

Ss. Cyril and Methodius University in Skopje
Faculty of Physical Education, Sport and Health

7th International Scientific Conference

RPESH 2026

BOOK OF ABSTRACTS

Active Children, a Healthy Future

From Scientific Evidence to National Action



18-20 September 2026

UKIM Congress Centre, Ohrid
Republic of North Macedonia

Every child moving, every day!

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FACULTY OF PHYSICAL EDUCATION, SPORT AND HEALTH

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Welcome Note

Dear colleagues,

It is our great pleasure to present the Book of Abstracts of the 7th International Scientific Conference RPESH 2026, organised by the Faculty of Physical Education, Sport and Health at Ss. Cyril and Methodius University in Skopje and held from 18 to 20 September 2026 at the UKIM Congress Centre in Ohrid, Republic of North Macedonia.

The central theme of the conference, “Active Children, a Healthy Future – From Scientific Evidence to National Action”, reflects a commitment to translating scientific evidence into effective educational, health and social action aimed at fostering more active, healthier and more successful future generations. The conference focused on contemporary scientific and professional developments in sport science, physical education and health.

This volume contains 41 abstracts organised into the four thematic groups of the conference: Children, Physical Activity and Health; Sports Performance and Rehabilitation; Psychological, Educational and Social Perspectives; and Technology and Research Methods. The contributions come from universities, research institutions, public-health and professional organisations in North Macedonia, Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Kosovo, Serbia and Slovenia, illustrating the regional and international character of the conference.

We sincerely thank all authors, plenary speakers, reviewers, members of the committees and participants whose contributions shaped the scientific quality of RPESH 2026. We hope that the research presented here will encourage new forms of regional and international cooperation. Authors of accepted abstracts are invited to submit their full papers to the journal Research in Physical Education, Sport and Health.

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Plenary Speakers and Thematic Areas

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Thematic Areas

Research at RPESH 2026 was presented across thirteen thematic areas, organised into four thematic groups. The abstracts in this book are arranged by thematic group and, within each group, alphabetically by the surname of the first author.

A. Children, Physical Activity and Health

- Physical activity, physical fitness and healthy habits among children and young people
- Physical and health education, and the development of active schools
- Sedentary behaviour, screen time, sleep and quality of life
- Sports nutrition and its relationship with health

C. Psychological, Educational and Social Perspectives

- Psychological, sociological and pedagogical aspects of physical education and sport
- History of physical education and sport
- Sport management, marketing and media
- Sport, recreation and tourism

B. Sports Performance and Rehabilitation

- Sports performance, training and performance diagnostics
- Motor control and motor learning
- Sports injuries, rehabilitation and return to sport

D. Technology and Research Methods

- New technologies and contemporary methods in sport science
- Innovative research approaches

A CHILDREN, PHYSICAL ACTIVITY AND HEALTH**A1**

Association between Organized Sports Participation and Motor Competence in Children Aged 6–8 Years

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Purpose. The aim of this study was to examine the association between participation in organized sports and motor competence among children aged 6–8 years.

Methods. A cross-sectional study was conducted on 842 first and second grade children (450 boys and 392 girls) from seven primary schools in Skopje, Republic of North Macedonia. Motor competence was assessed using the MOBAK 1–2 test battery, which evaluates locomotor and manipulative competence. Information on participation in organized sports was obtained using the Children's Leisure Activities Study Survey (CLASS). Participants were classified according to organized sports participation. Descriptive statistics, independent-samples t-tests, and Mann–Whitney U tests were used to compare motor competence between groups.

Results. Overall, 63.8% of the children participated in organized sports, whereas 36.2% did not. Children participating in organized sports achieved significantly higher scores in manipulative competence (4.81 vs. 3.86), locomotor competence (3.80 vs. 3.18), and total motor competence (8.61 vs. 7.04) than non-participating children (all $p < .001$). These findings demonstrate a significant positive association between organized sports participation and motor competence in early school-aged children.

Conclusion. Children participating in organized sports demonstrated significantly higher levels of motor competence than their non-participating peers. These findings highlight the importance of organized sports as a valuable context for promoting motor competence in early school-aged children.

KEYWORDS motor competence; organized sports participation; children; MOBAK 1–2; primary school

A CHILDREN, PHYSICAL ACTIVITY AND HEALTH**A2**

Diet, Physical Activity and the Gut–Muscle–Immune Axis in Children and Adolescent Athletes: From Microbiome Health to Sports Performance

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Purpose. This review synthesizes evidence on how diet and physical activity shape the gut microbiome and gut–muscle–immune interactions in children and adolescents, with emphasis on young athletes.

Methods. A structured narrative review of peer-reviewed literature published mainly from January 2010 to August 2026 was conducted. Pediatric randomized and controlled studies were prioritized, followed by athlete studies; adult and experimental evidence was used when pediatric data were insufficient. Given heterogeneity in populations, interventions, microbiome methods, and outcomes, findings were narratively synthesized without meta-analysis.

Results. Evidence from pediatric trials suggests that dietary fiber and structured physical activity can modulate gut microbial composition and inflammatory pathways, though most studies focus on obesity or metabolic disorders rather than healthy athletes. Athlete-focused investigations more consistently report benefits for gastrointestinal comfort, intestinal barrier integrity, and selected immune outcomes, while direct effects on performance remain inconsistent. A randomized pilot trial in young soccer players indicated possible improvements in sprint capacity with milk-protein supplementation, but microbiome-related mechanisms were exploratory and not confirmed. Overall, gut–muscle–immune communication appears biologically plausible, yet current human performance data are limited and heterogeneous.

Conclusion. A balanced, fiber-rich diet combined with regular physical activity may enhance microbial function, immune resilience, recovery, and training consistency in young athletes. However, available evidence does not support microbiome-targeted interventions as independent strategies for improving sports performance in healthy children and adolescents. Larger, well-controlled trials are needed to clarify causal pathways and establish practical recommendations.

KEYWORDS *gut microbiome; young athletes; dietary fiber; physical activity; sports performance*

A CHILDREN, PHYSICAL ACTIVITY AND HEALTH**A3**

Analysis of Physical Development Indicators and Determination of the Somatotype Profile of Fifth- and Sixth-Grade Students Practicing Handball

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Purpose. The aim of the study was to analyze selected indicators of physical development and determine the somatotype profile of fifth- and sixth-grade students practicing handball, as well as to examine physical education teachers' perceptions of anthropometric assessment and knowledge of somatotype.

Methods. The study included 106 fifth- and sixth-grade students aged 11–12 years from 112th Primary School "Stoyan Zaimov", Sofia. Height, body mass, triceps, subscapular, suprailiac and calf skinfolds, arm and calf circumferences, elbow and knee breadths, and body mass index were measured. Somatotype was determined using the Heath–Carter anthropometric method. Descriptive and variation analyses were applied. In addition, an online survey was conducted among 161 physical education teachers from Bulgaria.

Results. Fifth-grade students demonstrated relatively low variability in height ($V = 5.10\%$), while greater variability was observed in body mass and body mass index. Skinfold measurements showed high variability. Among sixth-grade students, height was relatively homogeneous, whereas body mass and body mass index demonstrated greater heterogeneity. The survey showed that 77.0% of teachers reported having knowledge of physical development during adolescence, while 60.2% believed that knowledge of students' somatotype could support the teaching process in physical education. The mesomorphic component predominated in both age groups, with a tendency toward greater mesomorphy with increasing age.

Conclusion. Anthropometric assessment and somatotype profiling can provide useful information for individualizing physical education and handball activities. Systematic assessment of physical development and continuing professional development of teachers may improve the adaptation of educational and training processes to the morphological characteristics and individual needs of growing children.

KEYWORDS anthropometry; somatotype; physical development; handball; adolescence

A CHILDREN, PHYSICAL ACTIVITY AND HEALTH**A4**

Screen Time and Sedentary Behaviour in Children and Adolescents: A Broader Public Health Perspective

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Purpose. This focused narrative review aimed to examine the relationship between screen time and sedentary behaviour in children and adolescents, with emphasis on their public health significance and opportunities for prevention.

Methods. A focused narrative review of scientific literature, systematic reviews and international recommendations addressing screen time and sedentary behaviour in children and adolescents was conducted. The literature was examined across three areas: the conceptual distinction between screen time and sedentary behaviour, their health consequences, and evidence on approaches aimed at reducing them.

Results. The review showed that screen time and sedentary behaviour are related but conceptually distinct. Sedentary behaviour encompasses a broader range of activities performed while sitting, reclining or lying with low energy expenditure, whereas recreational screen time represents one important form of sedentary behaviour. Longer screen time and prolonged sedentary behaviour are associated with increased risk of overweight and obesity, poorer physical fitness, and adverse effects on aspects of physical and psychosocial health. Intervention evidence indicates that screen time can be reduced, but effects are generally modest and vary across studies. Importantly, reducing screen time does not necessarily result in reduced total sedentary time.

Conclusion. Screen time and sedentary behaviour should be considered related but conceptually distinct public health concerns. Prevention should not focus solely on reducing screen time, but also on reducing prolonged sitting and creating opportunities for active behaviour within families, schools and communities. This broader approach may contribute to sustainable public health strategies for promoting health and an active lifestyle among children and adolescents.

KEYWORDS children; adolescents; screen time; sedentary behaviour; public health

A CHILDREN, PHYSICAL ACTIVITY AND HEALTH**A5**

Moving Forward: Physical Activity and Motor Development in Preschool Children — Environmental Conditions and Pedagogical Implications in North Macedonia

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Purpose. This study examines physical activity and motor development in relation to environmental conditions and pedagogical practices in preschools in North Macedonia. It focuses on children's motor competence, observed movement-supportive pedagogical practices, and physical-environment conditions.

Methods. A secondary descriptive analysis used aggregate data from the 2024 Measuring Early Learning Quality and Outcomes (MELQO) study in North Macedonia. The analysis examined gross motor competence, fine motor and visual-motor indicators, observed pedagogical practices, and physical-environment conditions. No new child assessment or classroom observation was conducted.

Results. The findings show an age-related difference in gross motor competence: 79% of children aged 3–5 years and 92% of children aged 5–6 years demonstrated competence. At the same time, 48.5% of observed classrooms showed insufficient attention to gross motor development, 41.6% included practices that could constrain exploration and fine motor development, 34.7% provided movement and singing without clearly defined learning goals, and 19.8% showed no gross or fine motor activities during observation. Physical-environment indicators were generally stronger, although only 64.4% of observed classrooms had sufficient space for all indoor activities.

Conclusion. The findings highlight a gap between children's motor competence and the pedagogical use of movement. Priorities include intentional movement-based learning, flexible use of indoor and outdoor spaces, professional development, and integration of physical activity across early childhood pedagogy.

KEYWORDS preschool education; motor development; physical activity; MELQO; North Macedonia

A CHILDREN, PHYSICAL ACTIVITY AND HEALTH**A6**

Possible Sources of Between-School Variability in Physical Fitness Among Primary Schoolchildren

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Purpose. This study examined whether between-school variation in health-related physical fitness followed a pattern consistent with the space and surface requirements of field tests conducted under standardized conditions.

Methods. Data from 2,045 children (1,033 boys, 1,012 girls; 5.5–11.7 years) from 13 primary schools in Skopje were analyzed. The same protocol, equipment, and trained assessors were used throughout. Tests included handgrip dynamometry, standing long jump, 4 × 10 m shuttle run, 30-second sit-ups, sit-and-reach, and the 20-m shuttle run. Maximal oxygen uptake (VO₂max) was estimated with the Léger equation. Measures were standardized for age and sex. Between-school differences were assessed by one-way analysis of variance, partial eta-squared, intraclass correlations, and Benjamini-Hochberg adjustment.

Results. All 10 indicators differed significantly among schools after false discovery rate adjustment (all adjusted $p \leq .018$). Effects were largest for the 4 × 10 m shuttle run ($\eta^2 = .161$) and standing long jump ($\eta^2 = .095$), and smallest for handgrip dynamometry ($\eta^2 = .015$) and sit-and-reach ($\eta^2 = .012$). Mean explained variance was 9.5% for tests with high space and surface dependence and 1.3% for tests with low dependence. Effects for body-composition indicators ranged from 1.3% to 5.2%.

Conclusion. The pattern suggests that testing space and surface may contribute to between-school differences, particularly in the 4 × 10 m shuttle run and standing long jump. Because infrastructure and physical education delivery were not measured, the findings are hypothesis-generating rather than causal.

KEYWORDS *health-related physical fitness; school context; testing conditions; primary schoolchildren; physical education*

A CHILDREN, PHYSICAL ACTIVITY AND HEALTH**A7****Functional Relationship between Trunk Flexor and Extensor Endurance as an Additional Biomechanical Indicator of Sagittal Postural Status in Children and Adolescents**

Martin Hristov, Sara Dimovska, Marko Velickovski, Vujica Zivkovikj, Serjoza Gontarev, Lence A. Velickovska

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Background. Sagittal postural status in children and adolescents is commonly evaluated through postural classification and separate measures of trunk-muscle performance. A ratio describing the functional relationship between trunk flexor and extensor endurance may provide additional analytical information beyond isolated test scores.

Objective. To determine whether the Functional Endurance Relationship (FER), calculated as trunk flexor endurance divided by trunk extensor endurance, differs between participants with physiological sagittal posture (PSP) and those with sagittal postural deviations (SPD).

Methods. This secondary cross-sectional analysis included 34 participants classified as PSP (n = 16) or SPD (n = 18). Sagittal postural status was assessed with the Spinal Mouse system. Trunk flexor endurance was measured using the FRONT test, whereas trunk extensor endurance was assessed with the Biering–Sørensen test. FER was calculated for each participant. Between-group differences were examined using Welch's t-test and the Mann–Whitney U test. Standardized effect sizes, receiver operating characteristic (ROC) analysis, and binary logistic regression were also performed.

Results. FER was higher in the PSP group than in the SPD group (3.49 ± 1.77 vs. 2.23 ± 1.08). The difference was statistically significant in both the Welch analysis ($p = 0.021$) and the Mann–Whitney analysis ($p = 0.037$), with a large standardized effect (Hedges' $g = 0.85$). ROC analysis yielded an area under the curve of 0.712. A cut-off value of 3.43 resulted in 50.0% sensitivity and 88.9% specificity. In the logistic model, higher FER was associated with greater odds of PSP classification (OR = 1.89, 95% CI: 1.06–3.34; $p = 0.030$).

Conclusion. FER may provide complementary analytical information when sagittal postural status is interpreted in relation to trunk-muscle endurance. These preliminary findings require confirmation in larger samples using standardized testing protocols and external validation.

KEYWORDS *sagittal posture; children; adolescents; trunk-muscle endurance; trunk flexor endurance; Biering–Sørensen test; functional endurance relationship*

A CHILDREN, PHYSICAL ACTIVITY AND HEALTH**A8**

Analysis of the Internal and External Environment of School Sports in Brčko District BiH

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School sports in the Brčko District are not aligned with contemporary social and institutional challenges, nor do they adequately contribute to the advancement of physical education and sports; this is a consequence of the lack of a systemic approach to developing this field as an area of special public interest. Addressing the current situation requires the comprehensive development of a School Sports Development Strategy for the Brčko District. Since any strategic process entails a detailed diagnostic assessment, the primary goal of this research is to provide a comprehensive and operational insight into the internal and external environmental elements of school sports in the Brčko District, as well as to integrate the findings. This integrative approach enables the precise identification of internal strengths and weaknesses, as well as external opportunities and threats, within the domain of school sports in the area under analysis. Following an individual brainstorming process, the primary study group consisted of 15 physical education teachers employed in schools across the Brčko District. Based on a synthesis of scientific knowledge, guidelines and strategic directions were formulated for selecting the optimal model for the future strategy. The research process employed a complementary methodology combining modern analytical (quantitative) methods with a qualitative approach rooted in the paradigm of strategic thinking. The results of the SWOT analysis, based on the views of Brčko District physical education teachers, indicate that school sports in this region possess specific internal capacities (strengths) that can serve as drivers of future development. By precisely establishing the interrelationships between the identified strengths, opportunities, and threats, the research aims to provide a consistent methodological platform for making strategic decisions and selecting an optimal development model for school sports in the Brčko District. Based on the results obtained from the analysis of the external and internal environments, guidelines for future scientific research point to their application in the process of strategic modeling.

A CHILDREN, PHYSICAL ACTIVITY AND HEALTH**A9**

Differences in Achievement Among Students Under the Influence of Inclusive Education

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Inclusive education entails the joint education of all children, enabling parents of children with developmental disabilities to enroll their children in the nearest school. This approach ensures that every child is included in quality education within the mainstream system, alongside their peers and in their natural environment. The interplay of the three groups of factors influencing a child's achievement relies heavily on the relationship and communication between the family and the school. Cooperation between the family and the school, specifically between parents and teachers, needs to be established as a non-hierarchical relationship, ensuring that neither party dominates or is relegated to an inferior position in the decision-making process. The aim of this study was to determine differences in educational achievement among fourth-grade primary school students under the influence of inclusive education. The study sample consisted of two fourth-grade classes: an experimental group of 20 students and a control group of 20 students. The experimental program (inclusive education) was implemented during the second semester of the 2025/26 school year. Students were assessed via a questionnaire at both the beginning and the end of the second semester to evaluate the initial and final status of the experimental and control groups. The results indicated that inclusive education, as opposed to the conventional, traditional approach, fostered greater interest in the work among both students and parents, increased motivation, and encouraged a more active and creative attitude toward the process. Students in the experimental group acquired broader knowledge regarding inclusive education. It is evident from the findings that the experimental and control groups progressed differently in terms of educational achievement. Students in the experimental group possessed a greater quantity and quality of knowledge.

KEYWORDS students; inclusive education; achievements; questionnaire; experiment

A CHILDREN, PHYSICAL ACTIVITY AND HEALTH**A10**

Normal-Weight Obesity in Schoolchildren Aged 6 to 11 Years: Definition-Dependent Prevalence Estimates and Physical Fitness Profile

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Purpose. To determine how alternative definitions affect prevalence estimates for normal-weight obesity (NWO) among schoolchildren aged 6 to 11 years and to characterise their physical fitness across nutritional-status categories.

Methods. This cross-sectional study included 2,032 children aged 6 to 11 years from 13 schools. Body composition was assessed by bioimpedance, and nutritional status was classified using International Obesity Task Force cut-offs, including underweight. NWO was defined using two absolute and two relative adiposity criteria. Fitness was assessed with five field tests and the 20-m shuttle run. Statistical inference used a wild cluster bootstrap with multiplicity correction.

Results. Fat mass and fat-free mass indices showed opposing fitness associations in 11 of 12 sex-by-outcome combinations. Compared with normal-weight boys, those with obesity had 15.5% greater absolute handgrip strength but 29.9% lower relative handgrip strength. Absolute criteria classified 0.2% to 9.0% of normal-weight children as NWO, whereas relative criteria yielded 15.9% by construction, precluding direct comparison. Depending on definition, children with NWO had estimated maximal oxygen uptake 1.37 to 1.46 mL/kg/min lower than low-fat normal-weight peers and lower relative handgrip strength; nevertheless, this strength remained higher than that of children with overweight.

Conclusion. NWO prevalence estimates are strongly definition-dependent. Affected children displayed an intermediate fitness profile, closer to that of children with overweight than to low-fat normal-weight peers. Body mass index may therefore conceal functionally relevant excess adiposity in primary-school children.

KEYWORDS *normal-weight obesity; body composition; body mass index; physical fitness; nutritional status*

A CHILDREN, PHYSICAL ACTIVITY AND HEALTH**A11**

Age and Menstrual Bleeding Volume as Predictors of the Presence and Severity of Primary Dysmenorrhea

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Purpose. This study focused on primary dysmenorrhea because it can affect women's everyday and professional lives.

Methods. In total, 401 menstruating women aged 18 to 65 years answered an anonymous online questionnaire in Albania. Age was recorded in five groups. The amount of bleeding and the regularity of the cycle were self-reported in ordered categories. All these variables were entered together in two models, so each result is adjusted for the others. A binary logistic model tested whether dysmenorrhea was present, in the whole sample ($n = 401$). An ordinal logistic model tested how severe it was, among the women who reported it ($n = 282$).

Results. The first model was significant and classified 70.8% of cases correctly. The odds of dysmenorrhea fell with each higher age group ($OR = 0.514$; 95% CI 0.368–0.718; $p < 0.001$). The odds were 2.56 times higher with a larger reported amount of bleeding ($OR = 2.560$; 95% CI 1.508–4.345; $p < 0.001$). The same two variables predicted severity (age $OR = 0.610$; $p = 0.010$; amount of bleeding $OR = 2.064$; $p = 0.008$). No other variable was significant in both models.

Conclusion. Age and the amount of menstrual bleeding predicted both the presence and the severity of primary dysmenorrhea. Both should be taken into account when other risk factors for menstrual pain are studied.

KEYWORDS primary dysmenorrhea; logistic regression; age; menstrual bleeding; severity

A CHILDREN, PHYSICAL ACTIVITY AND HEALTH**A12**

Participation of Children with Disabilities in Physical Education and Sport: A Multi-Stakeholder Survey in North Macedonia

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Purpose. This study examines stakeholder perceptions of opportunities, barriers, and support needs for the participation of children with disabilities in physical education (PE), sport, and recreation in North Macedonia.

Methods. A cross-sectional online survey included 174 respondents: 56 teachers/education staff, 44 other professionals, 34 parents/guardians, 32 sport participants and eight coaches/instructors. We descriptively analysed ten Likert items, role-specific questions, and multiple-response priorities. We examined an eight-item system-readiness score using Cronbach's alpha and Kruskal–Wallis tests.

Results. Perceived system readiness was low ($M = 2.50$, $SD = 0.76$; $n = 144$; $\alpha = 0.89$). Among valid responses, 71.9% disagreed that extracurricular programmes were sufficient, 66.5% disagreed that school conditions, equipment and support were adequate, and 57.0% disagreed that local clubs were ready to include children. The top barriers were insufficiently trained coaches (66.1%), insufficiently trained teachers (64.9%), and lack of adapted equipment (64.4%). Swimming (70.1%), walking/hiking (61.5%) and cycling (43.7%) had the greatest inclusion potential. Readiness scores differed by stakeholder role ($H(4) = 17.60$, $p = .001$). Parents rated it lower than teachers and other professionals after Holm adjustment. Structured training was associated with greater preparedness than no training/self-study ($M = 4.08$ vs. 3.31 ; $U = 1754$, $p = .002$).

Conclusion. Stakeholders perceived structural and workforce gaps despite support for adapted physical activity. Practical training, accessible facilities and equipment, and school-family-club pathways should be prioritised.

KEYWORDS *disability inclusion; adapted physical activity; physical education; sport participation; stakeholder perspectives*

A CHILDREN, PHYSICAL ACTIVITY AND HEALTH**A13****Dietary Habits of Primary School Children: An Analysis of Survey Results****Edin Užičanin, Jasmin Bilalić, Jasmin Mehinović, Nevres Muminović, Lejla Goletić, Emin Mujezinović, Merima Aljić, Belmin Bujaković***Faculty of Physical Education and Sport, University of Tuzla, Tuzla, Bosnia and Herzegovina*

Proper nutrition during childhood is one of the key prerequisites for normal growth, development, and academic success, and dietary patterns adopted during this period largely carry over into adulthood. The aim of this paper is to analyze the dietary habits of second-, third-, and fourth-grade primary school students based on data collected through a survey conducted within the programme for assessing the dietary habits of primary school children ("Trend" survey). The study included 2,224 students. The analysis covered the frequency of consumption of ten categories of food and beverages (bread, pastries, sweets, carbonated drinks, chips, rice, cereal flakes, fast food, fruit, and vegetables), breakfast habits, the consumption of water versus juices/sodas, and the time of day when children most often consume sweets and snacks. The results show that fewer than half of the respondents (44.9%) eat breakfast every day, that 75.9% of children always choose water over sugary drinks, and that fruit and vegetable consumption is satisfactory, while the proportion of children who consume sweets (30.0%) and white bread (71.1%) daily is notable. Differences between grades were also observed, particularly in breakfast habits. The results indicate the need for further strengthening of nutrition education programs in primary schools.

KEYWORDS *dietary habits; children; primary school; nutrition; breakfast; healthy lifestyle*

B SPORTS PERFORMANCE AND REHABILITATION**B1**

Motor Development in Preschool Children with Autism Spectrum Disorder: Implications for Physical Activity and Social Participation

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Purpose. Motor development plays an important role in children's everyday functioning and provides a foundation for active play, participation in physical activities, and interaction with peers. Motor difficulties are frequently observed in children with autism spectrum disorder (ASD) and may represent a barrier to age-appropriate activities. The aim of this study was to describe motor development in preschool children with ASD and consider its potential implications for physical activity and social participation.

Methods. The study included 30 children with ASD aged 2–6 years who were enrolled in an intensive rehabilitation program. Motor development was assessed as part of a clinical special education assessment and evaluated in relation to expected developmental achievements for chronological age. Children were classified according to whether motor development broadly corresponded to age expectations or showed a developmental delay of two or more years. Descriptive statistics were used to summarize the findings.

Results. Of the 30 children with ASD, 19 (63.3%) showed a motor developmental delay of two or more years, while 11 (36.7%) demonstrated motor achievements broadly corresponding to expectations for their chronological age.

Conclusion. Motor developmental delay was highly prevalent in the examined preschool children with ASD, affecting 63.3% of the sample. Although physical activity and social participation were not directly assessed, current evidence suggests that motor competence is relevant to opportunities for active play and physical participation. These findings highlight the importance of motor assessment and support within early rehabilitation, potentially facilitating engagement in physical activity, peer interaction, and social participation.

KEYWORDS *autism spectrum disorder; motor development; physical activity; active play; social participation*

B SPORTS PERFORMANCE AND REHABILITATION**B2**

Training Load Parameters in Acute and Chronic Training Conditions: A Systematic Review

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Coaches generally believe that the outcome of monitoring athletes in the training process depends on the type and amount of stimulus, understanding the cause-and-effect relationship between training load (TL) dosage (i.e., external load) and the response to that load (i.e., internal load), which is crucial for the training process. Therefore, this systematic review aimed to search for and analyze the effects of acute and chronic studies on TL parameters/variables. Papers published from January 2012 to January 2025 were searched digitally using the PubMed, Web of Science, Scopus, MEDLINE, ERIC, and Google Scholar databases. The results showed that the analysis of external load (EL) and internal load (IL) has been examined to the greatest extent in the form of their mutual connection, and to the greatest extent in team sports. In addition to their association, the relationship of measures of EL and IL with performance measures or fitness tests was determined, as well as the correlation of objective and subjective measures of IL. Additionally, most of the studies were chronic studies, where TL was investigated over a period of time of at least 2 weeks, up to the analysis of TL throughout the entire competition season. Specifically, the most important finding from these studies indicates that IL measures derived from the subjective measures and heart rate consistently show a positive relationship with global positioning system and accelerometer – EL measures. We can conclude that the most interesting and the most evaluated concept in this systematic review is the relationship between EL and IL, and this concept has the greatest potential for future research.

KEYWORDS external load; internal load; rating of perceived exertion; team sports

B SPORTS PERFORMANCE AND REHABILITATION**B3**

Anthropometric and Biomechanical Characteristics of 15–16-Year-Old Beach Handball Players by Playing Position

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Purpose. The aim of the study was to analyze anthropometric characteristics and biomechanical indices of 15–16-year-old beach handball players according to playing position, providing information for position-specific training and talent identification.

Methods. Ninety-four competitive players aged 15–16 years participated: goalkeepers ($n = 11$), central defenders ($n = 13$), left defenders ($n = 12$), right defenders ($n = 12$), left wingers ($n = 13$), centers ($n = 11$), right wingers ($n = 11$), and pivots ($n = 11$). Height, body mass, arm span, shoulder width, lower-limb length and body mass index were assessed. Appendicular index ($AI = \text{arm span}/\text{height}$), lower-limb length-to-height ratio (LLR), and shoulder-width-to-height ratio (SRR) were calculated. Descriptive statistics, analysis of variance and correlation analysis were used.

Results. Position-specific morphological patterns were observed. Pivots had the greatest mean height (179.17 cm) and body mass (71.06 kg). Left defenders had the greatest arm span (182.35 cm), lower-limb length (107.75 cm) and AI (1.03). Wings and left defenders showed the highest LLR (0.60–0.61). Goalkeepers demonstrated balanced AI and SRR values. BMI ranged from 20.42 to 23.80, with lower values generally observed in wings and right defenders.

Conclusion. Anthropometric and biomechanical characteristics showed meaningful position-specific patterns consistent with the functional demands of beach handball. These findings support individualized physical preparation and position-oriented training, while morphological indicators should be interpreted together with functional testing and playing behavior.

KEYWORDS beach handball; adolescents; anthropometric characteristics; biomechanical indices; playing position

B SPORTS PERFORMANCE AND REHABILITATION**B4**

Classification of Somatotypes and Their Relationship with Dance and Speed Performance in Elite Athletes in the Republic of North Macedonia

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Purpose. The purpose of this study was to examine the relationship between somatotype and performance in jump and speed tests in elite wrestlers in the Republic of North Macedonia, and to determine whether the dominant somatotype component is associated with better motor performance.

Methods. The study included 20 elite wrestlers from the Republic of North Macedonia, who belonged to different weight categories and had regular competition experience in national and international competitions. Somatotype was determined through standard anthropometric procedures according to the Heath–Carter method, while motor performance was assessed through the Squat Jump (SJ), Countermovement Jump (CMJ) and Drop Jump (DJ) jump tests, as well as the 30 m Sprint and 10 × 5 m Shuttle Run speed tests. Data were processed using descriptive statistics, the Shapiro–Wilk test, and Spearman correlation analysis.

Results. Wrestlers presented a relatively heterogeneous morphological profile, with the mesomorphic component being dominant in most athletes. However, somatotype did not show consistent and uniform associations with all jump and speed variables. Although some trends were observed, the associations were not strong enough across all motor tests to support a uniform predictive role of the somatotype alone.

Conclusion. Somatotype, especially mesomorphy, appears to be an important characteristic of elite wrestlers, but cannot alone explain the variability in jump and speed performance. Motor performance should be interpreted through the combined influence of somatotype, body structure, and other physical and functional characteristics important for wrestling performance.

KEYWORDS wrestling; elite wrestlers; somatotype; jump performance; speed

B SPORTS PERFORMANCE AND REHABILITATION**B5**

Functional Fitness Improves Without Significant Change in Body Composition After a 16-Week Training Programme in Recreational Adults

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Purpose. Structured training is often assumed to improve fitness mainly by changing body composition. This study examined whether a 16-week training programme improves functional fitness and cardiorespiratory capacity in recreational adults, and whether these gains are accompanied by measurable changes in body composition.

Methods. Forty recreational adults were allocated to an experimental group (women, $n = 20$) and a control group (women, $n = 20$) and were followed through initial, control and final measurements. Seven fitness variables and thirty morphological and functional predictors were monitored. An estimated cardiorespiratory index was obtained with a wearable device and body composition by bioelectrical impedance. Data were analysed with multivariate and univariate analyses, analysis of covariance with initial values as covariates, correlation and multiple regression.

Results. The programme produced significant, progressive gains in functional fitness. Static upper-body strength improved by 108.8% in experimental women against 27.0% in the control group. The estimated cardiorespiratory index increased in the experimental group, while no significant change was noted in the control group. In contrast, general body composition showed no significant multivariate group differences; instead, changes appeared in body circumferences, with a progressive reduction of thigh circumference in experimental women. Body-fat percentage was the strongest negative predictor of fitness.

Conclusion. In recreational female adults, a 16-week structured training process primarily generates functional and peripheral efficiency of the organism rather than a change in general body composition. Functional adaptation can precede, and occur independently of, measurable compositional change, and accessible measurement technology enables objective field monitoring of these effects.

KEYWORDS *physical fitness; body composition; cardiorespiratory fitness; recreational adults; wearable technology*

B SPORTS PERFORMANCE AND REHABILITATION**B6**

Kinematic and Segmental Coordination Characteristics of the Floor Back Handspring: An Exploratory Multiple-Case Study

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Purpose. This study aimed to describe and contrast the kinematic characteristics and phase-specific segmental coordination patterns of three floor back handspring performances.

Methods. Participants were a 23-year-old male recreational gymnast, a 10-year-old male competitive gymnast, and an 11-year-old female competitive gymnast. Three experienced judges selected the best of five recorded trials per participant. Two-dimensional kinematic analysis was conducted using SkillSpector from the initiation of the arm swing at its maximum backward position to the first foot contact upon landing. Vector coding quantified coordination among the absolute upper-arm, trunk, thigh, and shank angles across three couplings and four phases.

Results. The recreational gymnast achieved the highest centre-of-mass velocity at take-off (1.97 m/s). The male competitive gymnast exhibited the smallest centre-of-mass trajectory angle following take-off (17.2°), whereas the female competitive gymnast demonstrated the largest angle (42.3°) and the highest peak shoulder angular velocity before take-off (987.7°/s). During arm swing and leg take-off, upper-arm dominance in the upper arm–trunk coupling prevailed across performances (65.63–79.49%). The recreational gymnast exhibited trunk dominance in the trunk–thigh coupling (71.43%), while the female competitive gymnast showed 74.36% anti-phase thigh–shank coordination. In-phase coordination predominated during the first flight phase, and thigh–shank coordination was exclusively in-phase during hand support. Differences were greatest during leg take-off and hand support.

Conclusion. Combining kinematic measures with vector coding provided a detailed case-specific assessment of back handspring technique. Analysis of one selected trial per participant limits generalisation beyond these performances.

KEYWORDS artistic gymnastics; back handspring; kinematics; vector coding; segmental coordination

B SPORTS PERFORMANCE AND REHABILITATION**B7**

Longitudinal Changes in Physical Performance Among Assistant Referees Before and After the Introduction of VAR in the National Football Championship

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The introduction of VAR (Video Assistant Referee) technology represents a significant change in the conditions and organization of football refereeing, which could potentially be related to the physical performance of referees. The aim of this study was to examine the changes in the physical performance of assistant referees before and after the introduction of VAR technology. The research was conducted on a sample of 33 male assistant football referees at the national level between 2025 and 2026. The study used a comparative design with repeated measurements, including four tests for assessing physical performance (10 m acceleration, 30 m sprint, CODA test, ARIET test), and two additional variables (age and body weight). The obtained data were analyzed with appropriate statistical programs. Basic descriptive statistics were calculated, a t-test for dependent samples was used to assess changes, with normality tested with a Shapiro–Wilk test of paired differences in the results (2026 – 2025). The effect size for dependent samples was estimated with Cohen's d_z , and Holm's correction was applied for multiple comparisons of the three primary outcomes. The results obtained showed that in the examined period, no statistically significant difference was found in 10 m acceleration, whereas an improvement was observed in the 30 m sprint. Poorer performance was found in the CODA test (a higher result was obtained in 2026 compared to 2025). Since there is very little research in the scientific literature examining the impact of VAR technology on the physical fitness of assistant referees, we believe that this study will highlight the need for specific training that, in addition to speed, will also cover acceleration, deceleration, and change of direction.

KEYWORDS VAR technology; assistant referees; physical performance

B SPORTS PERFORMANCE AND REHABILITATION**B8**

Perceived Exertion and Heart Rate-Derived Training Load During High-Intensity Interval Training and Step Aerobics in Recreationally Active Women

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Purpose. This study compared perceived exertion (RPE) and heart rate-derived training load (TRIMP) during six weeks of modified high-intensity interval training (HIIT) and step aerobics in recreationally active women, and explored whether the RPE-TRIMP relationship differed between programs.

Methods. Two experimental groups completed 18 supervised sessions: modified HIIT ($n = 11$) and step aerobics ($n = 10$). Heart rate was recorded continuously with Polar H10 monitors; maximal heart rate was estimated with the Tanaka equation and TRIMP was calculated using Banister's method. RPE was rated on a 1–10 scale 10 minutes post-session. Between-group differences were tested with Welch t -tests, and the RPE-TRIMP relationship was examined with Pearson correlations at pooled, session-mean, and individual levels.

Results. Mean TRIMP did not differ significantly between groups (HIIT 151.45 ± 29.52 AU; step 153.36 ± 13.36 AU; $p = .849$), though between-individual variability was lower in step aerobics ($p = .026$). RPE was 0.50 units higher in HIIT (7.11 ± 0.64 vs. 6.61 ± 0.46 ; $d = 0.89$, $p = .052$). The RPE-TRIMP correlation was consistently higher in step aerobics ($r = .59-.66$) than in HIIT ($r = .35-.53$), though the between-group comparison was not statistically significant.

Conclusion. Modified HIIT and step aerobics elicited comparable cardiovascular load but may not be perceived identically, supporting the combined use of subjective and objective load monitoring in recreational exercise settings.

KEYWORDS RPE; TRIMP; training load; HIIT; step aerobics

B SPORTS PERFORMANCE AND REHABILITATION**B9**

Comparative Changes in Trunk Muscular Endurance and Isometric Knee Extension Strength Following Interval and Repetition-Based Training

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Purpose. The aim of this study was to compare changes in trunk muscular endurance and isometric knee extension strength following 12 weeks of interval training and training based on a predetermined number of exercise repetitions. Additional analyses examined side-specific responses and changes in bilateral asymmetry.

Methods. Twenty women (32.7 ± 13.6 years) completed either interval training ($n = 10$) or repetition-based training ($n = 10$), three times weekly for 12 weeks. Trunk endurance was assessed using the Trunk Flexor Endurance Test, Biering–Sørensen Test, and bilateral Side Bridge Test. Isometric knee extension strength was assessed in both limbs. Changes were analyzed using mixed-design ANOVA and bilateral asymmetry analyses.

Results. Significant time effects were found for trunk flexor endurance ($p < .001$), Biering–Sørensen performance ($p = .047$), Side Bridge Test performance ($p < .001$), and isometric knee extension strength ($p < .001$). A significant time $\times$ group interaction was found only for Side Bridge Test performance ($p = .025$), favoring interval training. A significant side effect was observed for isometric knee extension strength ($p = .027$), while interactions involving side were not significant. Bilateral asymmetry did not change significantly.

Conclusion. Both programs improved trunk muscular endurance and isometric knee extension strength. Interval training produced greater improvement in lateral trunk endurance, whereas changes in the remaining outcomes were comparable between groups.

KEYWORDS trunk muscular endurance; knee extension strength; interval training; bilateral asymmetry

B SPORTS PERFORMANCE AND REHABILITATION**B10**

Predictive Value of Anthropometric and Motor Variables on Swimming Performance in Adolescent Swimmers

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Purpose. The purpose of this study was to determine the predictive value of selected anthropometric characteristics, body composition variables, and motor abilities on swimming performance in adolescent swimmers. The study also aimed to identify which of these variables contribute most strongly to swimming performance.

Methods. The study included 70 adolescent swimmers (35 males and 35 females), aged 10–19 years, divided into three age categories. Anthropometric measurements included body height, body weight, arm span, sitting height, foot length, and body mass index. Body composition was assessed through fat percentage and muscle mass percentage. Motor and swimming performance were evaluated using the standing long jump, critical swimming speed, and 200 m and 400 m freestyle performance. Descriptive statistics, Pearson correlation analysis, and multiple regression analysis were applied.

Results. Significant predictive relationships were found for arm span ($\beta = -.48$, $p < .001$), standing long jump performance ($\beta = -.43$, $p = .001$), muscle mass percentage ($\beta = -.31$, $p = .004$), and fat percentage ($\beta = .22$, $p = .039$). Arm span and standing long jump performance showed the strongest predictive influence. The regression model explained 68% of the variance in swimming performance ($R^2 = .68$).

Conclusion. Anthropometric characteristics and motor abilities are important predictors of swimming performance in adolescent swimmers. In particular, arm span and lower-body explosive power may provide useful practical indicators for athlete monitoring, talent identification, and individualized training planning.

KEYWORDS *adolescent swimmers; swimming performance; anthropometry; motor abilities; talent identification*

B SPORTS PERFORMANCE AND REHABILITATION**B11**

Changes in Anxiety and Emotional Traits After Physical Therapy in Patients with Musculoskeletal Disorders

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Purpose. To examine changes in anxiety and selected emotional traits before and after physical therapy in patients with musculoskeletal disorders and to explore whether post-treatment profiles differed by sex, age, and treatment duration.

Methods. Sixty patients receiving physical therapy at Clinical Hospital Tetovo were assessed before and after treatment. Anxiety was measured with the Test Anxiety Inventory (TAI), while psychoticism, extraversion-introversion, neuroticism, and dissimulation were assessed with the Eysenck Personality Questionnaire (EPQ). Pre-post changes were tested using paired-samples t tests. Multivariate and univariate analyses of covariance were used to examine group differences while controlling relevant covariates.

Results. Anxiety decreased from 49.62 ± 6.27 to 43.67 ± 7.93 (-11.99%; $t = 8.81$, $p < .001$), and neuroticism from 12.38 ± 2.91 to 10.87 ± 2.34 (-12.20%; $t = 5.24$, $p < .001$). Changes in psychoticism, extraversion-introversion, and dissimulation were not significant in the total sample (all $p > .05$). At the final assessment, multivariate differences were not significant by sex (Wilks' $\lambda = .87$, $p = .186$), age group ($\lambda = .77$, $p = .176$), or treatment duration ($\lambda = .69$, $p = .058$). Age-group differences were detected only for anxiety in univariate analysis ($F = 4.30$, $p = .019$, partial $\eta^2 = .15$).

Conclusion. Physical therapy was accompanied by statistically significant reductions in anxiety and neuroticism, whereas the other assessed traits remained comparatively stable. Psychological status may therefore be useful to monitor alongside physical outcomes during musculoskeletal rehabilitation.

KEYWORDS *physical therapy; musculoskeletal disorders; anxiety; neuroticism; rehabilitation*

B SPORTS PERFORMANCE AND REHABILITATION**B12**

Aerobic Adaptation During High-Volume Periodised Marathon Training: A Six-Month Longitudinal Case Study Using the Bruce Treadmill Protocol

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Purpose. This case study aimed to examine six-month changes in estimated maximal oxygen uptake (VO_2max) in a 31-year-old Macedonian marathon runner undergoing a structured, high-volume and periodised endurance-training programme.

Methods. A longitudinal single-athlete case study was conducted over six months in an adult male marathon runner from North Macedonia. Aerobic capacity was assessed at baseline and follow-up using the standard Bruce treadmill protocol, with estimated VO_2max derived from total exercise duration using the established prediction equation. The athlete reported 90–100 km of running per week across 6–7 sessions. Training consisted predominantly of low-intensity aerobic running, complemented by one weekly interval session, tempo/threshold and progressive runs, hill training, and a weekly long run of 18–25 km. Recovery runs were maintained at low intensity, while strength and flexibility exercises were incorporated during part of the period. Training was periodised through phases of aerobic-base development, increased intensity and recovery, with reduced volume before competition.

Results. Estimated VO_2max increased from 51 to 56 mL/kg/min, representing an absolute increase of 5 mL/kg/min and a relative improvement of 9.8%. Estimated aerobic capacity relative to the predicted reference value increased from 120% to 127%, a rise of 7 percentage points.

Conclusion. A measurable improvement in estimated aerobic capacity was observed during six months of consistent, high-volume, periodised endurance training. This case illustrates the value of combining structured training with standardised physiological assessment for longitudinal monitoring of endurance adaptation. In this case, the athlete's VO_2max improved by a whole category, placing him in the superior aerobic capacity category for athletes aged 20–29 years.

KEYWORDS estimated VO_2max ; Bruce protocol; marathon running; aerobic adaptation; performance monitoring

B SPORTS PERFORMANCE AND REHABILITATION**B13**

Recommendations for Preparticipation Examination in Paediatric Athletes: Timing, Structure and Settings

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The main role of sports medicine is to keep athletes safe and healthy while participating in sports. This aim is especially important in sensitive populations, such as paediatric athletes. Intensive or even moderate physical activities could have a negative impact on the overall health of young participants. The pre-participation examination (PPE) is a well-established clinical tool used to identify athletes of all ages who may be at risk of adverse clinical outcomes through participation in sport. The examination is a screening tool to identify these individuals prior to participation in sports. Preparticipation physical evaluation (PPE) should be defined with timing, structure and setting to ensure participation eligibility. One of the essential aspects of the medical care of young athletes is cardiac evaluation and the management of cardiac disease. The cardiovascular care of paediatric-aged athletes can be challenging because many of the classic doctrines and principles in adult sports cardiology do not fully generalize to paediatrics, and there is a lack of the evidence base that may be present for adult athletes. The timing of the PPE within the training and competition calendar, as well as its frequency, is not internationally standardized and usually depends on the national or sports federation recommendations and rules. The structure of the PPE in young athletes also depends on national sports law, age, level of activity, level of competition and sports discipline. The purpose of this paper is to present the importance of regular and proper medical screening of young athletes, with special considerations of timing, structure and setting of PPE in paediatric athletes.

KEYWORDS *preparticipation examination; athletes; children*

B SPORTS PERFORMANCE AND REHABILITATION**B14**

Outcome-Specific Acute Responses to Postpartum Abdominal, Pelvic Floor and Breathing Strategies: A Narrative Review

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Purpose. This narrative review examined whether reported acute responses to postpartum abdominal, pelvic floor and breathing strategies show similar directional patterns across abdominal wall, pelvic floor and pressure-related outcome domains.

Methods. Peer-reviewed primary studies involving postpartum women were identified in Scopus and PubMed, supplemented by backward and forward citation searching. Studies examined immediate responses to defined abdominal, pelvic floor or breathing strategies using ultrasound, electromyography or pressure-based measures. Given the heterogeneity of study methods and outcomes, findings were grouped by outcome domain and direction of response and synthesized narratively.

Results. Across studies examining curl-up or head-lift conditions, inter-rectus distance generally decreased at one or more measurement sites, whereas drawing-in, abdominal hollowing and isolated m. transversus abdominis activation showed either increased inter-rectus distance or no significant change. These patterns were not uniformly mirrored by pelvic floor outcomes: curl-up/head-lift conditions were associated with bladder-base or pelvic-organ descent in several studies, while another study found a wider levator hiatus and longer pelvic floor muscle during crunch than during pelvic-floor contraction despite similar squeeze pressure. Pressure-related measures also varied by strategy, and when multiple outcomes were recorded concurrently they did not necessarily change in parallel.

Conclusion. The apparent acute effect of a postpartum strategy depends on the outcome used to assess it. An acute change in inter-rectus distance, muscle activity, displacement or pressure should be treated as evidence about that specific response, not as a proxy for the behaviour of other structures. This limits how broadly findings from single-outcome studies can be interpreted.

KEYWORDS *postpartum; abdominal exercise; pelvic floor; intra-abdominal pressure*

B SPORTS PERFORMANCE AND REHABILITATION**B15**

The Effects of Weight Training on Performance in 5 and 10 Kilometer Runners

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Running long distances is an endurance discipline in which sports performance depends on a combination of aerobic capacity, running economy, endurance and muscular strength. Although endurance training is the basis of preparation for long-distance runners, recent research suggests that properly designed and structured weight training can have a positive effect on running economy and competitive performance. The aim of this study was to examine the effect of additional weight training on race performance over 5 and 10 km, as well as on strength, explosive strength, and aerobic capacity in recreational runners. The study included 40 recreational runners aged 18 to 40 years who were divided into a control group and an experimental group. In addition to regular endurance training, the experimental group completed a weight training program twice a week for a period of 12 weeks, while the control group continued with their usual training without weight training. Before and after the intervention, 5 km and 10 km performance, maximum leg strength assessed using the one-repetition maximum squat test, explosive strength assessed using the standing long jump test, and maximal aerobic capacity (VO_{2max}) were evaluated. Descriptive statistical methods, paired and independent samples t-tests, and analysis of differences between baseline and final measurements were used for statistical analysis, with the level of statistical significance set at $p < 0.05$. The results showed a significant improvement in 5 km and 10 km performance in the experimental group compared with baseline measurements and the control group. The experimental group also showed a significant increase in maximum strength and explosive strength of the lower limbs, while changes in aerobic capacity did not show a statistically significant difference between the groups. The average 5 km time in the experimental group improved by 4.8%, while 10 km performance improved by 4.2% after 12 weeks of training. The results indicate that additional weight training, combined with regular endurance training, can significantly contribute to improved competitive performance in recreational runners over 5 and 10 kilometers. The improvement in performance without significant changes in the aerobic system suggests that the positive effect of weight training may be related to improvements in muscular strength, explosive ability, and running economy. The results support the use of weight training as an integral part of the modern training process for middle- and long-distance runners.

KEYWORDS *weight training; strength training; running; 5 km; 10 km; recreational runners; sports performance; running economy; VO_{2max}*

B SPORTS PERFORMANCE AND REHABILITATION**B16**

Changes in Specific Motor Skills After Three Consecutive Measurements in Karate Athletes

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The modern training process in karate is based on the continuous and systematic development of psycho-physical, technical-tactical and specific motor abilities. The main goal of this study was to monitor and determine changes in the specific motor abilities of cadet karate players. The research was conducted within the framework of the preparatory and pre-competitive period for participation in the Karate World Championship, during which the respondents were included in a ten-week programmed training process. The sample consisted of 16 cadets (U16). This study included four specific motor variables with which the relevant components in karate players were assessed. The data obtained from this research were processed with appropriate statistical programs that calculated: basic descriptive statistics, ANOVA – for each specific motor variable individually and MANOVA to determine the differences between the three measurements. Based on the results obtained from the three measurements, it can be concluded that there is a statistically significant difference between the three time sequences (measurements) for three of the four variables for assessing specific motor abilities. The results obtained from this research can have direct application in the training process and can help improve and optimize it, and above all enable the earliest possible detection of certain factors that can negatively affect the quality of peak performance.

KEYWORDS *programmed training process; specific motor skills; cadet karate players*

B SPORTS PERFORMANCE AND REHABILITATION**B17**

Sports-Related Injuries in Children Aged 6–14 Years: Epidemiology, Prevention, and Return-to-Sport Implications

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Purpose. This study aimed to characterise the distribution of sports-related injuries among children aged 6–14 years treated at a tertiary paediatric surgical centre and to consider the implications for injury prevention and safe return to sport.

Methods. A descriptive analysis was performed using clinical data from 379 patients aged 6–14 years who were treated for sports-related injuries at the University Clinic for Paediatric Surgery between 2022 and 2025. Injuries were grouped into six categories. Findings were summarised using frequencies and percentages.

Results. Ankle sprains were the most frequently recorded injuries (25%), closely followed by overuse injuries (24%). Soft-tissue injuries and muscle strains accounted for 20% of cases, fractures for 18%, knee injuries for 10%, and concussions for 3%. Collectively, the findings show that repetitive-loading conditions constitute almost one-quarter of clinical presentations, while acute musculoskeletal trauma remains prominent.

Conclusion. The injury profile demonstrates the need for prevention strategies tailored to the biological and functional characteristics of growing children. Priorities should include age-appropriate load progression, diversified participation rather than premature sport specialisation, sport-specific protective equipment, structured warm-up and recovery, and one to two rest days per week. Return-to-sport decisions should be individualised and based on clinical recovery, restored function, and gradual re-exposure to sport-specific demands.

KEYWORDS *paediatric sports injuries; injury epidemiology; overuse injuries; injury prevention; return to sport*

B SPORTS PERFORMANCE AND REHABILITATION**B18**

Effects of Combined Technical and Mental Training on Shooting Accuracy in Adolescent Basketball Players

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Purpose. To compare the effects of three training models on jump-shot accuracy after dribbling and performance on a composite basketball shooting test in adolescent players.

Methods. Seventy-five basketball players aged 15.5–16.5 years, with at least three years of training experience, participated in the experimental study. Three groups of 25 players completed shooting, dribbling and concentration training incorporating mental imagery (E1); shooting and concentration training (E2); or shooting and dribbling training (E3). The assessment battery comprised 13 tests of shooting accuracy, dribbling and concentration. The study included baseline, intermediate and final assessments. Between-group differences were examined using univariate and multivariate analyses of covariance, adjusting for baseline performance.

Results. Post-intervention performance differed significantly between groups at the multivariate level (Wilks' $\lambda = .19$; $F(26, 94) = 4.65$; $p < .001$). On the composite basketball shooting test (KPK-60), adjusted means were 79.21 points in E1, 64.83 in E2 and 59.04 in E3 ($F = 11.48$; $p < .01$). Significant between-group differences were observed for all seven jump-shot tests ($p < .05$), whereas free-throw accuracy did not differ significantly ($p = .28$).

Conclusion. The combined model yielded the highest composite shooting scores in this sample. These findings support integrating technical practice and concentration training in the preparation of adolescent basketball players.

KEYWORDS basketball; jump shot; dribbling; concentration; mental imagery

B SPORTS PERFORMANCE AND REHABILITATION**B19**

Motor-Cognitive Training Protocols for Balance Development in Rhythmic Gymnastics

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Purpose. The aim of this paper is to present current knowledge on training protocols aimed at developing balance in rhythmic gymnastics, with a particular focus on the types of motor and cognitive demands and the methods used to assess balance.

Methods. Review of existing knowledge on balance-oriented training protocols in rhythmic gymnastics was conducted, focusing on protocols that combine balance tasks with visual and auditory cues, reaction speed, proprioceptive challenges, unstable surfaces, and apparatus manipulation.

Results. The reviewed protocols emphasize the integration of information from different sensory systems and the combination of motor and cognitive demands. Balance training may incorporate visual and auditory stimuli, reaction-speed tasks, proprioceptive challenges, unstable surfaces, and manipulation of rhythmic gymnastics apparatus.

Conclusion. Motor-cognitive training represents a relevant approach for balance development in rhythmic gymnastics. The existing evidence may support the design of sport-specific training protocols that integrate balance with the perceptual, cognitive, and apparatus-related demands characteristic of the sport.

KEYWORDS *balance; postural control; motor-cognitive training; proprioception; rhythmic gymnastics*

B SPORTS PERFORMANCE AND REHABILITATION**B20**

Short-Term Changes in Body Composition Following a Seven-Day Alpine Skiing Course in Physical Education and Sport Students

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Purpose. This study examined short-term changes in body composition following a seven-day alpine skiing course in students of the Faculty of Sport and Physical Education.

Methods. Twenty students were assessed before and after the course using a Tanita BC-545N bioelectrical impedance analyzer. Body mass, body mass index, body fat percentage, total body water, muscle mass, physique rating, visceral fat rating, and metabolic age were recorded. Normality of paired differences was assessed with the Shapiro–Wilk test. Paired t tests were used for normally distributed continuous variables and Wilcoxon signed-rank tests for ordinal or non-normal variables. Significance was set at $p < 0.05$; Cohen's d_z was calculated for paired t tests.

Results. Total body water increased from $60.93 \pm 4.03\%$ to $61.77 \pm 4.36\%$ ($p = 0.022$; $d_z = 0.56$). Body fat percentage decreased from $15.96 \pm 5.89\%$ to $15.42 \pm 5.87\%$, without statistical significance ($p = 0.095$). Muscle mass changed from 58.44 ± 12.19 to 58.76 ± 12.20 kg ($p = 0.206$). Body mass and body mass index remained unchanged ($p = 0.506$ and $p = 0.633$). Physique rating, visceral fat rating, and metabolic age also showed no significant changes.

Conclusion. Total body water was the only measured variable that changed significantly after the seven-day course. Because bioelectrical impedance estimates are sensitive to hydration, small short-term changes in estimated body fat and muscle mass should be interpreted cautiously. Standardized hydration and measurement conditions are important when monitoring body composition during intensive skiing courses.

KEYWORDS alpine skiing; body composition; university students; bioelectrical impedance; total body water

C PSYCHOLOGICAL, EDUCATIONAL AND SOCIAL PERSPECTIVES**C1**

Sport as an Instrument in Building the Image of a Tourist Destination: The World Carp Fishing Championship in Mavrovo and the European Title of HC Ohrid

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Purpose. The paper analyzes whether sport can influence a tourist destination's image by comparing two mechanisms: hosting an international event and a local club's success. It examines two cases in North Macedonia that occurred within four months of each other in 2026.

Methods. The two cases are the EHF European Cup won by HC Ohrid in May 2026, a result rather than an occasion that visitors traveled to, and the World Carp Fishing Championship held at Lake Mavrovo in September 2026. Data from the State Statistical Office were analyzed to establish seasonality in both destinations. An anonymous online questionnaire measures familiarity with each case and perception of Ohrid and Mavrovo as sports destinations. Responses are analyzed using descriptive statistics, Pearson correlations, and independent-samples t-tests, comparing respondents by familiarity and place of residence.

Results. Data collection is ongoing, and findings will be presented in the full paper. Statistics from the State Statistical Office for 2011–2025 establish the context: the destinations are seasonal opposites, with July and August accounting for 65.9% of annual overnight stays in Ohrid and December to March for 48.9% in the municipality of Mavrovo and Rostuša. Both cases fell outside the peak season of their own destination.

Conclusion. Both fell when the destination had capacity available, yet neither was planned as a tourism measure. Because the destinations peak in opposite seasons, a single approach to off-season sport cannot serve both: what is off-peak in Ohrid is peak in Mavrovo. Planning for off-season sport therefore has to be done at the level of the individual destination.

KEYWORDS sport tourism; destination image; sporting events; sport fishing; handball

C PSYCHOLOGICAL, EDUCATIONAL AND SOCIAL PERSPECTIVES**C2**

Maksimir 1990: Sports Violence, Political Myth, and Collective Memory in the Disintegration of Yugoslavia

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Purpose. To examine how interpretations of the events at Maksimir Stadium on 13 May 1990 evolved from narratives of “the beginning of the war” and unilateral national blame toward myth-critical, institutional and security-oriented perspectives.

Methods. A longitudinal qualitative frame analysis was conducted on a purposively selected corpus of 18 sources published between 2009 and 2025, including Serbian and Croatian anniversary media reports, scholarly publications and international analytical texts. A deductive framework included six non-exclusive frames: war-beginning, national-heroic, unilateral blame, myth-critical/complexity, institutional-security and normalization/asymmetry of remembrance. Frame frequencies were compared across three periods (2009–2011, 2012–2020 and 2021–2025).

Results. In 2009–2011, the war-beginning frame appeared in 60.0% of sources, unilateral blame in 50.0% and the national-heroic frame in 40.0%. In 2012–2020, all sources (100%) adopted a myth-critical/complexity frame, while institutional-security and normalization frames each appeared in 60.0%. In 2021–2025, the myth-critical frame remained universal (100%), institutional-security appeared in 66.7%, and the national-heroic frame re-emerged through interpretations of Zvonimir Boban as a contested public symbol.

Conclusion. The findings indicate a shift from nationally polarized narratives toward critical, multidisciplinary interpretations of the Maksimir incident. Rather than the direct beginning of the Yugoslav wars, Maksimir is increasingly understood as a symbolic turning point, a political myth and a case of institutional failure in managing sporting events. The findings contribute to understanding collective memory, sport history and safety and security management.

KEYWORDS *Maksimir 1990; collective memory; political myth; media framing; safety and security management*

C PSYCHOLOGICAL, EDUCATIONAL AND SOCIAL PERSPECTIVES**C3**

Children's Games in Gymnastics Curricula in Serbia During the 19th Century

Aleksandra Ilić Rajković

Purpose. This paper examines the educational functions and meanings of children's games within gymnastics as a school subject in elementary education in Serbia during the 19th century. Physical education – under the name gymnastics – was first prescribed as a school subject in Serbia in 1871. At that time, the possibility of including games in the teaching of this subject was mentioned only in general terms. In the 1884 curriculum, games were given a clearly defined place within gymnastics. They retained this place in subsequent curriculum reforms in 1891 and 1898. The inclusion of children's games in the curriculum was accompanied by appropriate literature for children and teachers, as well as discussions within professional circles.

Methods. The analysis combines thematic examination of the material with discourse analysis to interpret the pedagogical, ideological, and other functions of children's games in a broader context.

Results. The analysis showed that the place of children's games in the curricula did not change significantly during the observed period. The curricula prescribed games already familiar to pupils, such as "mete", "robovi", and "šuke". These games were mostly collective and competitive with clearly defined rules.

Conclusion. Based on the results of the analysis, it may be concluded that the games were viewed primarily as a means of transforming spontaneous, often rough peer interaction into a polite and rule-governed activity. In the analysed discourse, the pedagogical significance of children's games was associated above all with moral and aesthetic education.

KEYWORDS *gymnastics; children's games; peer interaction; primary schooling in the 19th century*

C PSYCHOLOGICAL, EDUCATIONAL AND SOCIAL PERSPECTIVES**C4**

Exercise Integration in University Student Counseling

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Purpose. This review aims to examine how physical activity mitigates academic stress, anxiety, and depression among university students, especially those from demanding disciplines. Specifically, it addresses the question of how universities can leverage these findings to optimize the clinical profiles and operational models of campus counseling services.

Methods. Multi-cohort studies evaluated more than 1,500 university students (aged 18–33 years) at Ss. Cyril and Methodius University in Skopje during the period from 2007 to 2024. Validated psychometric scales (BDI, TMAS, BAI, and PSQ) measured depression, anxiety, and academic stress, while the IPAQ-SF tracked physical activity levels. Concurrently, student counseling records were analyzed to assess clinical presentations and institutional utilization barriers.

Results. High psychological distress was prevalent, with up to 12% of students exhibiting clinical depressive symptoms and 65.5% presenting elevated trait anxiety. Stress scores rose significantly across the semester. Chronically sedentary students faced the highest distress risks. Conversely, sports participation and engagement in physical activity correlated with significantly lower anxiety and higher professional efficacy. However, counseling data revealed that highly vulnerable cohorts—particularly women and early-stage students—frequently delayed seeking psychological help due to academic time constraints and perceived stigma.

Conclusion. Heavy academic workloads can severely degrade student mental health, yet traditional counseling remains underutilized. Integrating physical activity promotion—such as structured sports and exercise counseling—directly into campus psychological services and into curricula offers an accessible, low-stigma intervention. Combining exercise with counseling can reduce emotional distress and can enhance academic success.

KEYWORDS *academic burnout; physical activity; student counseling*

C PSYCHOLOGICAL, EDUCATIONAL AND SOCIAL PERSPECTIVES**C5**

The Relationship between Experience of Working with Students with Disabilities and Physical Education Teachers' Self-Perceived Preparedness for Inclusive Teaching

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Purpose. It remains unclear which aspects of teachers' education and experience relate to their preparedness for inclusive physical education. This study examined whether initial education, length of service and frequency of working with students with disabilities are associated with self-perceived preparedness for inclusive teaching.

Methods. Forty-eight physical education teachers in Croatian schools (24 women, 24 men; convenience sample) completed an anonymous online questionnaire in 2026. Preparedness was assessed with a Croatian translation of the CEFI-R (19 items, four-point scale; dimensions: conception of diversity, methodology, support, community participation). Cronbach's alpha, Spearman's correlations, Mann-Whitney and Kruskal-Wallis tests were used.

Results. Reliability was high for methodology ($\alpha = .93$) and community participation ($\alpha = .85$), but low for support ($\alpha = .56$). Teachers scored highest on methodology ($M = 3.51$) and lowest on conception of diversity ($M = 2.45$). Frequency of working with students with disabilities was the strongest correlate, relating to methodology ($\rho = .44$, $p = .002$) and conception of diversity ($\rho = .31$, $p = .033$). Perceived sufficiency of inclusion coursework during initial education was unrelated to all four dimensions ($\rho = -.09$ to $.12$). No differences emerged by sex, age or length of service.

Conclusion. Preparedness was associated with direct contact with students with disabilities rather than with recalled coursework. Teachers rated their methodological skills highly while remaining reserved about including such students in their own classes. Initial teacher education should prioritise supervised practical contact over additional theoretical content.

KEYWORDS *inclusive education; physical education teachers; self-perceived preparedness; students with disabilities; CEFI-R*

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D TECHNOLOGY AND RESEARCH METHODS**D1****Body Composition in Young Kickboxers from North Macedonia****Adam Gligoroski, Miodrag Todorovic, Martin Hristov***Faculty of Physical Education, Sport and Health, Ss. Cyril and Methodius University in Skopje, Skopje, Republic of North Macedonia**Corresponding author: adamatleta@hotmail.com*

Purpose. The aim of this paper is to evaluate the body composition of young kickboxers, between the ages of 13 and 16, at the beginning of puberty. During this period of growth and development, the bodies of young kickboxers are influenced by hormonal changes as well as by the training process.

Methods. The study involved 22 young male kickboxers aged 16–18 years (mean age 16.68 ± 0.72 years). The body composition was analyzed with InBody 720. The results are presented with lean body mass components (FFM – fat free mass, SLM – soft lean mass, SMM – skeletal muscle mass, protein, bone and mineral components) and obesity diagnosis parameters (BMI – body mass index, BFM – body fat mass, BF% – body fat percent, OD% – obesity diagnosed parameters).

Results. The average height of the young kickboxers was 175.6 ± 6.5 cm and their average weight was 70.6 ± 9.3 kg. According to the InBody 720 calculation, 11/22 (50%) of the kickboxers had ideal body weight and ideal body composition. 3/22 (13%) kickboxers had excessive body fat, and 8/22 (36%) of them showed insufficient body mass (fat and muscle component). Mean BF% was $12.33 \pm 5.3\%$. The mean value of relative SMM was 50.6%.

Conclusion. A substantial proportion (50%) of kickboxers younger than 18 deviated from ideal body weight and body composition. Coaches and athletes should carefully plan their training and nutritional regimes to achieve optimal body components.

KEYWORDS *kickboxing; adolescents; body composition; body fat; muscle mass*

D TECHNOLOGY AND RESEARCH METHODS**D2**

Acute Effects of EXOPULSE Mollii Neuromodulation Suit on Lower-Limb Muscle Symmetry in an Elite Young Football Player: A Case Study

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Purpose. Inter-limb muscle symmetry is an important aspect of neuromuscular function in elite football, as differences between the lower limbs may affect movement efficiency and sporting performance. Tensiomyography (TMG) provides a non-invasive method for assessing muscle contractile properties and identifying bilateral differences. The EXOPULSE Mollii suit uses electrical neuromodulation to influence neuromuscular activity. This case study aimed to examine the acute effect of a 60-min EXOPULSE Mollii session on lower-limb muscle symmetry in an elite young football player.

Methods. Bilateral TMG assessment was performed before and immediately after a 60-min session with the EXOPULSE Mollii suit. The basic TMG parameters assessed were contraction time (Tc), delay time (Td), sustain time (Ts), relaxation time (Tr), and maximal radial displacement (Dm). Measurements were performed on selected muscles of both lower limbs, with particular emphasis on the rectus femoris, vastus lateralis, and vastus medialis. Bilateral muscle symmetry was calculated before and after the intervention.

Results. Before the intervention, muscle symmetry was 81.12% for the rectus femoris, 76% for the vastus lateralis, and 79% for the vastus medialis. Following the 60-min EXOPULSE Mollii session, symmetry increased to 91%, 84%, and 84%, respectively.

Conclusion. A single 60-min session with the EXOPULSE Mollii suit could be associated with an acute improvement in bilateral muscle symmetry across all assessed quadriceps muscles. These findings suggest that neuromodulation may have potential for acutely modifying inter-limb neuromuscular symmetry in elite football. Further controlled studies with larger samples are required to confirm these preliminary findings.

KEYWORDS EXOPULSE Mollii; muscle symmetry; tensiomyography; elite football

D TECHNOLOGY AND RESEARCH METHODS**D3**

No Child Left Behind: Turning Routine Electronic Health Data into Actionable Intelligence for Child Health and Prevention

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Purpose. European child-health systems increasingly require longitudinal information to identify trends, inequalities and preventable risks. This assessment examined whether routinely collected electronic health data in North Macedonia's "Moj Termin" can support child-health surveillance, preventive policy-making and a future Digital Child Health Profile.

Methods. A retrospective population-based data-readiness assessment used electronic health records from 2023–2025. Unique children were identified through pseudonymised identifiers. Variables included systematic examinations, height, weight, calculable body mass index and repeated anthropometric measurements. Descriptive analyses assessed availability and completeness; longitudinal continuity was defined as measurements recorded in at least two calendar years.

Results. The available national dataset contained records for 214,815 children aged 6–14 years. At least one systematic or anthropometric record was available for 87,609 children (40.8%), while paired height and weight enabling body mass index calculation were available for 87,407 (40.7%). Only 18,746 children (8.7%) met the longitudinal criterion. Thus, approximately two in five children had usable anthropometric information, but fewer than one in ten could be followed over time, limiting assessment of growth trajectories, emerging risks, inequalities and prevention.

Conclusion. North Macedonia already generates electronic child-health data, but limited longitudinal continuity constrains their public-health value. Strengthening standardised data collection, linkage and follow-up could turn existing infrastructure into a resource for monitoring child health, identifying priority groups and preventable risks, and guiding prevention. These findings support a larger feasibility study to define national indicators, assess trends and inequalities, and translate routine data into measurable actions for decision-makers.

KEYWORDS child health; health surveillance; electronic health records; prevention; digital health

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