation or coronary angiography, blinded to FFR values; routine coronary angiograms were utilized. The bias was characterized using a Bland–Altman plot and multivariable regression was used to uncover its potential predictors.

Results: QFR calculation was successful in 73% of 595 patients with 778 vessels with FFR measurement results. Median bias of QFR was 0.011, but in 7% of the cases, the difference between the two exceeded 0.10. A good correlation was found between the two indices. Receiver operating characteristic curve analysis showed that the area under the curve of QFR for predicting FFR ≤ 0.80 was 0.912. FFR and QFR values were lower in the left anterior descending artery; acute coronary syndrome indication was associated with higher QFR values. Right coronary artery localization was associated with a greater bias of QFR, whereas female gender and aortic stenosis were associated with a lower bias of QFR. Both measurement time and bias decreased in a non-linear fashion with increasing experience.

Conclusions: QFR represents a viable alternative for functional coronary assessment in scenarios where FFR is unavailable in a real-world setting. Clinical and angiographic factors affect the bias of QFR versus FFR. QFR has a short learning curve with growing experience leading to shorter measurement time and less bias.

Self-Esteem as a Key Mechanism Linking Psychological Distress to Exercise Addiction: Evidence from a Mediation Model

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Regular physical activity and planned exercise are widely recognized for their positive effects on both physical and psychological well-being. However, when their practice becomes rigid, excessive, or driven by compulsion, it may develop into self-destructive exercise addiction (EA). This maladaptive behavioral pattern lacks a formal diagnostic status despite extensive research, with more than 1,000 empirical studies. EA has been linked to various indicators of psychological issues, but its connection with self-esteem has been inconsistent, showing both positive and negative connections. Thus, the specific role of self-esteem in explaining how psychological distress relates to EA is still insufficiently understood. This cross-sectional investigation surveyed 350 Italian adults (62% women; M = 34.17, SD = 11.06) using validated questionnaires assessing EA, psychological distress, and self-esteem. Structural equation modeling with bootstrapping was employed to test the hypothesized relationships. Findings indicated that psychological distress was strongly associated with lower self-esteem and that diminished self-esteem subsequently predicted higher EA risk scores, supporting a complete mediation pathway. Psychological distress did not directly forecast EA when self-esteem was included in the model, underscoring its central role. Men exhibited higher EA levels than women, whereas age was unrelated to EA tendencies. Overall, the study contributes to a clearer understanding of the psychological mechanisms linked to EA, suggesting that interventions aimed at strengthening self-esteem may be necessary for preventing or reducing problematic exercise behavior.

Analysis of Measurement Uncertainties in Stereo Camera–Based Hand Motion Assessment

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Our research aims to analyze the measurement uncertainties of a stereo camera–based hand motion assessment system that enables the recording of fine motor movements without requiring any additional worn equipment. This approach is particularly advantageous for children with limited range of motion or injuries, as it eliminates the need for markers or hand-mounted sensors. Using repeated measurements of standardized motion tasks, we evaluated the system's accuracy and reproducibility. Our findings define the reliable operational range of the stereo camera and contribute to the development of non-invasive motion assessment protocols.

The Role of 2D Speckle Tracking Echocardiography in Assessing Left/Right Ventricular And Left Atrial Adaptation in Young Athletes

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In pubertal athletes, differentiating physiological cardiac adaptation induced by regular endurance training from pathological alterations is crucial. Speckle tracking echocardiography enables the early detection of functional changes. As age- and sport-specific cut-off values are not yet available, comprehensive evaluation of these parameters and the assessment of their diagnostic power are of particular importance.

We examined young endurance athletes (n=23, mean age 14±3.7 years, cumulative training time 2252.2±1251 hours) and age-matched controls without regular physical activity (n=21, mean age 13.5±0.5 years) using echocardiography with a special focus on speckle tracking analysis. In addition to standard echocardiographic measurements, we performed three-view left ventricular global longitudinal strain (GLS) analysis, assessed left atrial reservoir, contractile and conduit strain, and measured right ventricular free-wall longitudinal strain (FWLS) and four-chamber strain (4CSL).

All left ventricular strain parameters were significantly more favourable in athletes ($p<0.001$; A4C: -28.7% vs -20.8%, A2C: -29.3% vs -22.5%, A3C: -30.6% vs -19.8%). Regarding left atrial function, athletes showed higher reservoir and contractile strain values, although not all differences reached statistical significance, whereas conduit strain differed significantly between groups ($p<0.05$; -41.4% vs -28.2%). Right ventricular longitudinal strain values were also significantly better in athletes ($p<0.05$; FWLS: -29.37% vs -24.03%, 4CSL: -26.38% vs -21.40%), indicating enhanced contractility both in free-wall and four-chamber measurements. Athletes exhibited larger right ventricular end-diastolic and end-systolic areas ($p<0.05$, RV-EDV: 18.6 vs 15.3 cm^2 and $p<0.001$, RV-ESV: 10.3 vs 7.3 cm^2), consistent with physiological dilation. Tricuspid S' velocities were significantly lower in athletes compared to controls ($p<0.05$), while other functional parameters did not differ substantially.

Our findings suggest that even at a young age, marked functional differences exist between regularly training young endurance athletes and their non-athletic peers. Speckle tracking echocardiography is highly sensitive in detecting normal, training-induced adaptation not only in the ventricles but also in the left atrium. Alongside left atrial dilatation, preserved or "supernormal" left atrial reservoir and conduit strain and "supernormal" right ventricular free-wall strain values represent adaptive changes. A decline in these strain parameters may indicate pathological processes and support the identification and screening of potentially at-risk young athletes.

Sustaining Player Wellbeing: Identifying Core Mental Health Challenges And Support Gaps Among Hungarian Soccer Players

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Introduction: Competitive sports have a positive impact on health, but they also involve numerous risks. In addition to physical injuries, mental health problems often arise due to constant performance pressure and the desire to win. Soccer is one of the most popular sports worldwide, which places even greater demands on its players. The study aims to assess the prevalence and severity of competitive anxiety among soccer players under stress, in relation to their coping indicators and perceived social support.

Materials and Methods: We conducted a cross-sectional study among Hungarian soccer players aged 18 years and older. Data collection took place voluntarily and anonymously through an online questionnaire in March 2019. The questionnaire included sociodemographic questions, sports-related education, and items regarding harmful addictions. Standardized instruments included the Competitive State Anxiety Inventory-2, the Athletic Coping Skills Inventory-28, and the Social Support Questionnaire. Competitive anxiety was assessed before a home and an away game. Descriptive statistics, two-sample t-tests, analysis of variance and correlation were performed using SPSS 20.0 ($p<0.05$).

Results: The respondents (N=106) had been playing soccer for an average of 19.4±5.3 years, 49.1% competed in 3rd League, and 31.1% played as midfielders. Participants reported moderate levels of somatic (14.9±4.2 points) and cognitive anxiety (18.1±3.6 points), alongside high self-confidence (29.5±3.8 points). Coping indicators were moderate (83±10.2 points), whereas social support was notably low (13.7±6.2 points). A strong positive correlation emerged between somatic and cognitive anxiety ($r=0.763$; $p<0.001$), and higher somatic anxiety was associated with reduced self-confidence ($r=-0.432$; $p<0.001$). Regarding match location, players exhibited the greatest self-confidence before home matches (home: 30.1±4.3; away: 28.8±4.9 points; $p=0.041$), elevated physical anxiety before away games (home: 14.6±4.4; away: 15.3±5.6 points; $p=0.258$), and higher cognitive anxiety before home games (home: 18.2±4.2; away: 17.9±4.3 points; $p=0.559$). Stronger coping abilities were associated with decreased anxiety and increased self-confidence across all measures (cognitive $p<0.001$; somatic anxiety $p=0.001$; self-confidence $p<0.001$). League division, years of experience, and playing position did not significantly affect anxiety levels ($p>0.05$). Social support showed no significant relationship with competitive anxiety or coping mechanisms.

Conclusions: The footballers surveyed exhibited moderate levels of competitive anxiety, limited coping skills, and minimal social support. In addition to strengthening anxiety-reducing factors, it would be important to seek the help of appropriate professionals to improve mental health.

Keywords: soccer players, competitive anxiety, coping, social support, ACSI-28, CSAI-2

Analysis Of Heart Rate Patterns During Short, High-Intensity Periods of Play

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Handball is a high-intensity, contact sport in which exertion is intermittent and requires both aerobic and anaerobic metabolism. Nowadays, two or three complete attacks can take place in a single minute. The aim of the study was to examine the heart rate patterns of top-level players over one minute so that coaches can plan substitutions more effectively. The study presents the results of seven world-class female handball players in a particularly high-intensity match in the Champions League. We examined heart rate patterns during different phases of the match (where there were at least two or three attacks) over the course of one minute. Heart rates were recorded using Polar Team Pro telemetry devices. After one minute of exertion, we observed the recovery, a minimum of 25-30 beats per minute, and the time elapsed during this period. The seven players examined reached 90% of their maximum heart rate. The average time required to reach a heart rate of 30 beats per minute was 46 seconds. We found no significant difference between the maximum and submaximal heart rates. The results suggest that sending the seven players onto the field as substitutes after such a short period of intense training does not require ranking.

Literature Review: Physical Limitations of NIRS in Measuring Muscle Oxygen Saturation

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Introduction: Near-infrared spectroscopy (NIRS) is a popular method for non-invasive measurement of skeletal muscle oxygen supply during exercise. It is also used in cycling to monitor performance and design training programs. Despite its usefulness, NIRS has significant physical and methodological limitations that can greatly affect measurement accuracy and physiological interpretation. Understanding these limitations is essential for the proper application of muscle oxygen saturation (SmO_2) data.

Physical and methodological limitations: Adipose tissue thickness (ATT) is the most significant confounding factor in NIRS measurements. With each mm increase in ATT, the total hemoglobin and myoglobin concentrations decrease. The short penetration depth of NIRS (15–20 mm from the skin surface) further limits measurements in superficial muscle areas, preventing extrapolation to the entire muscle. The reason for the optical limitation is that it is not possible to distinguish between the contributions of hemoglobin and myoglobin to the signal because both chromophores have nearly identical absorption spectra in the near-infrared range. This makes it difficult to interpret whether SmO_2 changes reflect changes in oxygen supply and/or oxygen consumption.

Blood flow in the skin is a confounding factor, as thermoregulatory vasodilation during exercise can cause measurement errors, regardless of muscle oxygenation. Movement distortions resulting from dynamic cycling, sensor placement, differences between repeated measurements, and tissue composition all cause systematic and random errors.

Recommended standardized protocol and identified shortcomings: To minimize confounding factors, a standardized protocol is recommended: (1) preliminary measurement of ATT with a skinfold caliper at the planned measurement site (marking if ATT exceeds 7 mm); (2) consistent placement of the sensor on the vastus lateralis, approximately 10 cm above the patella, parallel to the direction of the muscle fibers, with photographic documentation; (3) if possible, bilateral measurements due to leg asymmetry; (4) secure, non-restrictive fixation with medical adhesive tape and elastic bandage, opaque light shield; (5) recording of baseline values during 3–5 min of rest; (6) controlled protocols with a fixed pedaling rhythm (75–90 rpm); and (7) rigorous data collection and processing, recording all details.

Technological advances are needed to overcome remaining limitations. NIRS is a valuable tool for understanding muscle oxygenation and developing cycling training strategies. Results should not be overinterpreted beyond the superficial muscle assessment that the system fundamentally provides.

Keywords: near-infrared spectroscopy, muscle oxygen, adipose tissue, cycling, standardized protocol

ChatGPT-Driven Personalized Endurance Training Plans for University Students

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Background: AI-driven coaching tools are emerging in sports science to support individualized training. This study investigates the use of ChatGPT 3.5 to generate six-week personalized endurance running plans for university students who had previously failed their athletic course requirements. Plans were tailored using each participant's body composition, fitness level, performance goals, injury history, and training environment. The aim was to evaluate the efficacy and feasibility of AI-generated training programs for improving running performance and body composition in this population.

Methods: Twelve undergraduate students who did not meet athletic standards were enrolled. Participants provided data on body mass, body fat percentage, baseline fitness (timed run results), target race times, injury history, and available training resources. This information was used to prompt ChatGPT 3.5 to generate personalized weekly training schedules. Each schedule outlined progressive running workouts over six weeks, with varying distance, intensity, and recovery days, plus optional cross-training or strength sessions. For comparison, analogous plans were prepared by an experienced track coach. Performance (1500 m and 3000 m times) and body composition (body fat and lean mass) were measured before and after the program. Participants also reported their adherence and satisfaction with the training plan.

Results: Six participants completed the six-week program. Among completers, measurable improvements were observed: average 1500 m times decreased by approximately 8–12%, and 3000 m times decreased by 5–10% relative to baseline. Body composition also shifted favorably, with mean body fat reduction of about 2–3% and increased lean mass in several participants. Participants reported good adherence to the AI-generated plans and found them motivating and appropriately challenging. Comparing plan design, the AI-generated schedules had more gradual weekly progression and adaptive pacing, unlike the steeper progression of coach-designed plans.

Conclusion: This pilot study demonstrates that AI-based tools like ChatGPT can autonomously create customized endurance training plans that support athletic development. The AI-generated programs yielded measurable gains in running performance and improved body composition for these students. The gradual progression pattern in the AI plans may benefit adherence and reduce injury risk. These outcomes highlight the innovative role of AI in sports science and demonstrate the feasibility of hybrid AI–coach systems and integration into standard training practice.

Changes in the Body Composition of Hungarian Third Division Soccer Players: A Longitudinal Analysis Using Five Months of Bioelectrical Impedance Analysis

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Introduction: The body composition of professional soccer players is key to optimizing performance, as body fat percentage and fat-free mass influence strength and speed (França et al., 2024). The bioelectrical impedance analysis (BIA) method, such as InBody 720, is a reliable tool for monitoring body composition (McLester et al., 2020). The aim of this study was to analyze changes in the body composition of 16 Hungarian third division soccer players between two measurements (June 23, 2025 – November 25, 2025).

Materials and methods: The sample consisted of 16 adult male soccer players with an average age of (Measurement (1): Mean=26.66±4.26 years; Measurement (2): Mean=27.12±4.27 years). The measurements were performed using an InBody 720 device. Variables examined: body weight (BW) (kg), lean body mass (LBM) (kg), fat-free body mass (FFBM) (kg), muscle mass (MM) (kg and %), fat mass (FM) (kg and %), and trunk muscle mass TMM (kg). The data showed a normal distribution (Shapiro-Wilk), and we used a paired t-test to detect development, calculating the effect size based on Cohen's d. Statistical analysis was performed using JASP software (Version 0.95.3).

Results: The average body weight BW (kg) of the sample remained stable (M1: 78.47±6.61 kg; M2: 78.16±6.23 kg; where we found no significant difference: (t=0.866, p=0.400, d=0.216). There was no significant change in lean body mass (LBM (kg): t=-0.879, p=0.393, d=-0.220), fat-free body mass (FFBM (kg): t=-1.071, p=0.301, d=-0.268), muscle mass (MM (kg): t=-1.315, p=0.208, d=-0.329), and trunk muscle mass TMM (kg): (t=1.484, p=0.159, d=0.371). We found a significant decrease in fat mass (FM (kg): t=2.525, p=0.023, d=0.631) and fat mass percentage (FM (%), t=2.503, p=0.024, d=0.626), while a significant increase was found in muscle mass percentage (MM (%), t=-2.830, p=0.013, d=-0.707).

Conclusion: Over the 5-month period, the body composition of the soccer players improved. There was a relative increase in muscle mass and a decrease in fat mass, while absolute mass remained stable. Individual variability was observed, but the group trend showed an improvement in body composition. This indicates the effect of training and the season, as well as a potential performance advantage.

Keywords: body composition, InBody 720, muscle mass percentage

Complex Analysis of the Relationship Between Body Composition And Training Load In Elite Male Handball Players

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Introduction: In elite team sports, objective monitoring of body composition and training load has become increasingly important. Digital measurement systems allow for monitoring seasonal adaptations and health status; however, the practical interpretation of the relationship between cumulative load and body composition changes remains challenging, particularly during the competitive season.

Aim: The aim of this study was to analyze seasonal changes in body composition in elite male handball players and to examine their relationship with objective training and match load indicators.

Materials and Methods: Thirteen elite male handball players participated in the study (mean age: 27.5 ± 5.9 years; mean height: 192.3 ± 7.1 cm). Body composition was assessed at four time points during the season using an InBody 270 device. The analyzed variables included lean body mass (LBM), skeletal muscle mass (SMM), body fat mass (BFM), and visceral fat level (VF).

For ten players, objective load data were recorded using the Polar Team Pro system, including cumulative training load (TL), high-speed running distance (HSD), and micro-movement load. Data analysis was performed using paired samples t-tests and Spearman's rank correlation.

Results: During the season, lean body mass (+2.03 kg; $p<0.05$) and skeletal muscle mass (+1.25 kg; $p<0.05$) increased significantly, while body fat mass (–1.83 kg; $p<0.01$) and visceral fat level (–1.0 units; $p<0.01$) decreased significantly. Changes in lean body mass were strongly associated with changes in skeletal muscle mass ($\rho=0.95$; $p<0.001$), indicating that improvements in body composition were primarily driven by muscle mass gains.

Cumulative training load showed a significant negative correlation with changes in lean body mass ($\rho=-0.72$; $p<0.05$) and skeletal muscle mass ($\rho=-0.80$; $p<0.01$), whereas high-speed running distance was not significantly associated with body composition changes. A positive trend was observed between micro-movement load and muscle mass changes; however, this relationship did not reach statistical significance.

Conclusions: Favorable body composition adaptations were observed during the competitive season in the examined team. However, excessive cumulative training load may limit muscle mass development, highlighting the importance of objective load monitoring in optimizing training prescription and supporting health-conscious sport participation.

Keywords: handball; body composition; training load; muscle mass; InBody; Polar Team Pro

Relationship Between Motor Abilities, Body Composition Variables, And Match Performance in Youth Female Handball Players

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Introduction: Due to the high conditional demands of handball, it is essential to explore how motor abilities and body composition influence match performance. The aim of our study was to analyze the relationships between these factors in youth female handball players.

Materials and Methods: A total of 35 female players participated in the study (mean age: 16.83±1.27 years). We assessed sprint performance (10 m and 20 m sprint, s), vertical jump performance (countermovement jump, CMJ; relative peak power, $W \cdot kg^{-1}$), upper-body maximal strength (three-repetition maximum, 3RM bench press, kg), lower-limb maximal isometric strength (isometric mid-thigh pull, IMTP; N), and aerobic capacity (Yo-Yo Intermittent Recovery Test Level 1; total distance, m). Body composition was measured using the Accuniq BC-720 device (recorded variables: skeletal muscle mass (kg), body fat percentage (%)). Match analysis was conducted retrospectively using 20 league matches (Handball Statistics software). The evaluated variables included: goals, steals, technical errors, assists, 7-m situations, suspensions, fouls, blocks, and the integrated performance index. The study was complemented with performance-monitoring data (Polar Team Pro). All statistical data were normalized to playing time. Normality was assessed using the Shapiro-Wilk test, and relationship between variables were examined using Pearson's and Spearman's correlation coefficients (JASP v0,16).

Results: Skeletal muscle mass showed significant correlations with goals ($p=0.043$), blocks ($p=0.013$), fouls ($p=0.001$), and high-intensity running ($p=0.037$). Height correlated with blocks ($p=0.027$), while body mass correlated with fouls ($p<0.001$). Relative CMJ performance was a significant predictor of goals ($p=0.010$) and the performance index ($p=0.047$). The 20 m sprint time was also associated with goals ($p=0.012$). Yo-Yo IR1 performance influenced high-intensity running ($p = 0.001$) and playing time ($p=0.009$). Bench press strength correlated with fouls ($p=0.024$) and the performance index ($p=0.029$).

Conclusion: Body composition and motor abilities significantly contribute to players match performance. Greater muscle mass, better explosive power, speed, and aerobic capacity are key components of effective offensive play and high-intensity running performance. Comprehensive physical conditioning is therefore essential for optimizing competitive performance.

Assessment Of Scapular Dyskinesis in Young Wrestlers

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Introduction: Scapular dyskinesis (SD) is a common functional musculoskeletal disorder, yet its recognition and management receive relatively little attention. Abnormal scapular motion is most frequently observed in overhead sports (e.g., handball, water polo, volleyball); however, combat sports also place considerable load on the shoulder girdle, which may contribute to the development of SD.

Objective: The aim of this study was to investigate the prevalence of SD among young competitive wrestlers and to compare the results with an age-matched non-athlete control group. Additional objectives included analyzing the effects of a six-week, shoulder-specific physiotherapy program, differences in SD between sexes, the relationship between the dominant side and SD, and the association between SD and shoulder complaints.

Methods: A total of 76 wrestlers and 77 non-athlete youths were examined. The mean age of the wrestlers was 17.57 years (15–20), while that of the control group was 17.10 years (15–19). SD was assessed using the Lateral Scapular Slide Test (LSST) and the Wall Push-Up Test (WPUT). SD was considered positive if the distance measured between the two sides differed by at least 1.5 cm at a given arm position angle. Fifty-one wrestlers participated in a six-week physiotherapy program focusing on scapular and shoulder stabilization, after which the measurements were repeated.

Results: The prevalence of SD was 43.4% among wrestlers and 27.3% in the control group. The statistical relationship between SD and shoulder complaints was as follows: in boys ($\chi^2 = 0.4$; $p = 0.524$; OR = 0.67) and in girls ($\chi^2 = 1.316$; $p = 0.251$; OR = 0.22). SD positivity was 41.4% in boys and 50.0% in girls ($p = 0.262$). Among male wrestlers, a correlation between the dominant side and SD was observed in 51.52% of cases ($p = 0.811$). After the six-week physiotherapy program, the proportion of SD-negative cases increased from 56.6% to 62.8% ($p = 0.48$). Comparison between the wrestler and control groups yielded an odds ratio of 1.62 ($p = 0.20$).

Conclusions: Based on our results, no significant association could be demonstrated between SD and shoulder complaints, dominant side, or sex. The six-week shoulder-specific physiotherapy program resulted in a favorable but not statistically significant improvement. The prevalence of SD was higher among wrestlers than in the non-athlete control group; however, this difference did not reach statistical significance.

Effect of an Anaerobic Threshold–Intensity Lifestyle Program on Cardiopulmonary Performance in Healthy, Untrained Adults

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Introduction: Palpitations and reduced exercise tolerance are common complaints in cardiology practice and are often treated pharmacologically, most frequently with beta-blockers. Our aim was to investigate the effect of regular aerobic training based on the ventilatory threshold (VT1) on cardiopulmonary performance and symptoms in physically inactive individuals with structurally normal hearts.

Methods: Twenty-three physically inactive but cardiological healthy individuals initiated a lifestyle modification program according to our protocol. Eight participants showed low adherence to physical activity and subsequently withdrew from the study.

During cardiopulmonary exercise testing (CPET), individual heart-rate zones were determined, after which participants were prescribed regular aerobic exercise at a tolerable intensity (around the VT1 heart rate), consisting of 30–60 minutes of activity five times per week, in accordance with ESC recommendations.

After completing the 3-month program, repeat ergospirometry was performed. Based on follow-up testing, participants continued their training at zone-3 intensity.

Changes in key CPET parameters (VO_2max, oxygen pulse, oxygen uptake efficiency slope [OUES], VE/VCO_2 slope, and VO_2/W slope) were analyzed using paired t-tests. Subjective well-being and symptoms were monitored using a questionnaire (Exercise-related Symptom Questionnaire).

Results: After three months, participants who completed the training phase showed a consistent improvement in VO_2-max, oxygen pulse, VO_2/W slope, and gas-exchange efficiency. A statistically significant increase was observed in maximal achieved speed, maximal exercise capacity expressed in metabolic equivalents (METs), and peak respiratory exchange ratio (RER) during exercise testing.

In parallel with improved exercise tolerance, 100% of participants reported a reduction in palpitations.

Conclusion: VT1-intensity, lifestyle-based aerobic training resulted in significant symptomatic improvement even in the short term. These favorable clinical changes occurred before full cardiopulmonary adaptation was achieved and did not require pharmacological treatment.

Study Limitations Due to deconditioning, participants were only able to perform regular exercise at low intensity. Several individuals discontinued the training program and withdrew from the study. The overall number of study participants was low.

Relationships Between Spinal Functional Characteristics and Anthropometric Parameters in Competitive Swimmers

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Introduction: In competitive swimming, body build and the functional condition of the spine fundamentally influence performance and injury risk. However, limited data are available on the relationship between the Heath–Carter somatotype and comprehensive functional spinal assessment.

Materials and Methods: The aim of this study was to conduct an anthropometric assessment and somatotype classification of competitive swimmers from UNI-Győri ÚSZÓ SE, to perform a comprehensive spinal evaluation using the Idiag M360 system, and to analyze the associations between somatotypes and spinal functional parameters. A total of 31 swimmers participated in the study (8 females, 23 males). Based on anthropometric measurements performed according to the ISAK protocol, Heath–Carter somatotypes were determined: endomorphic 42% (n=13), mesomorphic 19% (n=6), and ectomorphic 39% (n=12). Spinal status was assessed using the Idiag M360 Spinal Mouse in standing position, during maximal trunk flexion, and during the Matthiass test. To explore the relationships between the dominant somatotypes of the sample and physiological spinal parameters, descriptive, inferential, and multivariate statistical methods were applied.

Results: A significant somatotype effect was observed for Overall evaluation ($F(2,28)=5,34$; $p=0,011$) and mobility-related parameters ($F(2,28)=4,16$; $p=0,026$). Endomorphic swimmers achieved significantly higher scores in both parameters compared to the mesomorphic group ($\Delta=19,2$; $p=0,009$ and $\Delta=14,9$; $p=0,029$, respectively), whereas no significant differences were found in comparisons with ectomorphic swimmers. No significant differences were detected for Posture ($p=0,377$) or Postural competence ($p=0,072$).

Conclusion: The findings indicate a moderate association between somatotype and global spinal function measured by the Idiag M360, primarily between endomorphic and mesomorphic swimmers. Postural and postural competence parameters show less differentiation by somatotype, highlighting the importance of sport-specific and individualized spinal profile assessment.

Bias-Field–Aware Quadriceps Muscle Volumetry from T1-Weighted Thigh MRI Using Classical Segmentation

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Quadriceps muscle volume is an important biomarker in sports medicine and rehabilitation, because it reflects training adaptation, disuse atrophy and recovery after injury. MRI is attractive for muscle volumetry due to its excellent soft-tissue contrast and lack of ionizing radiation, but in practice segmentation is often still based on manual outlining. Classical semi-automatic methods are appealing in clinical-adjacent research, because they are transparent and do not require large training datasets, yet they can fail when image assumptions are violated.

In this work we focus on quadriceps volumetry from axial T1-weighted thigh MRI and analyse why several classical methods initially performed poorly. On the raw images we observed a mild but systematic low-frequency intensity gradient, with a brightness increase toward the superficial–lateral region of the thigh. This shading artefact degraded region homogeneity, edge salience and tissue-class separability. We applied k-means and fuzzy c-means clustering to obtain an "all-mus-

cles" candidate region, Chan–Vese region-based active contours and geodesic active contours with a balloon term, as well as simple edge-based segmentation, and compared their behaviour before and after a filtering-based shading correction.

Without correction, all methods showed consistent failure modes: clustering leaked into background and bone, Chan–Vese either invaded subcutaneous fat or collapsed toward high-contrast structures, and edge-based models locked onto artefact-induced gradients. Slice-wise cross-sectional area curves contained obvious outliers, requiring frequent manual rescue. After estimating and removing the low-frequency bias field within a thigh-centred region of interest, tissue classes became more separable, clustering produced stable initial masks, and both Chan–Vese and geodesic contours converged more reliably to anatomically plausible quadriceps boundaries using fixed parameters. Slice-wise area profiles became smoother and required fewer corrections. We conclude that in T1-weighted thigh MRI a simple shading correction can restore the assumptions behind classical segmentation and enable a practical, interpretable semi-automatic pipeline for quadriceps muscle volumetry in sports medicine and rehabilitation.

Investigating The Associations Between Physical Activity, Metabolic and Cardiovascular Diseases Using Fuzzy Cognitive Maps Based on the NHANES Database

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The effect of physical activity on general health condition, as well as on the risk of developing metabolic and cardiovascular disorders, is clinically proven and widely documented. However, a deeper understanding of these complex dynamic relationships is essential for developing effective intervention strategies. Current work presents a data-driven Fuzzy Cognitive map (FCM) model suitable for examining the system dynamics of multidimensional risk factors. Dynamic iterations allow for mapping the effects of modifying different variables on outcome states, thereby helping to reveal the most relevant intervention points.

Data and methods: The FCM model was based on the National Health and Nutrition Examinations Survey (NHANES) 2017-2018 dataset, focusing on the population aged over 18. The multidimensional risk factors of physical activity, metabolic markers, current health status, comorbidity severity and the diseases outcomes were defined as so-called concept variables.

The FCM relational matrix (representing the weights of the dynamic relationships) was determined in a data-driven manner using partial correlation analysis. The refreshing of the activation level of the nodes was performed with logistic activation (sigmoid) function. The model was validated through dynamic iterations. The examination of the system's equilibrium allows for the analysis of how modifications to the input variables affect the risk of disease incidence. This simulation approach allows for the identification of the most sensitive points for interventions.

Results: The data-driven FCM network reveals complex, non-linear relationships between the examined risk factors and the disease outcomes, which extend beyond the linear associations detected by traditional statistics. The simulations rank the intervention points based on their network role and demonstrated that modifying the factor that elicits the largest input system effect causes the FCM model to converge to a low-risk equilibrium state. The model confirmed the prominent role of physical activity in the context of disease incidence.

Conclusion: FCM models are highly suitable for mapping the relational networks of complex systems, defining relevant variables, and analyzing chain-reaction effects within the system. Therefore, they provide an excellent opportunity for developing intervention strategies and for use as part of decision support systems in disease prevention.

Breast Reconstruction of Female Athletes By Plastic Surgery After Sport-Induced Impairment

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Background: In female athletes, breast size and shape are influenced not only by genetic factors, weight fluctuations, age, pregnancy, and breastfeeding, but also by the type of sport practiced and the intensity of training. Optimal breast size is particularly important for athletic performance, as excessively large breasts (macromastia) may hinder movement, impair biomechanics, and reduce endurance. Conversely, smaller or ptotic breasts generally do not limit sports participation, but may adversely affect body image and psychological well-being. The Female Athlete Triad can further affect breast morphology through alterations in hormonal balance and reduced body fat. Decreased estrogen levels is one of the hallmark consequences of the Triad, directly influence breast tissue, contributing to reduced glandular volume, changes in breast consistency, and overall atrophy, particularly in athletes with chronically low body fat.

Methods: We conducted a systematic review using a structured, predefined set of criteria to evaluate plastic breast surgeries (augmentation and reduction) performed in female athletes. The analysis focused on surgical indications, implant considerations, postoperative recovery, and timelines for return to daily activities and athletic performance.

Results: Implant size and shape can be determined using anatomical measurements, calibrated trial implants, and 3D computer-assisted planning. Return to sport after breast plastic surgery in female athletes requires a carefully designed, evidence-based rehabilitation strategy that considers surgical technique, tissue healing, and the biomechanical requirements of the athlete's sport. Postoperative recovery typically progresses through defined phases. In the first 1–2 weeks, the main priorities include protection of the surgical site, reduction of swelling, and maintenance of gentle upper-limb mobility without stressing the pectoral region. Light walking and low-impact aerobic activity are generally allowed if painless. Return to moderate and high-intensity, sport-specific training is usually possible between 6 and 12 weeks, depending on the procedure (augmentation, reduction, mastopexy, or combined interventions) and implant placement (subglandular or submuscular). Athletes participating in high-impact, overhead, or contact sports (for example, gymnastics, volleyball, martial arts) may require longer recovery due to increased mechanical forces applied to the chest wall. Before resuming full competition, athletes should demonstrate pain-free upper-body mobility, restored strength symmetry, and the ability to perform sport-specific actions without compensation or apprehension. Close collaboration among the plastic surgeon, sports physician, physical therapist, and strength-and-conditioning specialists is essential for a safe and gradual reintegration into training. Individual variability in healing must be respected, and athletes should be instructed to monitor for signs of overuse, including localized pain, swelling, or changes in breast position. A criteria-based progression—rather than adherence to a strict timeline—offers the safest and most effective pathway for minimizing complications and ensuring optimal athletic performance following surgery.

Conclusion: In female athletes with symptomatic macromastia, when conservative management and specialized sports bras fail to alleviate symptoms, surgical breast reduction should be considered, as it can substantially improve athletic performance and overall quality of life. Additionally, after the end of their competitive career, many female athletes may seek breast reshaping procedures to address changes resulting from the Female Athlete Triad or sport-related trauma. Breast augmentation using implants or autologous fat grafting may represent a therapeutic option in selected patients affected by the Female Athlete Triad, advanced 3D planning systems and AI-assisted volumetric analysis are expected to play a key role in patient selection and surgical decision-making.

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Monitoring The Effect of Physiotherapy Prehabilitation in Colorectal Surgery

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Introduction: Major abdominal surgeries cause severe stress reaction which can increase the number of complications, especially in high-risk patients. Among these patients, physical therapy before colorectal surgery might improve the physical condition of the patients, but the effect of such prehabilitation on postoperative outcome is controversial in literature.

Methods: Between September 2023 and December 2024, we selected high-risk patients awaiting elective colorectal surgery based on their medical history, comorbidities, and physical assessment results. These patients underwent a physical and dietary assessment prior to surgery and received personalized therapy. The physiotherapy lasted 4 weeks and was tailored to the area that needed improvement, so we recommended endurance or muscle strengthening exercises. The data were recorded at three time points: at the initial assessment, after prehabilitation prior to surgery, and at the 8th week postoperative follow-up. Parameters that were measured: 6 minute walk test (6MWT), handgrip strength in both hands, and the number of sit-ups that could be performed in 1 minute (STS, sit-to-stand test). We compared the changes over time using a paired t-test.

Results: 16 cases were analyzed. The average age was 59.8, and 87.5% were men. The average of 6MWT measurements were 310.6 +/- 132.5, 393.6 +/- 137.5, and 373.7 +/- 137.8 meters, respectively. The average grip strength of the right hand over time was 33.2 +/- 12, 35.2 +/- 11.7, and 32.7 +/- 11 kg, while the average grip strength of the left hand was 33 +/-10.5, 33.9 +/- 10.2, and 32.1 +/- 9.9 kg. The averages for the STS test were 28.2 +/- 11.3, 31.4 +/- 11.8, and 29.4 +/- 9.2 repetitions. For all three functional parameters, the measurements after prehabilitation showed a significant improvement compared to the initial values (6MWT p=0.003, right handgrip strength p=0.007, STS test p=0.009). The average hospital length of stay (LOS) was 7 +/- 2.7 days. Complications occurred in 31.3% of cases within 7 days and in 25% of cases within 30 days. While using Spearman's correlation to analyze these above, we found a moderate negative correlation (R= -0.5) between the initial 6MWT and the LOS, which is at the threshold of significance (p=0.049).

Conclusions: The above results show that all three parameters describing physical condition improved significantly as a result of prehabilitation before surgery. After surgery, the measured values returned to or remained above baseline, minimizing the deterioration caused by surgery. Based on our data, patients with better initial functional capacity required shorter hospital stays. However, we still recommend recording all three parameters to monitor the effectiveness of physical therapy and to estimate the risk of postoperative morbidity.

Digitization of Paper-Based ECG Recordings For AI-Supported Analysis of Sports Cardiology Signals

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Electrocardiography is a fundamental diagnostic tool in sports cardiology; however, a substantial number of ECG recordings are still available only in paper-based form, or digitally as image files or textual documents with embedded ECG images. Since different acquisition devices employ different output formats, the identification and localization of information-bearing image and file segments is not trivial, but rather constitutes a complex problem involving character, scale and signal recognition.

Most currently used classical and artificial intelligence-based ECG analysis methods expect the ECG signal as a time-domain sampled waveform, represented as a sequence of amplitude values. Consequently, measurements stored in paper-based, image-based or text-based formats cannot be directly used for modern signal processing or AI-based analysis without reliable digitization. In this work, we present a Python-based framework supported by artificial intelligence that aims to convert paper-based ECG printouts into digital signals.

The proposed method processes ECG sheets with colored or black grid backgrounds. The algorithm automatically detects textual elements and the grid structure, determines grid spacing, orientation and the spatial scale of the recording. Using the extracted grid information, individual ECG channels are separated from the background, converted into one-dimensional signals and resampled to a uniform temporal resolution. The current implementation reliably identifies grid lines and letter markers on the ECG paper, enabling accurate spatial localization of the signal. Robust grid detection is particularly important, as grid color, line thickness and printing quality may vary considerably.

The digitized ECG signals serve as inputs for further artificial intelligence-based analysis. The proposed approach enables the reuse of archived paper-based ECG recordings, supports dataset expansion, and facilitates the integration of historical data into modern sports cardiology processing pipelines.

Artificial Intelligence Based Detection of Characteristic ECG Points in Sports Cardiology Signals

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Accurate identification of characteristic ECG points is of particular importance in sports cardiology, where even subtle waveform changes may indicate physiological adaptation or early pathological alterations. In this work, we present an artificial intelligence-based method for detecting characteristic points in digitized ECG signals, with special emphasis on signals originating from paper-based recordings.

The method is trained and evaluated using one or more publicly available online ECG databases containing expert annotations. A neural network-based model is employed to detect the main characteristic points of the ECG cycle, including the P, Q, R, S and T points. Ongoing developments aim to extend the detection beyond peak locations toward identifying the onset of the P wave and characteristic features of the T wave, which are required for the computation of several clinically relevant intervals. The method has been designed to operate in conjunction with a processing pipeline for digitizing paper-based ECG recordings.

Preliminary results demonstrate reliable PQRST point detection across a wide range of signal qualities and heart rate conditions. Since publicly available ECG databases predominantly contain 12-lead resting ECG recordings acquired from supine patients, adapting these models to sports cardiology signals presents a particular challenge. Such signals are typically recorded with fewer channels, are considerably noisier, yet extend over longer time intervals. This mismatch is especially critical for artificial intelligence-based methods trained on large volumes of short, pre-filtered recordings, making the investigation of signal pre-filtering strategies an essential part of the study.

The modular structure of the system allows adaptation to different sampling frequencies and noise conditions, which is particularly important when processing digitized paper-based ECG signals. The combination of digitization and AI-based analysis enables automated, reproducible ECG evaluation for sports cardiology applications.

Cardiovascular And Ventilatory Adaptations in Different Athlete Populations

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Background: Ventilatory efficiency is typically quantified by the VE/VCO_2 slope obtained during incremental exercise testing. It reflects the interaction between pulmonary function, metabolic demand and cardiovascular response. The relationship between ventilatory efficiency and cardiovascular function provides insight into the physiological adaptations of elite athletes.

Aim: This study aimed to compare the VE/VCO_2 slope, O_2 pulse, and performance at ventilatory thresholds among swimmers, track and field athletes, and kayakers to identify sport-specific physiological profiles.

Methods: Sixteen athletes aged 14–17 (swimmers n=5, kayakers n=6, track and field athletes n=5) underwent standardized ergospirometry testing. Ventilatory efficiency was quantified using VE/VCO_2 slope and VE/VO_2 ratios. Cardiovascular stress response was assessed using the heart rate rise slope (HR/VO_2), peak heart rate, ventilatory threshold heart rates (VT1, VT2 and VT3), and oxygen pulse (O_2 pulse). Associations among variables were examined using Spearman correlation analysis, and sport-specific differences were assessed using ANOVA.

Results: No differences were found between the sport groups for ventilatory efficiency (VE/VCO_2) ($F(2, 13) = 0.307$, $p = 0.741$). Group differences were found for O_2 pulse ($F(2, 13) = 5.602$, $p = 0.018$), with post-hoc tests revealing that kayakers (20.6) had a significantly higher O_2 pulse than track athletes (14.7, $p = 0.017$). Differences were also identified for power output at the second (VT2 Watt, $p = 0.020$) and third (VT3 watt, $p = 0.007$) thresholds. Spearman's correlation revealed that O_2 pulse was strongly and negatively correlated with HR/VO_2s ($\rho = -0.646$, $p = 0.007$) and strongly positively correlated with power output at VT3 ($\rho = 0.765$, $p < .001$).

Conclusion: For this cohort of athletes, the primary physiological distinctions are not found in ventilatory efficiency but in central cardiovascular function and high-intensity performance. Kayakers demonstrated a superior cardiovascular capacity, evidenced by a higher O_2 pulse, which was linked to their ability to produce greater power output at anaerobic thresholds. These findings suggest that O_2 pulse and performance at ventilatory thresholds are more sensitive markers for differentiating sport-specific adaptations than the VE/VCO_2 slope.

The Influence of Training Modality on Hematological and Aerobic Profiles in Adolescent Athletes

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Background: Cardiovascular adaptations in junior athletes are shaped by training modality. While endurance training provides sustained aerobic loading, anaerobic sports emphasize high-intensity bursts. Characterizing these differences is crucial for athlete assessment and identifying atypical adaptations.

Aims: To compare the cardiovascular and hematological profiles of junior athletes engaged in anaerobic-dominant versus endurance-dominant disciplines.

Methods: Sixteen elite junior athletes (swimming-5 kayaking-6, and athletics-5) were classified as anaerobic-dominant (n=11; sprinters, ≤500 m events) or endurance-dominant (n=5; ≥800 m events) based on their primary competition discipline. Ergospirometry (VO_2 max, O_2 pulse) and hematological parameters (hemoglobin, hematocrit, serum ferritin, transferrin) were assessed. Group comparisons were conducted using non-parametric Mann–Whitney U tests. Associations between iron status and aerobic capacity were assessed using Spearman correlation.

Results: No differences were found between the anaerobic and endurance groups in any cardiorespiratory or performance-related variable. Measures of maximal aerobic capacity (VO_2 max 55.3 vs. 55.8 mL/kg/min, p=1.000), O_2 pulse (17.3 vs. 18.1 mL/beat; $p = 0.43$), power output at thresholds (e.g., VT2 Watt, p=0.733), and oxygen-carrying capacity (hemoglobin 137.8 vs. 137.6 g/L; p=0.524) were similar. In contrast, the anaerobic group exhibited significantly higher concentrations of transferrin (p=0.027) and total iron binding capacity (TIBC) (p=0.019) compared to the endurance group. Transferrin and TIBC are correlated ($\rho = 0.993$, $p < .001$), confirming they measure the same underlying biological process. Serum iron showed a strong negative correlation with both transferrin ($\rho = -0.681$) and TIBC ($\rho = -0.684$). As expected, hemoglobin and hematocrit were moderately and positively correlated ($\rho = 0.593$, $p = 0.033$).

Conclusion: Global measures of aerobic fitness did not distinguish between training specializations. However, the elevated transferrin and TIBC in the anaerobic group point to a distinct difference in iron metabolism. This suggests that the high-intensity, intermittent nature of anaerobic training may induce greater metabolic stress or inflammatory responses that influence iron transport and regulation. Therefore, specific biomarkers of iron metabolism appear to be more sensitive for detecting training-specific adaptations in young athletes than traditional measures of cardiopulmonary capacity.

Careful Interpretation of Ergospirometry Data is Recommended for Predicting Race Performance in Junior Athletes Across Various Endurance Sports

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Background: Ergospirometry is a common tool for assessing physiological parameters in athletes, aiming to predict race performance. However, its predictive validity, particularly in junior athletes with varying physiological profiles and sport types, remains uncertain. This study evaluates the role of VO_2 max and related markers in predicting race performance across three different endurance sports (swimming, athletics, and kayaking).

Aims: To investigate the relationship between ergospirometry-derived metrics and race performance in junior athletes, examining the predictive power of these assessments and exploring differences among sports.

Methods: Sixteen junior athletes (ages 14-17), consisting of swimmers (5), athletes (5), and kayakers (6), were evaluated using ergospirometry for VO_2 max, O_2 pulse, lactate levels, and heart rate metrics. Statistical analyses included ANOVA, regression, MANOVA, and SEM to assess correlations between physiological data and race performance.

Results: The mean VO_2 max for the cohort was 55.4 ml/kg/min, with swimmers showing a peak at 59.2 ml/kg/min. Despite inter-sport variations, the following parameters showed no correlation with race rankings: VO_2 max, O_2 pulse. In contrast, better race performance (a lower numerical rank) was strongly correlated with higher power output at specific thresholds (VO2Ws, $\rho = -0.776$, $p < .001$; VT2 Watt, $\rho = -0.556$, $p = 0.031$) and greater respiratory capacity (FEV1, $\rho = -0.706$, $p = 0.003$). The SEM confirmed that heart rate dynamics at ventilatory thresholds were significant predictors of ranking. MANOVA confirmed significant multivariate differences between the sport disciplines ($p < .001$).

Conclusion: Our results suggest that while VO_2 Max and O_2 Pulse are not direct predictors, their influence on performance is complex and indirectly mediated through more specific variables like power output (watts) and heart rate dynamics at ventilatory thresholds.

Linear Performance Progression Curve of Female Adolescent Swimmers Is a Good Predictor of Entry to Adult Top Elite

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Background: Predicting future success in adolescent athletes, particularly female swimmers, presents a significant challenge. Traditional longitudinal studies are often limited by small sample sizes, confounding factors, and the historical underrepresentation of female athletes in sports science. This study aimed to develop a novel predictive model by analyzing large-scale, publicly available swim ranking data to characterize and compare the performance progression curves of top-elite and sub-top swimmers.

Methods: Season's best long-course performance times were collected from the official Hungarian swimming association's public database. The dataset included male and female swimmers aged 10 to 18 who qualified for the 2022 Hungarian Junior National Championships. Performances were categorized by gender, age, stroke (freestyle, backstroke, breaststroke, butterfly, individual medley), and distance (50m to 800m). General development curves were generated from this data and compared to the progression patterns of established top-elite athletes who had qualified for the Olympic Games.

Results: The analysis revealed a critical divergence in performance progression between average and elite female swimmers during mid-adolescence, most prominently in the mid-distance evens (200-400 m). While the average female swimmer's performance tends to stagnate or plateau between the ages of 13 and 16, the elite female athlete's progression continues on a consistent, linear downward trajectory, indicating steady improvement. Sustained linear performance progression during a developmental stage where peers typically experience a performance plateau was identified as a significant predictor of attaining elite status. In contrast, both average and elite male swimmers demonstrated a more consistently linear improvement curve throughout their adolescent years without a similar performance plateau.

Conclusion: These results suggest that the absence of a mid-adolescent performance plateau is a powerful predictor of a female swimmer's potential to reach the top-elite level. The ability to maintain a linear rate of improvement through the physiological changes of puberty distinguishes future elite athletes from the general swimming population. This provides a specific, data-driven marker that can be invaluable for talent identification and the strategic long-term development of female swimmers.

Cardiopulmonary Exercise Test Results of Junior Male Handball Players

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Introduction: Sports cardiology screening and performance diagnostics of junior elite athletes are essential for the objective assessment of exercise capacity, aerobic capacity, and possible cardiac abnormalities. Handball is a high-intensity, intermittent exercise sport that places significant cardiopulmonary demands on athletes. The aim of our study was to compare the cardiopulmonary endurance parameters of selected for the national team and non-selected junior male handball players.

Methods: We performed retrospective data processing based on the maximal cardiopulmonary exercise testing (CPET) data of 21 junior male handball players. The athletes were divided into selected for national team (n = 12) and non-selected (n = 9) groups. During the analysis, we examined the main CPET parameters characterizing aerobic performance and exercise capacity, with particular emphasis on relative VO_2 max values, oxygen pulse, OUES, and hemodynamic parameters associated with ventilation thresholds. Statistical analysis was performed using JASP software, applying independent samples T-tests. The significance level was set at $p < 0.05$.

Results: We found no statistically significant differences between the selected for national team and non-selected groups in any of the cardiopulmonary fitness indicators examined. Group-level comparisons of relative VO_2 max, oxygen pulse, and OUES values showed similar aerobic capacity in both populations. No relevant arrhythmias were detected during exercise.

Conclusion: Based on the results of our study, whether a player is selected for the national team in this sample was not associated with demonstrably better cardiopulmonary endurance. The endurance indicators of all athletes indicated good aerobic capacity appropriate for their age and fitness level. Our results indicate that selection for the national team at the junior level is not primarily based on endurance parameters, but rather on technical and tactical skills, coordination, decision-making, and sport-specific motor skills. Accordingly, at this age, cardiopulmonary exercise testing primarily serves to objectively assess exercise capacity, check the conditions for safe sports participation, and support individual training optimization, rather than selection based on performance level.

The main limitation of the study is its small sample size, which reduces its statistical power. Prospective studies of larger sample sizes are needed to confirm our results.

Relative Changes in Systolic Blood Pressure during and After High Intensity Exercise in Young Elite Football Players with Different Age

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Introduction: During maximal exercise, blood pressure responses reflect cardiovascular strain and adaptation. In trained youth populations, age-related differences in systolic blood pressure (SBP) values and their post-exercise recovery may indicate developmental changes in hemodynamic regulation. Most studies focus on pathological BP responses; however, little is known about the typical patterns and recovery dynamics in healthy adolescent athletes. A derived indicator, the systolic blood pressure recovery ratio (SBP%), may provide additional insight into individual adaptation beyond absolute values.

Methods: Healthy male football players aged 14–18 were enrolled and divided into four groups based on their competitive age category (under the certain year of age: U): U15, U16, U17, and U19. Resting, peak, and 5-minute recovery SBP values were collected during a maximal cardiopulmonary exercise test on a treadmill. SBP recovery % was calculated as: [(peak SBP – 5min SBP) / (peak SBP – resting SBP)] x 100. Data distribution was assessed using the Shapiro-Wilk test. Depending on normality, either a parametric (one-way ANOVA with Tukey's post hoc test) or a non-parametric (Kruskal-Wallis test followed by pairwise Mann-Whitney U test) approach was applied to compare groups. Statistical significance was set at p<0,05.

Results: A total of 72 participants (age 15.3 ± 1.3 years, mean ± SD) were included. Absolute resting and 5-minute recovery SBP values showed no significant differences between groups. However, peak SBP values were significantly higher in the older age groups (U17: 186.3 ± 15.9 mmHg, U19: 184.6 ± 18.5 mmHg) compared to U15 and U16 players (172.3 ± 8.9 mmHg and 171.9 ± 7.3 mmHg, respectively; U17 and 19 versus U15 and U16, $p<0.05$). Although group differences in SBP recovery % were not statistically significant ($p=0.266$), a declining trend was observed with increasing age: U15: 122±38%, U16: 117±41%, U17: 110±30%, U19: 100±37%.

Conclusions: In elite youth football players, older age groups exhibited higher SBP values during peak exercise, while resting and recovery SBP were similar. The calculated SBP recovery % revealed a downward trend with age. This phenomenon potentially reflects age-related differences in cardiovascular adaptation mechanisms and alterations in cardiovascular efficiency or autonomic recovery capacity in youth athletes.

Diastolic blood pressure during exercise in elite football players is an underexamined vital variable

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Introduction: During dynamic endurance exercise, diastolic blood pressure (DBP) typically remains stable or slightly decreases in healthy adolescents. Unlike systolic BP, which shows a pronounced increase, diastolic response offers unique insights into vascular resistance and autonomic regulation. Despite its physiological importance, DBP dynamics and recovery patterns are rarely studied in young athletes. This study investigates age-related patterns of DBP and its recovery following maximal effort in elite football players.

Purpose: This study aimed to determine the development of diastolic blood pressure values in young football players with different ages.

Methods: Male football players aged 14–18 years from a professional youth academy were included. Participants were grouped based on competition age category (under the certain year of age: U) U15, U16, U17, U19). DBP was measured at rest, immediately after peak exercise, and 5 minutes into recovery during a treadmill-based cardiopulmonary exercise test (CPET). Athletes with RQ >1.0 were included. Diastolic BP recovery % was calculated as: [(5min DBP – peak DBP) / (rest DBP – peak DBP)] × 100. In statistical analysis normality was assessed using the Shapiro-Wilk test. For group comparisons, one-way ANOVA was used for normally distributed variables, while the Kruskal-Wallis test was applied for non-normally distributed variables. Where applicable, post hoc analysis was performed using Tukey's test (for ANOVA) or Mann-Whitney U test (for Kruskal-Wallis).

Results: Young football players (n=72, age: 15,3±1,3 years, mean±SD) were included in the final analysis, with an average relative maximal oxygen consumption (rVO_2max) of 60,4±3,5 ml/kg/min. No statistically significant differences were found in absolute DBP values between age groups at any timepoint. However, the DBP recovery % showed a decreasing trend with age: in U15: 40.6 ± 15.7%, in U16: 37.3 ± 19.7%, in U17: 34.8 ± 17.8%, and in U19: 11.4 ± 76.0% (p = 0.484, ns). Notably, in the U19 group, 3 players had higher DBP at 5-minute recovery than at peak effort. Among them, 2 also showed exaggerated systolic BP response, suggesting altered post-exercise regulation.

Conclusions: Although group-level differences in DBP recovery were not statistically significant, a clear inverse trend was observed with advancing age. These findings suggest potential maturational changes in vascular tone or autonomic recovery in adolescent athletes. DBP recovery %, as a derived indicator, may help characterize subtle differences in cardiovascular adaptation during the developmental years.

Psychological Readiness to Return to Sport After Injury: The Role of Motivation Discrepancy and Pain Experience

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Return to sport after injury is not only a physical process but also a psychological one, in which athletes' perceptions and motivations critically influence successful outcomes. Psychological readiness reflects athletes' confidence, emotional state, and perceived preparedness to resume sport participation, yet the motivational and pain-related factors underlying readiness are not fully understood. In this cross-sectional study, athletes (N = 54) post-injury completed measures of psychological readiness to return to sport, internal and external motivational regulation for return, and subjective sport injury-related pain experience. Motivation discrepancy was operationalized as the difference between external and internal motivation scores to examine how the relative dominance of external motivation relates to readiness outcomes. Psychological readiness to return to sport was positively associated with more autonomous (internal) motivation and more adaptive pain perceptions. Importantly, a larger discrepancy in which external motivation exceeded internal motivation was associated with lower psychological readiness, suggesting that athletes driven primarily by external pressures rather than internal values and enjoyment feel less mentally prepared to resume sport participation. These findings indicate that psychological readiness after injury is multifaceted, shaped not only by physical and pain-related factors but also by the quality and balance of motivational regulation. A greater relative dominance of external motivation, such as pressure from coaches, peers, or return deadlines, may undermine readiness, highlighting the importance of rehabilitation practices that foster internal motivation and adaptive psychological coping. In the future, artificial intelligence–based assessment and monitoring tools may further support return-to-sport decision-making by integrating psychological, motivational, and recovery-related data to provide personalized feedback and readiness support.

Age Differences in Balance and Hand Grip Strength Among Physically Active Older Women

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Introduction: According to demographic projections, the aging of the population will continue. This will lead to numerous social and economic problems. One way to solve these problems is through activities aimed at maintaining and improving the health and quality of life of the elderly. *Methods subjects:* The study included 106 physically active elderly women from Győr, with an average age of 71.3 ± 6.71 years. During the study, we determined their anthropometric characteristics: body height (BH), body weight (BW), F%, Muscle mass) and measured their hand grip strength (digital hand dynamometer, QttvbTna). We measured their static balance with a proprioceptive-stabilometric measuring device (TecnoBody, Prokin 252, Italy). During the examination, we recorded the total stability index [°], AP axis stability index [°], and ML axis stability index [°]. *Results:* We formed three groups based on age (60, 70, and 80 years old). We found no significant differences in any anthropometric or body composition characteristics. We found a significant difference in hand grip strength between the 60-80 age groups (HGR=26.47 16.1-19.78 12.32), (F=5.153), p<.009, HGL=24.95 4.93-18.67 10.72, (F=6.49), p<.003. There was also a significant difference in the total stability index (TSI) between the youngest and oldest groups. *Conclusions:* We found no significant differences in body composition characteristics and stability indicators for other spatial axes, which may indicate the beneficial effects of physical activity.

Keywords: demographic projections, physically active, proprioceptive-stabilometric, hand grip strength.

Abstracts are presented as submitted by authors.

Science and Innovation: Széchenyi István University as a Hub for Medical Technology Research

Széchenyi István University (SZE), headquartered in Győr and operating campuses in Mosonmagyaróvár, Zalaegerszeg, and Budapest, is one of Hungary's most dynamically developing, internationally recognized higher education institutions. Approximately 17,000 students come from nearly 90 countries, creating a diverse and inspiring, academic community. The University consistently appears in the rankings of Quacquarelli Symonds and Times Higher Education, demonstrating international acknowledgement of its research achievements and the high-quality of academic programs.

The University's educational portfolio extends beyond engineering, IT and technology programs to include health and sport sciences, economics, law, education, arts, social sciences, and agricultural and food sciences. It offers high-quality bachelor's, master's, doctoral and postgraduate programs, as well as higher education vocational training, with more than fifty programs available in English.

Széchenyi István University offers its students a multicultural scientific community (Photo: András Adorján/Széchenyi István University)

The University's Health Technology Campus Is Taking Shape

Medical technology research and development constitute one of the strategic priorities of Széchenyi István University. The institution is developing its MedTech Campus on the site of the former hospital on Zrínyi Street in Győr, with the aim of creating a multidisciplinary research and innovation environment where engineering, medical, IT and natural science competences converge.

In the first phase of the investment, the renovation of Building Q was completed. It began operation with research laboratories, specialist outpatient clinics, occupational health services, and – in partnership with Semmelweis University in Budapest – Hungary's first Pető Point outside the capital. Thanks to this initiative, conductor-supported therapy has become accessible in Győr for individuals living with central nervous system disorders or movement development difficulties.

The first completed building of the MedTech Campus of Széchenyi István University, which also accommodates medical technology research. (Photo: András Adorján/Széchenyi István University)

Working together with the Petz Aladár University Teaching Hospital of Győr-Moson-Sopron County and numerous esteemed experts from across the country, Széchenyi István University is realizing medical technology developments that support the application of digitalization and artificial intelligence in medtech, the modernization of rehabilitation technologies, the advancement of patient monitoring and diagnostic systems, as well as the research and introduction of medical devices. Innovations include an AI-based home rehabilitation system that enables patients to perform rehabilitation exercises at home under remote supervision. The system automatically evaluates movement accuracy and provides detailed feedback to the treating physician.

A specialized eye-examination device developed by the University's Digital Development Centre enhances the precision of neurological diagnostics, while its surgical streaming platform – already granted a utility model protection – is capable of broadcasting minimally invasive, endoscopic and laparoscopic surgeries in real time, supporting the professional development of healthcare practitioners. Medical technology research and direct patient care are also advanced by the Da Vinci surgical robot purchased by the University and put into operation at the Győr hospital.

Innovative Education and Research

The Faculty of Health and Sport Sciences at Széchenyi István University offers bachelor's programs in nursing and patient care, and recreation, alongside master's programs in

healthcare management, obstetric-gynaecological sonography, health psychology, nutritional sciences and midwifery, with a strong emphasis on sports health. Through specialized programs such as sports healthcare specialist, sports mental trainer, sports manager, professional coaching and nutritional science, the faculty contributes to the region's professional talent pipeline. The University also plans to introduce programs in sport psychology, sports healthcare specialist training and a bachelor's degree in sport sciences, and – in cooperation with the National Institute of Sports Medicine – it is working towards establishing a physiotherapy specialization.

Széchenyi István University's Faculty of Health and Sport Sciences offers its programmes in both Hungarian and English. (Photo: András Adorján/Széchenyi István University)

The Faculty is home to the research of Dr Erzsébet Stephens-Sarlós on primitive reflexes, covering areas from early childhood movement development and swimming instruction to enhancing athletes' mental performance and slowing cognitive decline in older adults. Among the Faculty's researchers is Professor Attila Szabó, psychologist, who appears on the Stanford lists of the world's top 2% most cited scientists based on annual and career-long citation impact. His work on behavioral addictions and placebo effects also connects to sporting contexts. Professor Andrea Petróczi, whose expertise lies in doping, anti-doping and integrity in sport, likewise belongs to the Faculty's distinguished researchers. The University's experts conduct sports nutrition research with the National Institute of Sports Medicine, collaborate with the Hévíz St Andrew's Rheumatology Hospital on rehabilitation topics, and work with Nort Komplex Pro Ltd. on developing training methods for football players. In addition to its cooperation with the Győr Petz Hospital and Semmelweis University, the institution also maintains a strategic partnership with the Kaposi Mór Teaching Hospital of Somogy County, with a focus on medical technology.

Széchenyi István University aims to contribute significantly to effective health development supported by cutting-edge technologies – from prevention to rehabilitation – through high-quality training of future professionals, research, innovation and modern services. In this spirit, it places strong emphasis on sport, supporting elite athletes in obtaining degrees through a dual career model. Alongside its own sports club, it maintains close partnerships with numerous major sports organisations in the region, such as Audi ETO KC (women's handball), ETO University Handball Team (men's handball), ETO FC Győr (football), Uni-Győr Swimming SE (swimming) and Uni Győr ETO HC (ice hockey).

The institution maintains close partnerships with major sports clubs in the region (Photo: András Adorján/Széchenyi István University)

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Akos Koller
Editor-in-Chief

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