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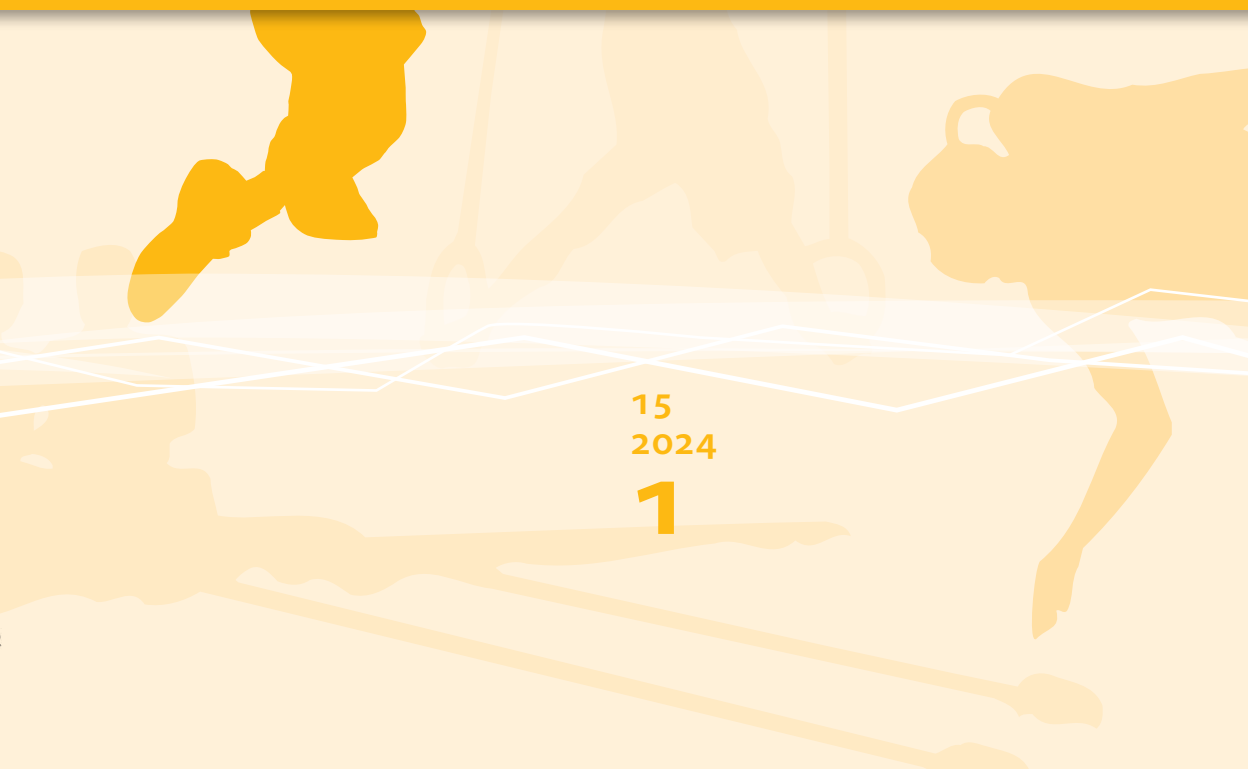

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EDITORIAL

The current issue of our scientific journal, Annales Kinesiologiae, features a collection of articles that address some of the most pressing topics in sports science and physical health today. These studies offer crucial insights and practical applications aimed at improving well-being and performance across various age groups, from children to the elderly. The research presented not only advances our understanding of physical health but also underscores the importance of innovative approaches in addressing contemporary health challenges.

Bandaru et al. explore innovative ways of improving the physical outcomes among elderly individuals using rollators through a lab-video-based dance intervention. As the global population continue to age, finding effective methods to maintain physical health and mobility in older adults is crucial. This study highlights the potential of integrating technology and physical activity to enhance the well-being of older adults, suggesting a future where ICT can play a pivotal role in elderly care.

Monacis et al. investigate the impact of the COVID-19 pandemic on the motor development of Italian children. The pandemic has disrupted routines and limited physical activity opportunities for many children, potentially affecting their motor skills. This study underscores the need for targeted interventions to support children's motor development in the wake of such disruptions. Ensuring that children regain and maintain their motor competence is vital for their overall development and long-term health.

Karasek et al. address the increasingly common issue of forward head posture among young athletes. In today's digital age, where children spend significant time in front of screens, poor posture is a growing concern. This study emphasizes the need for early intervention and corrective measures to prevent long-term health problems. The implications are clear: promoting better posture in young athletes can lead to healthier, more active lives and potentially enhance athletic performance.

Kolar et al. provide valuable insights into the development of national sport strategies. In a time where promoting physical activity is more important than ever, having a well-formulated national strategy can have a significant impact. This article outlines the key steps and considerations for policymakers, emphasizing the importance of evidence-based approaches and stakeholder engagement. Effective sport strategies can lead to increased participation, improved public health and a more active society.

These articles highlight the critical role of sports and physical activity in promoting health and well-being in today's society. From addressing postural

issues in young athletes to improving mobility in the elderly, and from developing national strategies to understanding the pandemic's impact on children, the research presented here underscores the importance of proactive and innovative approaches to physical health.

This issue concludes with detailed reports from three international conferences: SPE-BALKAN-SKI, Padova Muscle Days, and EQOL 2024, as well as a comprehensive summary of the 2023 Bed Rest Campaign.

We cordially invite you to explore these insightful contributions and comprehensive reports.

Luka Šlosar, PhD,
Editor

UVODNIK

Tokratna številka naše znanstvene revije Annales Kinesiologiae vsebuje članke, ki obravnavajo nekatere najbolj pereče teme na področju športne znanosti in telesnega zdravja. Vključene raziskave ponujajo ključna spoznanja in praktične aplikacije za izboljšanje dobrega počutja in zmogljivosti pri različnih demografskih skupinah, od otrok do starejših. Predstavljene raziskave ne izboljšujejo le našega razumevanja telesnega zdravja, temveč tudi poudarjajo pomen inovativnih pristopov pri reševanju sodobnih zdravstvenih izzivov.

Bandaru in sodelavci raziskujejo inovativne metode, ki temeljijo na video posnetkih, za izboljšanje telesne zmogljivosti starejših posameznikov, ki za hojo uporabljajo hojco. Zaradi staranja svetovnega prebivalstva je treba najti učinkovite načine za ohranjanje telesnega zdravja in mobilnosti starejših oseb. Študija poudarja potencial integracije tehnologije in gibalne aktivnosti za izboljšanje blaginje starejših odraslih, kar nakazuje, da bo informacijsko-komunikacijska tehnologija v prihodnosti imela ključno vlogo pri oskrbi starejših.

Monacis in sodelavci proučujejo vpliv pandemije covida-19 na gibalni razvoj italijanskih otrok. Pandemija je porušila rutine in omejila gibalno aktivnost številnih otrok, kar posledično vpliva na njihove gibalne sposobnosti. Študija poudarja potrebo po ciljno usmerjenih intervencijah za podporo gibalnemu razvoju otrok, še posebej v primeru morebitnih novih omejitev gibanja. Zagotavljanje, da otroci pridobijo in ohranjajo gibalno kompetentnost, je ključno za njihov celostni razvoj in dolgoročno zdravje.

Karasek in sodelavci obravnavajo vse pogostejšo težavo naprej pomaknjene drže glave med mladimi športniki. V današnji digitalni dobi, ko otroci preživijo veliko časa pred zasloni, postaja slaba drža vse večja skrb. Študija poudarja potrebo po zgodnji intervenciji in korektivnih ukrepih za preprečevanje dolgoročnih zdravstvenih težav. Pomembnost teh ugotovitev je jasna: spodbujanje boljše drže pri mladih športnikih lahko vodi do bolj zdravega in aktivnega življenja in potencialno izboljša športne rezultate.

Kolar in sodelavci ponujajo vpogled v razvoj nacionalnih športnih strategij. V času, ko je spodbujanje gibalne športne aktivnosti pomembnejše kot kadar koli prej, lahko dobro zasnovana nacionalna strategija naredi pomembno razliko. Članek obravnava ključne korake in vidike za odločevalce, poudarja pomen pristopov, ki temeljijo na dokazih, in vključevanje udeležencev. Učinkovite športne strategije lahko prispevajo k večji udeležbi, izboljšanju javnega zdravja in aktivnejši družbi.

Predstavljeni prispevki poudarjajo ključno vlogo športne gibalne aktivnosti pri spodbujanju zdravja in dobrega počutja v današnji družbi. Od obravnave

težav s telesno držo pri mladih športnikih do izboljšanja mobilnosti pri starejših, razvoja nacionalnih strategij in razumevanja vpliva pandemije na otroke, predstavljene raziskave poudarjajo pomen proaktivnih in inovativnih pristopov k telesnemu zdravju.

Številko revije končujejo poročila s treh mednarodnih konferenc: SPE-BALKAN-SKI, Padova Muscle Days in EQOL 2024, kot tudi celovit povzetek kampanje Bed Rest 2023.

Vljudno vabljeni k branju celovitih prispevkov in poročil.

Dr. Luka Šlosar,
urednik

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EVALUATING PHYSICAL OUTCOMES IN ELDERLY SPORT AND DANCE ROLLATOR USERS: A SINGLE-ARM PILOT STUDY USING LAB-VIDEO-BASED DANCE INTERVENTION WITH A FOCUS ON INTEGRATING INTER-COMMUNICATION TECHNOLOGY IN ROLLATOR DANCE

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ABSTRACT

The present single-arm pilot study investigates the effects of a video-based dance intervention on physical outcomes in elderly individuals utilizing sports and dance rollators. In addition, the dance videos used in the current study are intended to integrate into the future Intercommunication Technology (ICT)-Rollator for the elderly. The aim is to evaluate the physical outcomes (such as gait, balance, mobility, and hand grip strength) during guided movement training (dance) using a video projected in a laboratory setting. The pilot study involved six elderly rollator users (aged 85 and above). In the initial assessment, subjects were screened for mobility and coordination limitations prior to pre-testing using a four-square-step test and the SF-36 questionnaire. Both pre-testing and post-testing included assessments of mobility, balance, and spatiotemporal gait parameters using the Timed Up-and-Go (TUG) test, Berg Balance Scale (BBS), and the Optogait system, respectively. Hand grip strength was measured using a hand dynamometer and reaction time was measured using a pipe-drop test. Blood pressure was monitored every 15 minutes during the training sessions to prevent adverse events, maintaining an upper range of 140-150/90-96. Adherence rates were measured based on the total duration of activity, calories burned per session, and dropout rates.

Post-session questionnaires were administered to verify the respondents' qualitative evaluations of their degrees of exhaustion, enjoyment, impediments, facilitators, and suggested changes. The intervention included heart rate monitoring, which revealed gradual and slight increases in heart rate intensity and gradual decreases in heart rate ranges (HRR) during the dance sessions. The results indicate improvements in balance, mobility, gait, and adherence rates. Future longitudinal research will further examine the effectiveness of the dance intervention using the ICT-Rollator, comparing it to a control group using a conventional rollator. The ICT-Rollator could be a unique rehabilitation aid for the elderly, offering promising improvements.

Keywords*: intercommunication technology rollator, dance intervention, scoping review, future longitudinal study, home-based technology interventions.*

OCENJEVANJE TELESNIH REZULTATOV PRI STAREJŠIH UPORABNIKIH HODULJ S KOLESI ZA ŠPORT IN PLES: ENOSKUPINSKA PILOTNA ŠTUDIJA O PLESNI INTERVENCIJI, KI TEMELJI NA VIDEOPOSNETKIH, Z VIZIJO INTEGRACIJE MEDKOMUNIKACIJSKE TEHNOLOGIJE PRI HODULJAH S KOLESI ZA PLESNO TERAPIJO

IZVLEČEK

V pričujoči pilotni študiji z eno skupino je bil raziskan učinek plesne intervencije na osnovi videoposnetkov na telesne rezultate pri starejših, ki uporabljajo športne in plesne hodulje s kolesi. Poleg tega so plesni videoposnetki, uporabljeni za intervencijo v pričujoči študiji, vgrajeni v prihodnjo medkomunikacijsko tehnologijo (IKT) za hodulje s kolesi za starejše. Trenutni cilj je oceniti telesne rezultate (kot so hoja, ravnotežje, mobilnost in moč prijema) vodene gibalne vadbe (ples) z uporabo video projekcije v laboratorijskem okolju. V pilotni študiji je sodelovalo šest starejših (85+) uporabnikov hodulj s kolesi. Pri začetni oceni smo pred testiranjem z uporabo testa korakanja v štirih kvadratih in z vprašalnikom SF36 preverili gibalne in koordinacijske omejitve udeležencev. Pred testiranjem in po njem smo preverili parametre gibljivosti, ravnotežja in časovnih ter dolžinskih spremenljivk hoje z uporabo časovno merjenega testa vstani in pojdi (TUG), Bergove lestvice za oceno ravnotežja (BBS) oziroma sistema Optogait. Hkrati smo z ročnim dinamometrom izmerili moč prijema in izvedli test spusta cevi za merjenje odzivnega časa. Poleg tega smo med plesno dejavnostjo vsakih 15 minut merili krvni tlak, da bi preprečili neželene dogodke in ohranili zgornji razpon 140–150/90–96. V tej pilotni študiji smo sodelovanje udeležencev merili na osnovi skupnega trajanja dejavnosti, kalorij, porabljenih na vsakem treningu, in stopnje opustitve. Po vsakem treningu pa smo za sodelujoče pripravili vprašalnik, da bi

preverili kvalitativne ocene anketirancev o stopnji izčrpanosti, užitku pri dejavnosti, ovirah, olajševalnih dejavnikih in potrebnih spremembah. Intervencija je vključevala spremljanje srčnega utripa, ki je pokazalo postopno in rahlo povečanje intenzivnosti srčnega utripa in postopno zmanjšanje razponov srčnega utripa (HRR) med plesnimi dejavnostmi. Rezultati kažejo izboljšano ravnotežje, mobilnost, hojo in stopnjo sodelovanja. Prihodnje longitudinalne raziskave bodo nadalje preučile učinkovitost plesne intervencije z uporabo IKT-hodulj s kolesi in jo primerjale s kontrolno skupino z običajnimi hoduljami s kolesi. IKT-hodulje s kolesi so lahko edinstveni pripomoček za rehabilitacijo starejših, ki omogoča tudi obetavne izboljšave.

***Ključne besede**: hodulja s kolesi z medkomunikacijsko tehnologijo, plesna intervencija, pregled področja uporabe, prihodnja longitudinalna študija, tehnološke intervencije na domu.*

INTRODUCTION

Physical rehabilitation is essential for the elderly, as age increases the risk of developing chronic diseases, exacerbates symptoms, decreases cardiovascular fitness, and limits physical mobility (Langhammer, Bergland, & Rydwik, 2018). Implementing comprehensive preventive measures, such as physical activity interventions, behavioral changes concerning physical activity, lifestyle modifications, and promoting a healthy lifestyle, significantly reduces the risks. This subsequently enhances the quality of life of older adults. The inclusion of physical activity in their daily lives has been demonstrated to improve rehabilitation results (Langhammer et al., 2018).

Furthermore, Xiong, Ye, Wang, and Zheng (2021) conducted a systematic review exploring the effects of physical activity on brain health, cognitive health, and motor abilities in the elderly. Their findings indicate that physical activity not only restores and maintains cognitive function and metabolic control, but also positively affects brain health by reducing the risk of dementia, depression, and stress. The findings from previous studies suggest that multimodal dance may also have positive effects on grey matter decline and the prevention of neurodegenerative diseases in the elderly (Müller et al., 2016). At the same time, a study discovered research has shown that a six-month sports dance intervention in seniors aged 63 to 80 years had a positive impact on structural brain changes, cognitive and motor performances, and the molecular mechanism of brain-derived neurotrophic factor (BDNF) (Rehfeld, 2015).

According to a study by Meulenberg et al. (2023), dance training holds promise for enhancing balance, mobility, and gait in Parkinson's patients. It suggests that dance therapies may improve quality of life and motor skills. However, further research is needed to fully understand and optimize the benefits of dance training for these populations. According to the above study, dance may be more advantageous than pure aerobic-physical interventions for healthy aging, because it combines physical activity with cognitive, coordination, and aerobic training in a social-emotional setting. Additionally, a meta-analysis by Yuan et al. (2022) revealed that dance enhances mobility and general fitness in older individuals with cognitive impairment.

Older adults with limited physical health are more likely to experience falls due to mobility limitations and balance deficits. Various dance interventions have been explored by the studies to improve mobility and balance in the elderly, including low-impact aerobic dance, dance-based aerobic exercise, Turkish folklore dance, ballroom dancing, contemporary dance, salsa dance training, and creative dance (De Oliveira et al., 2020). Research has shown the beneficial

effects of dance-based therapies, such as yoga, Pilates, tai chi, and aerobics (Nagano, Sparrow, & Begg, 2022), can be beneficial for improving balance and reducing falls in senior citizens. The evidence shows that dance interventions can significantly enhance balance and mobility in older adults, highlighting the need for structured dance intervention programs (Bahramian et al., 2023).

In the current pilot study, the elderly rollator users received the dance intervention utilizing a sport and dance rollator. This study incorporates social cognitive theory, which posits that group training sessions allow participants to learn through observation of their peers and the environment, thereby enhancing their self-efficacy and motivation to dance (Bandura, 1977). Over extended periods, this intervention may modify the behaviors of both elderly individuals with chronic conditions and healthy older adults, enhancing or maintaining their physical fitness (Bandura, 1977).

The current intervention is also based on flow theory by Chen and Tang (2023), which emphasizes complete immersion with no distractions, as dance with good music can facilitate the enjoyment and loss of self-consciousness. The dance intervention upholds clear objectives and provides immediate feedback based on blood pressure data, allowing elderly participants to relax through breathing exercises and modify their actions in real-time. Furthermore, the intervention maintains a balance between skill and challenge throughout the duration, tailoring the movements to the participants' fitness and fatigue levels.

Ammar et al. (2021) explored the use of digital technology to encourage physical activity and a healthy lifestyle among the elderly during pandemic-related confinement. This study discussed how digital tools and interventions could reduce the negative effects of isolation, support active lifestyles, and enhance mental well-being in elderly adults during physical limitations and reduced social interaction (Ammar et al., 2021). However, the elderly have low engagement in physical activity due to a lack of facilities, mobility issues, living arrangements, levels of education, and financial constraints. Additionally, numerous studies have also failed to consider the psychological status of the elderly during rehabilitation (Biering, 2019).

Furthermore, a preliminary scoping review conducted before the pilot study found no technology-based physical activity interventions that could provide mobility assistance during dancing. Very few inventions have focused on socialization for the elderly while performing physical activities with the aid of technology, and only a limited number of studies have provided high-quality feedback to users during activities. Research has shown that integrating technology into dance programs reduces the risk of falls and improves physical and cognitive functions in the elderly (Franco et al., 2020). According to research, both

conventional and technology-aided dance interventions provide safe means of improving gait, balance, and mobility in the elderly, thereby enhancing their quality-of-life. The dance intervention in the current study involves a warm-up that includes active mobilization exercises accompanied by music, followed by basic joint motions, dancing in patterns or circles, and dance moves that enhance lower limb strength, all delivered through videos.

The future goals of this pilot study are to provide psychological support through social inclusion platforms and opportunities for physical activity. The project also aims to combine interactive games, strength training, gait training, balance training, and guided movement dance training. The ICT-Rollator will assist and provide physical activity training programs, regardless of the participant's location. Therefore, the primary objective of the present pilot study is to assess the influence of interventional dance films on the participants' level of commitment and physical results (such as gait, balance, mobility, and hand grip strength) during guided movement training (dance), employing a projected video in a lab environment.

METHODS

Study Design and Participants

Otto von Guericke University Magdeburg, Germany, recruited elderly participants for this single-arm, lab-based study through a newspaper advertisement. Initially, six patients, five of whom were women and one man, all aged 85 or older, participated in the pilot trial. However, the participation of one subject was subsequently terminated for confidential reasons. The remaining five participants received intervention for five sessions and one extra group session. Due to the limited availability of rollators, two participants were simultaneously trained to ensure their care and safety while dancing.

The elderly subjects initially exhibited marked immobility and inactivity during four square-step tests, where all participants made considerable errors. Furthermore, the SF36 questionnaire also highlighted their initial low functional mobility levels. The elderly participants were notable for their low levels of mobility and activity. They came from a variety of backgrounds, reflecting a wide range of life experiences, medical histories, and activity levels. One participant had a history of stroke but had completely recovered ten years

before the start of the pilot study, which allowed for a thorough analysis of the intervention's effects.

Before and after the interventions, all 5 participants were tested and screened using the Timed Up-and-Go (TUG) test for mobility, the hand dynamometer for hand grip strength, the Berg Balance Scale (BBS) for balance, and the Barthel Index for quality of life.

Study Procedures

Figure 1: A) Optogait Measurement System; B) Hand Dynamometer; C) Polar; D) Sphygmomanometer; E) Test for Reaction Time

Figure 2: Intervention of Pre-Recorded Dance Videos Using a Projector

Preparation Phase: The participants provided their written consent. We granted the participants access to the Barthel Index after obtaining their consent, to assess their various histories of falls, surgeries, and strokes. The SF36 questionnaire and four-square step test were used as a pre-screening tool to understand functional mobility and coordination status.

Pre-testing Phase: The Pre-testing was conducted to assess the subjects' physical readiness for the dancing intervention and to gauge its effects from pre-testing to post-testing. The TUG test and the Optogait system were used during the pre-testing phase to analyze the mobility and spatiotemporal gait parameters. The TUG test is a validated tool for assessing mobility in elderly women aged 80-93 (Zarzeczny et al., 2017). The BBS, which is also validated for assessing balance in the elderly, was also fitted to analyze each elderly subject's balance during the pre-testing phase (Pereira, Maia, & Silva, 2013). Hand grip strength was measured using a hand dynamometer, and reaction time was measured using a pipe with measurements (Figure 1). Pre-testing and assessments of the physical capabilities of the elderly were done before the dance intervention.

Intervention Phase: The first session consisted of live dance sessions with simple steps. After each intervention session, a post-session questionnaire was administered to gather participants' qualitative evaluations of their degrees of

exhaustion, enjoyment, impediments, facilitators, and suggested changes. On the second day, the subjects received the dancing intervention using a projector and pre-recorded videos. These pre-recorded videos are intended to be integrated with the Rollator's intercommunication technology. The current study objective is to assess how pre-recorded, customized dance videos affect physical outcomes in the elderly.

During each session, the POLAR heart rate monitor was placed on the chest before the intervention began and will be taken off after the intervention. The purpose was to keep track of the participants' levels of activity during the entire intervention, as well as their minimum, average, and maximum heart rates. During all the dance intervention sessions, blood pressure was measured before, every 15 minutes during, and after the intervention to avoid adverse events and avoid training above the limit of 140-150/90-96 blood pressure. The video-based dance intervention was employed in the 2nd, 3rd, 4th, and 5th sessions (Figure 2). The final session consisted of a group dance session without videos, held in a sports hall to support participants' psychological well-being and reduce feelings of isolation.

Post-testing Phase: All tests administered during pre-testing were repeated during post-testing.

Intervention Duration: The intervention lasted four weeks. The senior rollator users were given sufficient recovery time between the two sessions per week. Each session lasted approximately one hour (60 minutes), with a 5-minute break every 15 minutes. Training was provided to two participants simultaneously.

Intervention Feasibility

The feasibility and utility of the intervention were evaluated based on the total duration of activity levels for each session recorded via POLAR. Additionally, the total number of calories burned throughout each session, and their minimum, average, and maximum heart rates were measured. The number of intervention dropouts was also assessed. Quality of life assessments were also carried out before and during the sessions. To ensure participants' safety and prevent falls, three supervisors were present, standing three meters from the seniors during each session. To avoid the high risk of falls and medical emergencies, blood pressure was monitored every 15 minutes.

Statistical Analysis

The pilot study involved a small sample size (N = 5). Descriptive statistics (mean and standard deviations) were used to visualize the HRR and average heart rate (AHR) intensities for all sessions. Given the small sample size and to prevent outliers in the data, medians were used to illustrate the differences between gait cycle time, BBS scores, gait speed, TUG test duration, stride length, and cadence from pre-testing to post-testing. No inferential statistics were conducted in the current pilot study.

RESULTS

The median and interquartile range (IQR) values for balance, mobility, and gait variables are presented in Figure 5 and Table 2. The BBS scores increased from a median of 34 (IQR 20) pre-testing to a median of 41 (IQR 33) post-testing. Similarly, the time taken for the TUG test decreased significantly, from a median of a median of 47 (IQR 15.375) to a median of 19.29 (IQR 7.28). Gait speed increased from a median of 0.385 (IQR 0.3725) to a median of 0.695 (IQR 0.115), while cadence improved from a median of 41.005 (IQR 57.0725) to a median of 100.67 (IQR 37.7375). The median and IQR values show mobility, balance, and gait improvements in the current pilot study.

Figures 3 and 4 show the comparison of HRR and AHR intensities across five training sessions. Table 1 presents the mean and standard deviations of fluctuations in HRR and heart rate intensity for all five sessions.

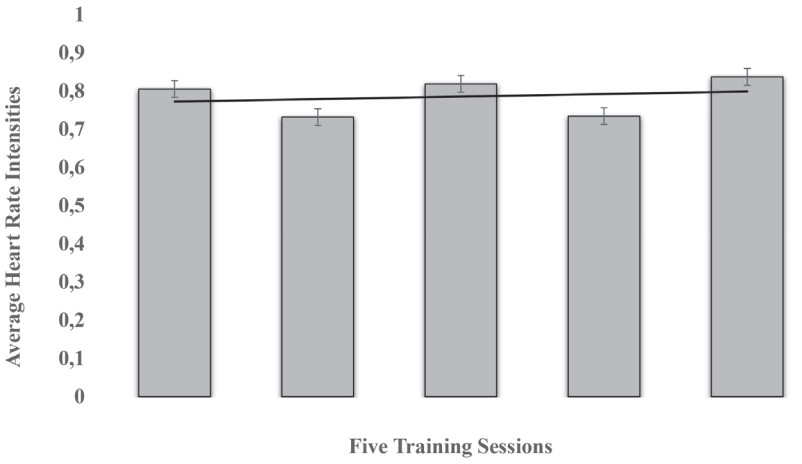

Figure 3: Comparison of Average Heart Rate Ranges (HRR) Between the Five Training Sessions

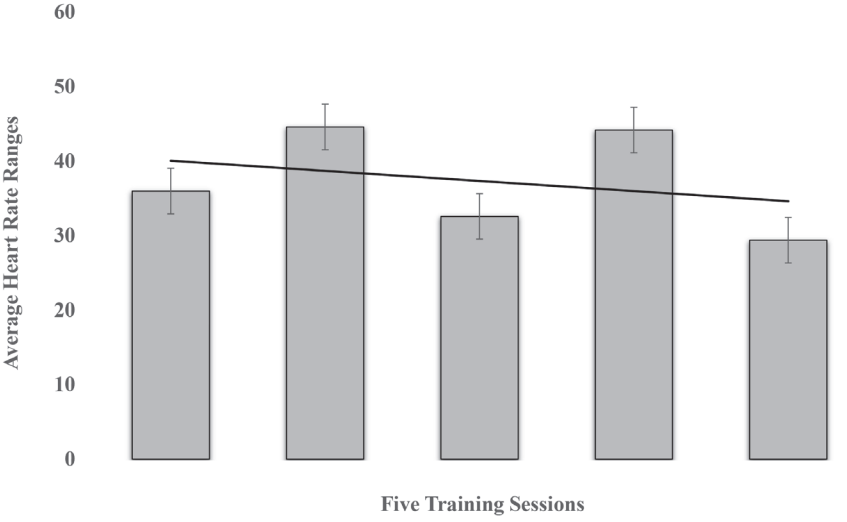

Figure 4: Comparison of Average Heart Rate (AHR) Intensities Between the Five Training Sessions

Table 1. Mean and Standard Deviation of HRR and Heart Rate Intensities:

Number of Sessions	Heart Rate Range		Heart Rate Intensity	
	Mean	SD	Mean	SD
Session1	36	12.24	0.80	0.05
Session 2	44.6	13.64	0.73	0.10
Session 3	32.6	11.09	0.81	0.07
Session 4	44.2	12.72	0.73	0.11
Session 5	29.4	10.50	0.84	0.06

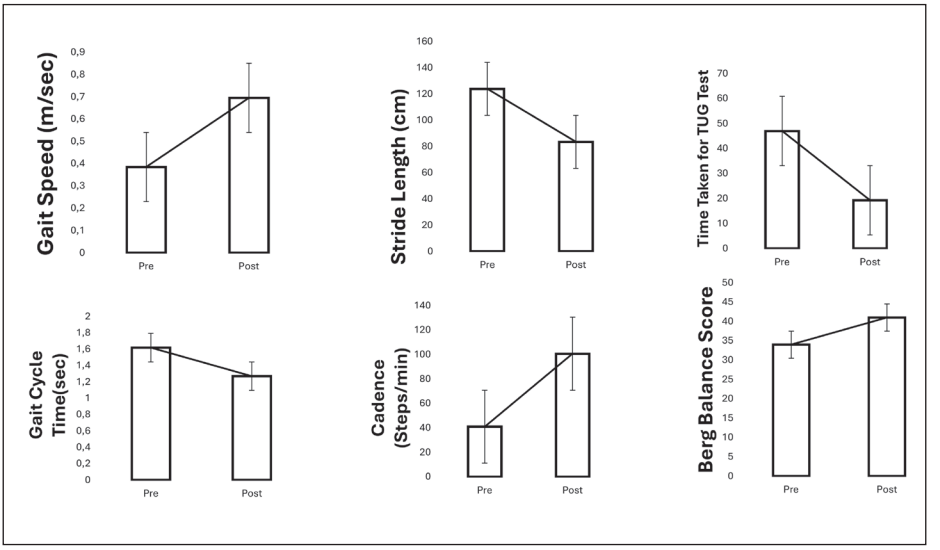

Figure 5: Median differences in BBS, Time taken for TUG test, and Gait variables

Table 2: Median and Interquartile Ranges of Gait Variables, BBS, and Time taken for the TUG Test

Variables	Pre-Testing		Post-Testing	
	Median	Interquartile range	Median	Interquartile range
Berg Balance Scale Score	34	20	41	33
Timed-Up-and-Go Test (sec)	47	15.375	19.29	7.28
Gait Cycle Time (sec)	1.618	1.78825	1.2695	0.61525
Stride Length (cm)	123.8	55.075	83.45	23.4
Gait Speed (m/sec)	0.385	0.3725	0.695	0.115
Cadence (steps/min)	41.005	57.0725	100.67	37.7375

DISCUSSION

The current pilot study focused on evaluating the physical outcomes of elderly individuals after a dance video intervention supported by a dance rollator in a laboratory setting. The results show improvements in mobility, balance, and gait, as assessed using the Timed Up-and-Go (TUG) test for mobility, the Berg Balance Scale (BBS) for balance, and Optogait system for measurement of spatial-temporal parameters of gait before and after the intervention. Previous studies have shown improved mobility in the elderly after dance interventions, assessed through the TUG test. The TUG test is a valuable tool for measuring mobility with high participant attendance rates, supported by a study by Klotzbier, Korbus, Johnen, and Schott (2021). Balance, gait symmetry, and dual-task performance improved after dance intervention assessed by the TUG test in populations with specific health problems (Fontanesi & DeSouza, 2021). Additionally, dance training has been found to improve spatiotemporal gait parameters, balance, and TUG test performance in adults with neurological conditions (Patterson, Wong, Prout, & Brooks, 2018). At the same time, research considering the elderly with Parkinson's disease has shown a positive impact on functional mobility and gait parameters after modified dance intervention (Delabary et al., 2020). Consistent with previous research, our study observed

improvements in mobility and reduced variability according to interquartile ranges from pre-testing to post-testing (Figure 5; Table 2). Notably, during screening before the intervention, all participants exhibited maximum errors (>5) when tested on the four-square-step test. Therefore, the TUG test is a valuable tool for evaluating functional mobility in the elderly.

In the current study, BBS scores improved from pre-testing to post-testing and the variability of scores within the dataset widened. This indicates a broader range of performance among the subjects and explains diverse responses from pre-testing to post-testing. Confirming the results from the current study, previous studies found that Cha-Cha dance training significantly enhanced balance ability in healthy elderly individuals (Li et al., 2022). The qualitative survey conducted after the intervention found that respondents reported feeling more stable when performing domestic tasks, consistent with the improvement in the BBS score from pre-testing to post-testing (Figure 5; Table 2). The enhanced balance performance corroborates findings from earlier studies, suggesting that the dance intervention can effectively improve the balance in the elderly (Hiyamizu, Morioka, Shomoto, & Shimada, 2011). Studies by Pereira et al. (2019) and Moratelli et al. (2022) highlight the benefits of dance for Parkinson's disease, showing improvements in gait and endorsing dance as one of the therapeutic interventions for gait in the elderly. Similarly, our active trial study showed that gait cycle time and stride length decreased. Moreover, gait speed and cadence increased (Figure 5). This is possibly due to enhanced speed and better balance (Hak, Houdijk, Beek, & Van Dieën, 2013).

The video-based dance interventions produced positive results for balance and mobility in the elderly rollator user population. Overall, the synthesis of these studies suggests that video-based dance interventions can be a promising approach to enhancing balance in the elderly population. These can be achieved through cognitive-motor training, rhythmic auditory cueing, and engaging in dance activities through video games. Such interventions can potentially improve balance, mobility, and gait parameters in elderly rollator users. contributing to overall well-being and reducing the risk of falls in the elderly.

Furthermore, study research on older women has shown improved better heart rate variability and the cardiac autonomic modulation responses after engaging in a dance protocol, indicating a potential increase in heart rate intensity (Pires et al., 2021). Similarly, waltz dancing has been linked to improved exercise capacity correlating with heart rate changes in heart failure patients (Belardinelli, Lacalaprice, Ventrella, Volpe, & Faccenda, 2008). In the ongoing preliminary study, the HRR gradually decreased (Figure 3; Table 1), and heart rate intensities slightly increased during the five sessions of dance intervention

(Table 1, Figure 4). In the first, second, and third sessions, there is an increased AHR intensity, which may be because participants are gradually pushing themselves harder (Figure 4), and there is a decrease in HRR due to improved movement control (Figure 3). Conversely, the average heart rate intensity in the second and fourth sessions gradually reduced, perhaps due to the participants' interspersed times of lower-intensity movement or rest between routines. Additionally, a wider range of heart rate responses during the second and fourth sessions may signify that participants were engaged in more dynamic and diverse movements. Several dance movements were introduced in the second and fourth sessions. The fact that the participants' AHR either stayed the same or went down slightly across all the sessions shows that they may be adapted to the dancing motions and increased their cardiovascular efficiency. These results indicate that a well-planned dance intervention that includes recovery, variety-oriented, high-intensity, and low-intensity portions can benefit the body's general conditioning and cardiovascular fitness.

The present study had high adherence rates as there were no dropouts and all the subjects attended all five sessions, except for the one dropout before pre-testing. Hand grip strength showed no noticeable difference, likely due to the nature of the dance intervention involving a dance rollator, which the participants used for support throughout the session. This restriction in upper body movement may have limited the impact on hand grip strength and reaction time. While there is substantial research on the benefits of dance interventions for improving balance and mobility in the elderly, further studies should focus on examining heart rate variables during dance training and the effects on gait parameters before and after the intervention in elderly rollator users. Moreover, future studies should explore exercise intervention plans with or without the use of technology to improve upper body strength and activity in elderly rollator users.

Future Study

In future research, a longitudinal study will compare dance and physical rehabilitation training over six months using an ICT-Rollator versus a control group using a standard rollator (Figure 6). Both groups will undergo the same pre-testing and post-testing questionnaires as used in the pilot study. The length of training will be recorded for the control group and the intervention group, and will be uploaded to the ICT-Rollator server. The intervention group will have access to a social inclusion platform, guided movements, fall prevention sensors, and feedback. During the sessions, both visible and audible cues will be provided.

Figure 6: Initial Digitalized Version of Sport and Dance Rollator

Limitations

The analysis in this study is limited to descriptive statistics due to the small sample size. The POLAR values, which also consider heart rate measurements taken during intersession breaks, may have affected the results. Additionally, because of the elderly participants' low fitness levels, the pre-testing conducted without support resulted in very minimal measurement errors for gait testing. Furthermore, the results are preliminary, as the study has a small sample size and limited generalizability, which may impact the conclusions.

CONCLUSION

The ICT-Rollator holds promise as a beneficial tool for the elderly to use for physical activity in every living setting, providing support and protection. It helps prevent falls using fall detection sensors, guides movement with visual and audible cues, and assists in mobility by maintaining an upright posture while moving around. The integration of customized dance videos with the ICT-Rollator in future studies is expected to further improve balance, mobility, and gait. There is a need to conduct a longitudinal study with a larger sample, a control group, and a specific dance intervention program for the elderly with different health conditions. The pilot study demonstrated excellent adherence rates, with no dropouts and all participants completed five training sessions, with no adverse events or reported falls occurring during the pilot study sessions using a sport and dance rollator.

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EVALUATING BASIC MOTOR COMPETENCE IN ITALIAN CHILDREN POST-COVID-19 PANDEMIC: IMPLICATIONS FOR MOTOR DEVELOPMENT

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ABSTRACT

Motor competence assessment represents one of the most important topics in the field of motor development and physical education. The present cross-sectional study aims to assess basic motor competence, self-perception and enjoyment during physical activity (PA) in a sample of normal weight, and overweight or obese children post-COVID-19 pandemic. The participants (N = 107, age = 8-9 years old) were recruited from an experimental project conducted in Lecce (Italy). The motor competence assessment was undertaken using MOBAK 3-4 protocol, and self-perception and enjoyment were evaluated with two validated questionnaires. A multivariate analysis of variance (MANOVA) was performed to assess the effect of gender and BMI on the variables considered. Despite the MANOVA results indicating no significant interaction effects between variables, a significant main effect was found for gender [$F(10,93) = 2.353$, $p = .013$, $\eta^2 = 0,218$] and BMI cutoff [$F(10,93) = 2.351$, $p = .013$, $\eta^2 = 0,218$]. Moreover, an independent t-test highlighted significant differences in catching, dribbling, balancing and object movement according to gender ($p < .05$), and in balancing, rolling and self-movement according to BMI cutoff ($p < .05$). Self-efficacy differed significantly between males and females, while no significant effect was found for enjoyment. Further

studies should investigate the effect of BMI and factors related to physical activity on motor competence development.

***Keywords**: basic motor competence, motor development, self-efficacy, obesity.*

OCENA OSNOVNIH MOTORIČNIH SPOSOBNOSTI PRI ITALIJANSKIH OTROCIH PO PANDEMIJI COVIDA-19: KAKŠNI SO UČINKI PANDEMIJE NA MOTORIČNI RAZVOJ?

IZVLEČEK

Ocenjevanje motoričnih sposobnosti je eden najpomembnejših vidikov na področju gibalnega razvoja in telesne vzgoje otrok. S to presečno študijo smo želeli oceniti osnovne motorične sposobnosti, samopodobo in užitek ob telesni dejavnosti na vzorcu otrok z normalno telesno težo in otrok s prekomerno telesno težo po pandemiji covida-19. Udeleženci (N = 107, starost = 8–9 let) so bili izbrani v okviru projekta, ki je bil izveden v mestu Lecce v deželi Apulija. Motorične sposobnosti smo ocenili s pomočjo protokola MOBAK 3-4, medtem ko so otroci samopodobo in užitek ob telesni dejavnosti ocenili z dvema potrjenima vprašalnikoma. Vpliv spola in indeksa telesne mase (BMI) na obravnavane spremenljivke smo ocenili z multivariatno analizo variance (MANOVA). Čeprav rezultati analize MANOVA niso pokazali pomembnega medsebojnega vpliva med spremenljivkami, smo ugotovili, da imajo pomemben glavni vpliv spol [Ž(10,93) = 2.353, p = .013, η² = 0.218] in mejne vrednosti indeksa telesne mase [Ž(10.93) = 2.351, p = .013, η² = 0,218]. Poleg tega je neodvisni t-test pokazal pomembne razlike v lovljenju, preigravanju, ohranjanju predmeta v ravnotežju in premikanju predmeta glede na spol (p < .05) ter v lovljenju ravnotežja, kotaljenju in samostojnem gibanju glede na mejne vrednosti indeksa telesne mase (p < .05). Ugotovili smo pomembne razlike pri samoučinkovitosti otrok moškega in ženskega spola. Zaznali nismo nobenega učinka na užitek ob športni dejavnosti. V nadaljnjih raziskavah bi bilo treba raziskati vpliv indeksa telesne mase in dejavnikov, povezanih s telesno dejavnostjo, na razvoj motoričnih sposobnosti.

***Ključne besede:** osnovne motorične sposobnosti, motorični razvoj, samoučinkovitost, debelost*

INTRODUCTION

New theoretical frameworks (Herrmann & Seelig, 2017a; Herrmann, Gerlach & Seelig, 2016; Legarra-Gorgoñon et al., 2023; Strotmeyer, Kehne, & Herrmann, 2021) posit that motor competence is not merely the observable performance of skills itself (e.g., dribbling, bouncing, catching, rolling), which are considered *basic motor qualifications*. Instead, *basic motor competence* is defined by a child's ability to engage and manage their own resources to solve motor tasks (e.g., the ability to dribble, bounce, catch, roll).

This construct refers to a result-oriented and functional response to a specific motor task, representing an evolution and addition to the concepts of capabilities, defined as person's genetic potential for success in a specific task (Goodway, Ozmun, & Gallahue, 2021) and motor skills, as experientially based action (Goodway et al., 2021), respectively. Moreover, research has demonstrated a positive association between competence in fundamental movement skills (e.g., kicking, jumping) and physical activity in young people (Hulteen, Morgan, Barnett, Stodden, & Lubans, 2018). Fundamental Motor Skills (FMS), citing Stodden et al. (2008), "are the equivalent of the ABCs in the world of physical activity", composed of locomotor skills and object control skills. The first class of movement includes moving the body through space and includes skills such as running, galloping, skipping, hopping, sliding and leaping; the second one consists of manipulating and projecting objects and includes skills such as throwing, catching, bouncing, kicking, striking and rolling. These skills represent the basis for future movement and physical activity.

Stodden et al. (2008) proposed a theoretical model explaining the potential role of motor competence (i.e., Ulrich, 2000; Henderson, Sugden & Barnett, 2007) in promoting positive or negative trajectories of physical activity (i.e., ActiGraph GT3X-BT accelerometer; Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997) health related-fitness (i.e., Council of Europe, 1993; Morrow, Mood, Disch, & Kang, 2015) and weight status, during infancy, adolescence and adulthood. In this concept, motor competence (MC) is a precursor to physical activity and learning to move is necessary for participation in physical activity (PA) and subsequent healthy weight. In this view, motor competence is a key factor promoting engagement in motor activity for health. Perceived motor competence plays a key role in the educational process, as it promotes children's engagement in motor activity and sport (Estevan & Barnett, 2018) and is directly related to physical activity levels and inversely to body weight (De Meester et al., 2016). Robinson et al. (2015) suggest that healthy lifestyles

and motor competence development early in life promote physical activity and other positive health trajectories across the lifespan.

Faigenbaum, Rebullido and MacDonald (2018), in developing their model of the "Pediatric Inactivity Triad", describe three interrelated factors that contribute to physical inactivity: exercise deficit disorders, pediatric dynapenia and physical illiteracy: (a) exercise deficit disorder is a condition characterized by low levels of moderate to vigorous physical activity (MVPA; '<60 mins daily), including active transportation, free play, recreation, sport and structured exercise; (b) pediatric dynapenia is a loss of muscular strength and power and the consequent functional limitations, activity-related injuries and adverse health outcomes in children; (c) physical illiteracy is a lack of confidence, competence and motivation to move proficiently when engaged in any type of physical activity. The interaction between these factors lead to the progressive decline of physical activity levels (PAL) and physical fitness levels during the developmental age, with negative effects on global health status (Wyszyńska et al., 2020; Santana et al., 2017). These negative trends not only contribute significantly to the increase in the prevalence of overweight and obesity in children and adolescents, but are also among the main determinants of the decline of physical activity levels, with negative repercussions on the development of motor competence.

In the light of this evidence, the aim of the present study is to assess motor competence levels in primary school children according to gender and BMI cutoff following the COVID-19 pandemic.

MATERIALS AND METHODS

Sample

The sample comprises 107 primary schoolchildren (male = 52, female = 55) aged 8-9 years old, who were recruited from three schools joined an experimental project in the Province of Lecce (Italy). The project, promoted by the University of Salento Didactic Laboratory of Motor Activities was aimed at studying motor development of primary school children highlighting psychopedagogical and methodological implications for physical education (PE) teachers' training. According to this study's purpose, both normal weight and overweight or obese children were included. Consecutive sampling was applied using BMI cutoffs – normal weight and overweight or obese children according

to Cole's Scale (2000) – and an age range of 8-9 years as eligibility criteria to ensure better representation of the target population.

Procedure and Assessment

After reaching an agreement between the University of Salento and the participating schools, motor evaluations were conducted from October to December 2023 for a total of 8 weeks. Prior to starting the motor assessments, the children's age, weight and height were reported, and they were asked if they engaged in extracurricular physical activity (or sports) following the COVID-19 pandemic. Children were then classified into categories of normal weight, overweight and obese according to Cole's Scale (Cole, Bellizzi, Flegal, & Dietz, 2000).

The motor competence assessment was conducted using the MOBAK 3-4 protocol, a test instrument designed for children aged 8-9 years old that investigates two areas of basic motor qualifications (BMQ): object movement and self-movement. Moreover, according to Herrmann & Seelig (2019), each basic motor qualifications encompasses four latent factors or basic motor competencies (BMC). These include throwing, catching, bouncing and dribbling for object movement, and balancing, rolling, jumping and running for self-movement qualifications. The children were asked to perform two attempts of each MOBAK test item, reporting results as follows: 0 points for 2 attempts failed, 1 point for 1 successful attempt, and 2 points for 1 both successful attempts. Moreover, the protocol provides 6 attempts only for the throwing and catching BMC, changing results interpretations (0-2 hits = 0 points, 3-4 hits = 1 pints, 5-6 hits = 2 points). The MOBAK total score can be obtained by adding the score of each BMQ, with a maximum 8 points for each BMQ and 16 as the MOBAK total score. The test instrument showed good factors of reliability (from 0.54 to 0.72), structure for the latent factors (BMQ) and content validity as confirmed by other studies (Herrmann & Seelig, 2017a; Carcamo-Oyarzun & Herrmann, 2020).

Self-efficacy was assessed with the Perceived Physical Ability Scale (Colella, Morano, Bortoli, & Robazza, 2008), a six-item questionnaire assessing strength, speed and coordinative abilities in primary school children. Item responses were based on a 4-point Likert scale (1 = run very slowly, 4 = run very fast), so the total score ranged from 1 to 24 points. High scores reflect better self-perception during physical activity, while lower scores indicate worst self-perception.

Enjoyment during physical activity was assessed with the Physical Activity Enjoyment Scale (PACES) (Carraro, Young, & Robazza, 2008), comprising 16 items rated on a 5-point Likert scale with two subscales (positive and negative). Children were asked to indicate their agreement (or disagreement) with sentences investigating how they feel during physical activity. As with the Physical Ability Scale, higher scores on the positive scale and lower scores on the negative scale indicate greater enjoyment during PA. In this study, negative items were reversed, and total PACES score were calculated ranging from 16 to 80 points.

As confirmed by validation studies, both questionnaires showed good reliability and content validity for target population (Carraro et al., 2008; Colella et al., 2008).

The assessment was conducted in the schools' gymnasiums by PE teachers and ten graduates in Sports Sciences – recruited by the Didactic Laboratory of Motor Activities – during curricular PE lessons. Before starting the evaluation, five training meetings were held to standardize the assessment procedure. To ensure that the assessment of motor competence did not have an effect (positive or negative) on self-efficacy and enjoyment, the MOBAK was carried out before the self-reports. In addition, based on the number of students, two or three evaluation tests were proposed at a time in each lesson of MOBAK (object movement at first and then self-movement qualifications).

Statistical Analysis

A priori power calculation was conducted using G*Power, setting parameters as follows: medium effect size f^2 (V) = 0.15 (Cohen, 2013), and α level at 0.05. Results suggested a sample size of 100, which is consistent with the 107 participants involved in the present study. In addition to descriptive statistics (mean ± standard deviation), a two-way factorial MANOVA was performed to assess MOBAK basic motor competencies' items based on gender, BMI cutoff and their interaction. Levene's test was performed to assess the multivariate homogeneity of variance-covariance matrix assumption, while factorial MANOVA was robust (with more than 10 participants per group) against deviations from multivariate normality. Due to the small and unequal sample size, Pillai's *F* statistic was used to evaluate the main effects of gender and BMI cutoff on the dependent variables to control for type I error rate. The effect of gender was analyzed using separate MANOVAs for each BMI cutoff, and vice versa. Partial eta squared was used to estimate effect size, interpreting results as

follows: 0.01 = small effect, 0.06 = medium effect, and 0.14 or higher = large effect (Cohen, 2013). Furthermore, two independent t-tests were performed to assess significant differences according to gender and BMI cutoff, respectively. Bonferroni correction was applied for multiple-comparison adjustment. Cohen's *d* was used as the effect size measure, with value: 0.2 = small effect, 0.5 = medium effect and 0.8 = large effect (Cohen, 2013). All significant indexes were determined at $p < .05$. SPSS (ver. 26) was used to perform all statistical analyses.

RESULTS

The sample's descriptive anthropometric characteristics, measures of basic motor competences, self-efficacy and enjoyment are presented in Table 1 and Table 2, according to gender and BMI cutoff. The number of observations in each group exceeds the number of dependent variables assessed, indicating sample size adequacy for conducting the analysis. Moreover, as fewer than 5% of children reported engaging in physical or sport activities outside of school, sports participation was not included in subsequent analyses.

A multivariate analysis of variance (MANOVA) was used to assess the effect of gender and BMI cutoff on MOBAK items, self-efficacy and enjoyment in children aged 8-9 years old. Univariate normality was confirmed by the Shapiro-Wilk test, and no multivariate outliers were found in the data, thereby assuming multivariate normality. Moreover, the correlation between variables (Table 3) was below the recommended threshold of 0.9.

Pillai's Trace (Table 4) indicated a statistically significant difference in MOBAK items and questionnaires between gender [$F(10,93) = 2.353$, $p = .013$] and cutoff [$F(10,93) = 2.351$, $p = .013$] with a substantial effect size ($\eta^2 = 0.218$). However, the interaction effect was not significant [$F(10,93) = .791$, $p = .648$].

To investigate how gender can affect the variables, two independent t-tests were performed to assess significant difference among the male and female sample (Table 5), as well as between normal weight and overweight or obese children (Table 6). Pairwise comparisons according to gender revealed that males exhibited better performance in catching ($p = .011$, $d = 0.199$), dribbling ($p = .020$, $d = 0.197$), total object control score ($p = .004$, $d = 0.201$), balancing ($p = .002$, $d = 0.204$) and self-efficacy ($p = .024$ $d = 0.197$). Moreover, normal weight children performed significantly better in balancing ($p = .029$, $d = 0.200$), rolling ($p < .001$, $d = 0.209$) and total self-movement ($p = .001$, $d = 0.205$).

Table 1. Sample Anthropometric Characteristics.

Gender	Group	Measures	Mean	SD	Min	Max	Range
Female							
	Nw (32)	Age	8,28	0,46	8	9	1
		Height	1,34	0,067	1,24	1,50	0,26
		Weight	28,96	4,76	20,00	41,00	21,00
		BMI	16,12	1,59	13,00	18,37	5,37
	Ow-Ob (23)	Age	8,48	0,511	8	9	1
		Height	1,37	0,12	1,14	1,58	0,44
		Weight	39,93	8,16	28,50	57,00	28,50
		BMI	21,16	2,84	18,60	30,00	11,40
Male							
	Nw (21)	Age	8,19	0,40	8	9	1
		Height	1,33	,05	1,20	1,42	0,22
		Weight	28,95	4,45	21,00	36,00	15,00
		BMI	16,34	1,60	13,22	18,37	5,15
	Ow-Ob (31)	Age	8,32	0,47	8	9	1
		Height	1,36	0,074	1,15	1,50	0,35
		Weight	40,15	7,26	28,40	63,00	34,60
		BMI	21,75	3,38	18,44	32,60	14,17

Legend: Nw = normal weight; Ow-Ob = Overweight and Obese.

Table 2. Basic Motor Competence and Questionnaires assessment

		BMI Cutoff									
		Nw					Ow-Ob				
Gender		**N**	**Min**	**Max**	**M**	**SD**	**N**	**Min**	**Max**	**M**	**SD**
Female											
	Throwing	32	0	1	0,25	,440	23	0	2	0,30	0,559
	Catching	32	0	6	2,16	2,034	23	0	6	1,43	1,805
	Bouncing	32	0	2	0,53	,842	23	0	2	0,52	0,846
	Dribbling	32	0	2	0,34	,545	23	0	2	0,26	0,541
	Object Mov.	32	0	10	3,28	2,932	23	0	8	2,52	2,937
	Balancing	32	0	2	1,06	,878	23	0	2	0,57	0,896
	Rolling	32	0	2	1,06	1,014	23	0	2	0,39	0,783
	Jumping	32	0	2	0,41	,756	23	0	2	0,17	0,576
	Running	32	0	2	1,03	,897	23	0	2	0,78	0,902
	Self Mov.	32	1	8	5,22	2,310	23	0	8	3,17	2,640
	Self-Efficacy	32	16	24	20,34	2,119	23	11	24	19,43	3,245
	Enjoyment	32	52	72	63,41	4,478	23	35	68	60,57	6,721
Male											
	Throwing	21	0	2	0,48	,680	31	0	2	0,52	0,677
	Catching	21	0	6	2,86	2,308	31	0	6	2,84	2,131
	Bouncing	21	0	2	0,67	,856	31	0	2	0,87	0,806
	Dribbling	21	0	2	0,71	,644	31	0	2	0,42	0,564
	Object Mov.	21	0	10	4,71	3,437	31	0	10	4,65	3,104
	Balancing	21	0	2	0,43	,676	31	0	2	0,26	0,575
	Rolling	21	0	2	1,14	,964	31	0	2	0,35	0,755
	Jumping	21	0	2	0,19	,512	31	0	2	0,16	0,523
	Running	21	0	2	0,81	,928	31	0	2	0,90	0,908
	Self Mov.	21	0	8	4,10	2,119	31	0	10	3,06	2,279
	Self-Efficacy	21	18	24	21,19	2,040	31	15	24	20,81	2,358
	Enjoyment	21	44	69	61,29	5,524	31	57	67	62,06	2,792

Table 3. Correlation Matrix.

	Catch	Boun	Drib	Obj Mov.	Bal	Roll	Jump	Run	Self Mov	SE	Enjoy
Throw	0,309**	0,327**	0,157	0,508**	0,029	0,119	0,027	0,004	0,081	0,017	-0,015
Catch	1	0,455**	0,411**	0,921**	0,143	0,365**	0,067	0,073	0,294**	0,217*	-0,058
Boun		1	0,359**	0,694**	0,125	0,178	0,110	0,140	0,248*	0,116	0,059
Drib			1	0,582**	-0,057	0,225*	0,107	-0,115	0,097	0,148	-0,025
Object Mov.				1	0,123	0,355**	0,099	0,065	0,295**	0,206*	-0,031
Bal					1	0,355**	0,308**	0,224*	0,758**	-0,003	-0,008
Roll						1	0,164	0,056	0,626**	0,104	0,088
Jump							1	0,131	0,495**	0,008	0,179
Run								1	0,533**	-0,025	0,097
Self Mov.									1	0,067	0,137
SE										1	-0,129

* = $p < 0,05$; ** = $p < 0,01$.

Table 4. Multivariate Test

Multivariate Tests[a]							
Effect		**Value**	**F**	**Hypothesis df**	**Error df**	**Sig.**	**η^2**
Gender	Pillai's Trace	0,218	2,353[b]	10,000	93,000	0,013	0,218
BMI Cutoff	Pillai's Trace	0,218	2,351[b]	10,000	93,000	0,013	0,218
Gender*BMI Cutoff	Pillai's Trace	0,086	0,791[b]	10,000	93,000	0,648	0,086

Table 5. Differences in Basic Motor Competence based on Gender

Measures	Gender	Mean	Mean Difference	p	Std. Error	C.I. 95%		
						LLIC	ULIC	Cohen's d
Throwing	Female	0,277	-0,219	0,062	0,081	-0,449	0,011	0,197
	Male	0,496	0,219	0,062	0,083	-0,011	0,449	
Catching	Female	1,796	-1,052*	0,011	0,283	-1,861	-0,244	0,199
	Male	2,848	1,052*	0,011	0,293	0,244	1,861	
Bouncing	Female	0,526	-0,242	0,143	0,114	-0,568	0,083	0,196
	Male	0,769	0,242	0,143	0,118	-0,083	0,568	
Dribbling	Female	0,302	-0,265*	0,020	0,078	-0,487	-0,042	0,197
	Male	0,567	0,265*	0,020	0,081	0,042	0,487	
Object Mov.	Female	2,901	-1,778*	0,004	0,422	-2,982	-0,575	0,201
	Male	4,680	1,778*	0,004	0,436	0,575	2,982	
Balancing	Female	0,814	0,471*	0,002	0,105	0,171	0,770	0,204
	Male	0,343	-0,471*	0,002	0,108	-0,770	-0,171	
Rolling	Female	0,727	-0,022	0,900	0,121	-0,368	0,324	0,194
	Male	0,749	0,022	0,900	0,125	-0,324	0,368	
Jumping	Female	0,290	0,114	0,344	0,084	-0,124	0,352	0,195
	Male	0,176	-0,114	0,344	0,086	-0,352	0,124	

Measures	Gender	Mean	Mean Difference	p	Std. Error	C.I. 95%		
						LLIC	ULIC	Cohen's d
Running	Female	0,907	0,051	0,777	0,124	-0,303	0,404	0.194
	Male	0,856	-0,051	0,777	0,128	-0,404	0,303	
Self Mov.	Female	4,196	0,616	0,183	0,320	-0,296	1,529	0,196
	Male	3,580	-0,616	0,183	0,331	-01,529	0,296	
Self-Efficacy	Female	19,889	-1,109*	0,024	0,336	-2,067	-0,152	0,197
	Male	20,998	1,109*	0,024	0,347	0,152	2,067	
Enjoyment	Female	61,986	,311	0,747	0,668	-1,595	2,216	0,194
	Male	61,675	-,311	0,747	0,691	-2,216	1,595	

Table 6. Differences in Basic Motor Competence based on BMI Cutoff

Dependent Variable	(I) CUTOFF	(J) CUTOFF	Mean Difference	Std. Error	p	C.I. 95%		Cohen's d
						LLIC	ULIC	
Throwing	Nw	Ow-Ob	-0,047	0,116	0,685	-0,277	0,183	0,194
	Ow-Ob	Nw	0,047	0,116	0,685	-0,183	0,277	
Catching	Nw	Ow-Ob	0,370	0,408	0,366	-0,438	1,178	0,194
	Ow-Ob	Nw	-0,370	0,408	0,366	-1,178	0,438	
Bouncing	Nw	Ow-Ob	-0,097	0,164	0,554	-0,423	0,228	0,194
	Ow-Ob	Nw	0,097	0,164	0,554	-0,228	0,423	
Dribbling	Nw	Ow-Ob	0,189	0,112	0,095	-0,033	0,411	0,195
	Ow-Ob	Nw	-0,189	0,112	0,095	-0,411	0,033	
Object Mov.	Nw	Ow-Ob	0,414	0,607	0,496	-0,789	1,618	0,193
	Ow-Ob	Nw	-0,414	0,607	0,496	-1,618	0,789	
Balancing	Nw	Ow-Ob	0,334*	0,151	0,029	0,035	0,633	0,200
	Ow-Ob	Nw	-0,334*	0,151	0,029	-0,633	-0,035	
Rolling	Nw	Ow-Ob	0,730*	0,174	0,000	0,384	1,075	0,209
	Ow-Ob	Nw	-0,730*	0,174	0,000	-1,075	-0,384	
Jumping	Nw	Ow-Ob	0,131	0,120	0,279	-0,107	0,369	0,195
	Ow-Ob	Nw	-0,131	0,120	0,279	-0,369	0,107	

Dependent Variable	(I) CUTOFF	(J) CUTOFF	Mean Difference	Std. Error	p	C.I. 95%		Cohen's d
						LLIC	ULIC	
Running	Nw	Ow-Ob	0,077	0,178	0,665	-0,276	0,431	0,194
	Ow-Ob	Nw	-0,077	0,178	0,665	-0,431	0,276	
Self Mov.	Nw	Ow-Ob	1,538*	0,460	0,001	0,625	2,451	0,205
	Ow-Ob	Nw	-1,538*	0,460	0,001	-2,451	-0,625	
Self-Efficacy	Nw	Ow-Ob	0,646	0,483	0,183	-0,311	1,604	0,194
	Ow-Ob	Nw	-0,646	0,483	0,183	-1,604	0,311	
Enjoyment	Nw	Ow-Ob	1,031	0,961	0,286	-0,874	2,936	0,195
	Ow-Ob	Nw	-1,031	0,961	0,286	-2,936	0,874	

DISCUSSION

The results of the present study revealed significant effects of gender and BMI cutoff on basic motor competencies. The observation of MOBAK motor tasks indicated that males performed significantly better than females in catching, dribbling and total object movement qualification, but not in balancing. Considering BMI differences, the statistical analysis revealed significant differences in only two MOBAK test scores (balancing and rolling) and in total self-movement qualification, favouring normal weight compared to overweight or obese children. Moreover, males exhibited significantly higher self-efficacy compared to females, whereas no statistically significant differences were observed in enjoyment and self-efficacy when comparing BMI groups. These results align closely with findings reported in similar studies within the field.

According to Carcamo-Oyarzun, & Herrmann (2020), gender has small to moderate relationship with object movement and self-movement competencies, and BMI was inversely related to self-movement, indicating that children with lower BMI achieved better results in MOBAK tests. Similar results were also reported in a cross-sectional study assessing basic motor competencies in children aged 6-8 years, according to which (a) boys performed significantly better than girls in object movement, (b) girls achieved higher scores in self-movement qualification, and (c) a small significant negative correlation between BMI and self-movement emerged (Wälti et al., 2022).

However, the effect of body composition on locomotor and object manipulation skills remain a topic of debate in this research field, strictly related to assessment methods and measures (Webster, Sur, Stevens, & Robinson, 2021; Herrmann & Seelig, 2017b; Vega-Ramirez, Pérez-Cañaveras, & De Juan Herrero, 2021; Wood, McMillan, Imai, Swift, & DuBose, 2022).

Self-efficacy and enjoyment did not exhibit significant differences among groups in this study (except for self-efficacy in males and females) and showed no significant correlation with other variables investigated. Contrary to the results obtained from this study, several findings have highlighted the mediation role of self-efficacy and enjoyment in enhancing basic motor competence development (Ensrud-Skraastad & Haga, 2020; Peers, Issartel, Behan, O'Connor, & Belton, 2020; Morales-Sánchez et al., 2021 Barnett et al., 2022; Greule et al., 2024). These results may be related to poor practice of physical activity declared by children (< 5% of total sample).

Prior to the COVID-19 pandemic, epidemiological studies indicated that a large percentage of young boys (78%) and girls (85%) aged 11 to 17 did not meet international guidelines and recommendations for physical activity

(Guthold, Stevens, Riley, & Bull, 2020), and since 2016 the American Academy of Pediatrics (AAP) has advised that children, adolescents and, especially parents, limit the time spent in front of monitors, smartphones, TV and game consoles.

However, while some studies have highlighted a significant reduction in motor competence development during and after COVID-19 pandemic (Cheng, Tai, & Wang, 2023; Carballo-Fazanes, Rodrigues, Silva, Lopes, & Abelairas-Gómez, 2022), not all authors have reported the same results (den Uil et al., 2023a). This is probably due to the complexity of factors involved by lockdown measures in each country, as well as specific regional and local variables that impact motor competence development in children.

Furthermore, recent findings have highlighted the fundamental role of physical activity in mediating and moderating the relationship between BMI and motor competence acquisition (Burton et al., 2023; Dapp, Gashaj, & Roebers, 2021; Herrmann, Heim, & Seelig, 2019). Studies suggest that the relationship between BMI, engagement in physical activity, and both motor and perceived motor competence begins to manifest from ages 6 to 9 years (den Uil et al., 2023b). This underscores the inference that sedentary lifestyles and the decreased practice of physical activity post-pandemic may further hinder motor development, especially in children who are not physically literate or have poor physical literacy.

In fact, poor engagement in physical or sports activity has been found to negatively with both object and self-movement qualifications, while high engagement (particularly, individual and team sports) has shown a medium to high correlation with BMQ (Herrmann & Seelig, 2017a; Herrmann & Seelig, 2017b; Wälti et al., 2022).

The COVID-19 pandemic drastically changed the already low levels of physical activity among children and adolescents, leading to a significant increase in time spent in sedentary behavior and screen time (Paterson et al., 2021; Neville et al., 2022).

Another important consideration relates to the type and accessibility of physical activity opportunities. As suggested by Walker et al. (2023), new physical activity trends are characterized by a growing dependence on structured and organized physical activity, leaving out spontaneous play and unstructured physical activity, promoting barriers in participation for lower socio-economic status children.

These data are highly significant for informing the development of interventions and policies aimed at promoting opportunities for physical activity and fostering healthy eating habits in primary school children. Moreover, in

addition to quantitative data on physical activity (i.e., time of motor engagement, intensity, % of MVPA, etc.) even the quality of motor experiences plays a fundamental role in motor competence development (Schmutz et al., 2020).

CONCLUSIONS

The assessment of motor competencies during childhood is crucial to ensure the quality of the teaching process and monitor the stages of children's motor development. The present results show poor levels of motor competencies in both boys and girls, as well as a negative impact of BMI on basic motor qualifications.

Considering the growing prevalence of overweight and obesity during developmental age, coupled with declining levels of daily physical activity among children and adolescents, the interpretation of these findings raises significant methodological and pedagogical considerations for the future directions of physical education (PE) teachers' training and motor activities. On the one hand, there is a need to enhance qualitative opportunities for motor learning at school. On the other hand, it is essential to engage institutions and families in developing physical activity interventions outside of school.

Further research should assess the effects of experimental interventions on motor competence development, evaluating the mediating role of structured and unstructured physical activity between BMI and motor competence.

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FORWARD HEAD POSTURE IN SPORTS-INVOLVED CHILDREN

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ABSTRACT

Purpose: *Forward head posture (FHP) is the most common cervical postural fault in the sagittal plane that can cause various issues and conditions. The purpose of this study is to determine the prevalence of FHP among sports-involved children and to examine the differences in craniovertebral angle (CVA) with regard to gender, age, neck pain, and the sports in which they participate.*

Methods: *A cross-sectional study was conducted among 154 sports-involved children (76 males and 78 females), aged 11–14, participating in various sports (basketball, football, volleyball, and athletics). After obtaining signed consent, photography of the sagittal view was performed in a standing position, which was then used to measure the CVA using the Web Plot Digitizer software. A questionnaire was used to gather data about gender, age, sports in which a participant is involved, presence of neck pain, and pain scale.*

Results: *Among the 154 children, 37 (24.03%) exhibited FHP (15 males, 22 females). The mean CVA for the entire sample was 51.30° ± 6.20°. Female participants had a significantly lower CVA ($p = .021$) compared to male participants. No significant differences were found with regard to age, presence of neck pain, or engagement in a specific sport.*

Conclusion: *FHP is present in sports-involved children, with a higher prevalence among females.*

Keywords: *forward head posture, craniovertebral angle, children, physical activity, sport, ages 11–14*

ANTERIORNA DRŽA GLAVE PRI OTROCIH, KI SE UKVARJAJO S ŠPORTOM

POVZETEK

Namen: *Anteriorna drža glave je najpogostejša vrsta napačne drže vratu v sredinski ravnini, ki lahko povzroči različne težave in stanja. Z raziskavo smo želeli določiti pojavnost anteriorne drže glave pri otrocih, ki se ukvarjajo s športom, in preučiti razlike pri kraniovertebralnem kotu glede na spol, starost, bolečine v vratu in šport, s katerim se ukvarjajo.*

Metode: *Med 154 otroki (76 moškega in 78 ženskega spola), starimi med 11 in 14 let, ki se ukvarjajo z različnimi športi (košarka, nogomet, odbojka in atletika), smo izvedli presečno študijo. Ko smo prejeli pisna soglasja, smo posneli fotografije sredinske ravnine v stoječem položaju, ki smo jih nato uporabili za merjenje kraniovertebralnega kota s pomočjo programske opreme Web Plot Digitizer. Z vprašalnikom smo zbrali podatke o spolu, starosti, izbranem športu, prisotnosti bolečin v vratu in lestvici bolečine.*

Rezultati: *Anteriorno držo glave smo odkrili pri 37 (24,03 %) od 154 otrok, in sicer pri 15 otrocih moškega in 22 otrocih ženskega spola. Povprečen kraniovertebralni kot za celoten vzorec je bil 51,30° ± 6,20°. Pri subjektih ženskega spola smo odkrili znatno manjši kraniovertebralni kot ($p = .021$) v primerjavi s subjekti moškega spola. Starost, prisotnost bolečin v vratu in udejstvovanje v različnih športih niso dali statistično pomembnih razlik.*

Zaključek: *Anteriorna drža glave je prisotna med otroki, ki se ukvarjajo s športom, pri čemer je večja pojavnost značilna za ženski spol.*

Ključne besede: *anteriorna drža glave, kraniovertebralni kot, otroci, fizična aktivnost, šport, 11–14 let*

INTRODUCTION

Good posture is defined as a musculoskeletal balance that creates a minimal amount of stress and strain on the body (Yip, Chiu & Poon, 2008). Good posture in the sagittal plane implies that a vertical posture line passes slightly in front of the ankle joint and the center of the knee joint, slightly behind the center of the hip joint, through the shoulder joint, and through the external auditory meatus (Haughie et al., 1995, as cited in Yip et al., 2008). While desirable, many people do not possess good posture (Shaghayeghfard, Ahmadi, Maroufi, & Sarrafzadeh, 2016). Inadequate posture leads to shortening and tension in the muscles, which leads to difficult movements in the joints (Westcott, 1997, as cited in Ruivo, Pezarat-Correia, & Carita, 2014), and it is often accompanied by pain (Ruivo et al., 2014).

FHP is the most common cervical postural fault in the sagittal plane (Mahmoud, Hassan, Abdelmajeed, Moustafa, & Silva, 2019). Prevalence data indicate that the incidence of FHP can be as high as 63% in a elementary school students (Verma, Shaikh, Mahato, & Sheth, 2018). FHP is defined as "any alignment in which the external auditory meatus is positioned anterior to the plumbline through the shoulder joint" (Peterson-Kendall, 2005, as cited in Shaghayeghfard et al., 2016). It is characterized by the hyperextension of the upper part of the cervical spine (C1–C3) and flexion of the lower part of the cervical spine (C4–C7) (Ruivo, Pezarat-Correia, & Carita, 2017). Considering its location and the fact that the head constitutes 6% of total body weight, disrupting its position can result in various musculoskeletal problems, most often in the neck, shoulder joint, chest, and upper extremities (Szczygieł, Waśniowski, Chmiel, & Golec, 2022).

FHP can cause various issues and conditions. Neck pain due to FHP is a frequently researched problem, with several studies proving that increased FHP leads to neck pain in adults (Kim, Yi, Kwon, Cho, & Yoo, 2008; Mahmoud et al., 2019; Yip et al., 2008); whereas, in the review study by Mahmoud et al. (2019), no connection was found between FHP and neck pain in adolescents. FHP affects muscles around the head and shoulders, including the trapezius, sternocleidomastoideus, suboccipital, and temporal, which can cause persistent pressure in the muscles, fascia, and nerves of the neck and shoulders (Lee, 2016). It also leads to limited neck mobility (Fernández-de-las-Peñas, Alonso-Blanco, Cuadrado, & Pareja, 2006; Sarig Bahat, Levy, & Yona, 2023).

Furthermore, persistent tension in the head and posterior neck muscles can lead to tension headaches (Lee, 2016). A systematic review by Elizagaray-Garcia, Beltran-Alacreu, Angulo-Díaz, Garrigós-Pedrón and Gil-Martínez

(2020) demonstrated that individuals with chronic primary headaches exhibit greater FHP. FHP is also associated with changes in the thoracic shape and reduced respiratory function (Koseki, Kakizaki, Hayashi, Nishida, & Itoh, 2019), decreased cervical proprioception (Ha & Sung, 2020), increased muscle activity (Alowa & Elsayed, 2021; Nishikawa et al., 2022), and increased muscle fatigue (Nishikawa et al., 2022).

It was found that even professional athletes tend to have postural disturbances and/or spinal curvature disorders (Zwierzchowska, Gaweł, Maszczyk, & Roczniok, 2022). A study conducted by Grabara (2020) found that volleyball training affects the alignment of the pelvis, shoulder girdle, and scapulae. Furthermore, Xing and Popik (2020) reported that both volleyball and basketball could negatively impact the body posture of adolescents. Certain sports pose risks to children, such as football, where head impacts may affect cognitive function in adolescents (Zhang, Red, Lin, Patel, & Sereno, 2013). In the United States, regulations prohibit heading the ball for children under 11 years old, while those aged 12–13 are limited to 15–20 headers per week (US Club Soccer, 2016). However, there are no studies on the impact of repetitive movements associated with heading the ball on the development of FHP.

Assessing upright posture in children and adolescents might be an effective tool for identifying and preventing the early development of musculoskeletal issues (Lafond, Descarreaux, Normand, & Harrison, 2007). One objective way to assess FHP is by measuring the CVA. It is the angle between a horizontal line passing through the spinous process of the 7th cervical vertebra and a line from the spinous process of the 7th cervical vertebra through the tragus of the ear. It can be measured while the subject is sitting or standing, with research recommending measurement while the subject is standing (Shaghayeghfard et al., 2016). CVA values below 48°–50° indicate the presence of FHP (Shaghayeghfard et al., 2016).

Although studies on FHP in children have been carried out, most focused on samples of schoolchildren (Batistão, Moreira, Coury, Salasar, & Sato, 2016; Chandoliya, Chorsiya, & Kaushik, 2021; Dolphens et al., 2012; Ruivo et al., 2014, 2017; Szczygieł et al., 2022; Verma et al., 2018; Wiguna et al., 2019), with only one study examining FHP in children that participate in sports (Guedes & Amado João, 2014). Sports are important for children and young adults to achieve their recommended level of physical activity. The World Health Organization (2020) states that children and youth aged 5–17 should accumulate at least 60 minutes per day of moderate to vigorous intensity, mostly aerobic physical activity, across the week, including activities that strengthen the

muscles and bones, at least three times per week. Alongside all the benefits of participating in sports, studies have shown that children who engage in sports have better posture than those who do not (Kasović, Štefan, Piler, & Zvonar, 2022).

The purpose of this study was to determine the prevalence of FHP among children participating in sports and to examine differences in CVA values concerning gender, age, presence of neck pain, and sports they engage in.

METHODS

Sample

A total of 154 sports-involved children (76 males and 78 females) were included in this cross-sectional study, aged between 11–14 (12.42 ± 1.06 years old), from Novi Sad, Serbia. All participants were involved in sports: 55 (35.7%) football players, 43 (27.9%) basketball players, 28 (18.2%) volleyball players, and 28 (18.2%) track and field athletes. All participants had at least three training sessions per week. Thirty-two participants (20.80%) reported neck pain, with a neck pain score of 4.22 ± 1.77 on a scale of 1–10. Signed consent from parents was required for each participant to take part in the study.

Sample of measuring instruments

Head posture was measured using CVA. The CVA is the angle between the horizontal line passing through the 7th cervical vertebra (C7) and a line extending from the tragus of the ear to C7. A lower CVA indicates a greater degree of head protrusion, with a value below 48°–50° signifying the presence of head protrusion (Shaghayeghfard et al., 2016). In this study, participants with a CVA of 48° or less are identified as having FHP. For photographing the athletes, a mobile phone was mounted on a tripod at a height corresponding to the participant's shoulder level. The mobile phone was mounted at a distance of 1.5 meters from the participants. A marker (a sticky, reflective ball) was placed on the participant's skin at the level of the 7th cervical vertebra. The participants were asked to stand sideways with their feet just wider than hip distance. To achieve a neutral, self-balanced neck posture, participants were asked to perform three movements of flexion and extension of the head and neck with

a full range of motion, after which they were asked to assume the most natural position for the head and neck (Shaghayeghfard et al., 2016). After that, a photograph of the participant's right side was taken. Photographs were transferred to a PC and analyzed using *Web Plot Digitizer* software, which was used to measure the CVA. The use of this software for clinical analysis of the CVA was assessed as an effective, simple, and accessible method (Mani, Sharma & Singh, 2018), with excellent intra-rater reliability with ICCs ranging from 0.92 to 0.99 (Muniandy, Singh, Mani, & Omar, 2019).

Also, a questionnaire was used to gather the following data about participants: gender, age, sport in which they are involved, presence of neck pain, and pain scale.

Study design

This cross-sectional study was conducted from August to September 2023. Measurements were taken in sports facilities where athletes train, during training sessions, by a kinesitherapist trained to perform this procedure.

Statistical analysis

The statistical analysis was done using SPSS software (SPSS 26.0, IBM Inc., Chicago, IL, USA). The Shapiro-Wilk test of normality was performed to assess the distribution of the data. An independent-sample t-test was conducted to examine the differences in CVA based on gender in different sports, between genders regardless of engagement in sports, and between participants with and without neck pain. A one-way ANOVA was used to assess differences in CVA concerning the participants' ages and the sports they engage in.

RESULTS

The results of the Shapiro-Wilk test indicated that all the variables, except for the CVA, were not normally distributed.

The prevalence of FHP according to different sports is shown in Figure 1. Among the 154 participants observed, 37 (24.03%) exhibited FHP. Specifically, FHP was observed in 9 basketball players (6 males and 3 females), 16 football

players (6 males and 10 females), 8 volleyball players (2 males and 6 females), and 4 track and field athletes (1 male and 3 females).

Table 1. CVA according to gender and engagement in different sports

Sport	Male		Female		*p*
	n	CVA (°) (mean ± SD)	n	CVA (°) (mean ± SD)	
Basketball	23	50.60 ± 6.02	20	52.16 ± 4.14	.335
Football	31	53.32 ± 7.43	24	48.41 ± 5.39	.009
Volleyball	15	55.20 ± 7.17	13	47.80 ± 5.09	.005
Athletics	7	48.96 ± 6.87	21	51.74 ± 4.10	.203

Legend: n – number; CVA – craniovertebral angle; $p \leq 0.05$

The mean CVA for the entire sample was 51.30° ± 6.20°. Table 1 presents the results of the independent-sample t-test for CVA according to gender in different sports. Among male participants, track and field athletes had the lowest mean CVA of 48.96° ± 6.87°, followed by basketball players with 50.60° ± 6.02°, football players with 53.32° ± 7.43° and volleyball players with the highest CVA of 55.20° ± 7.17°. On the other hand, among female participants, volleyball players had the lowest CVA of 47.80° ± 5.09°, followed by football players with 48.41° ± 5.39°, track and field athletes with 51.74° ± 4.10° and basketball players with the highest CVA of 52.16° ± 4.14°. There was a significant difference between male and female participants in football ($p = .009$), and volleyball ($p = .005$), with female participants showing lower CVA values.

The findings from the independent-sample t-test for CVA, according to gender and the presence of neck pain, are presented in Table 2. A statistically significant difference was observed in CVA between male participants (52.47° ± 7.08°) and female participants (50.16° ± 5.00°) ($p = .021$). However, no significant difference was found concerning neck pain ($p = .986$). Participants with neck pain had a mean CVA of 51.32° ± 4.68°, while those without neck pain had a mean CVA of 51.30° ± 6.55°.

Table 2. CVA according to gender and presence of neck pain

		CVA (°) (mean ± SD)	*p*
Gender	Male (n=76)	52.47 ± 7.08	.021
	Female (n=78)	50.16 ± 5.00	
Neck pain	No (n=122)	51.30 ± 6.55	.986
	Yes (n=32)	51.32 ± 4.68	

Legend: n – number; CVA – craniovertebral angle; $p \leq 0.05$

Table 3. CVA according to engagement in different sports and age

		CVA (°) (mean ± SD)	*p*
Sport	Basketball (n=43)	51.32 ± 5.23	.974
	Football (n=55)	51.18 ± 7.00	
	Volleyball (n=28)	51.76 ± 7.23	
	Athletics (n=28)	51.04 ± 4.94	
Age	11 (n=38)	51.84 ± 6.70	.437
	12 (n=43)	50.00 ± 5.56	
	13 (n=44)	51.98 ± 5.56	
	14 (n=29)	51.48 ± 7.29	

Legend: n – number; CVA – craniovertebral angle; $p \leq 0.05$

The results of the one-way ANOVA for CVA, according to engagement in different sports and the age of the participants, are shown in Table 3. No significant differences in CVA with regard to sport were found ($p = .974$). Track and field athletes exhibited the lowest CVA (51.04° ± 4.94°), followed by football players (51.18° ± 7.00°) and basketball players (51.32° ± 5.23°), while volleyball players had the highest CVA (51.76° ± 7.23°).

No significant differences were found concerning the age of the participants ($p = .437$). Participants aged 12 years had the lowest CVA (50.00° ± 5.56°), followed by those aged 14 years (51.48° ± 7.29°) and participants aged 11 years

(51.84° ± 6.70°), while the participants aged 13 years had the highest CVA (51.98° ± 5.56°).

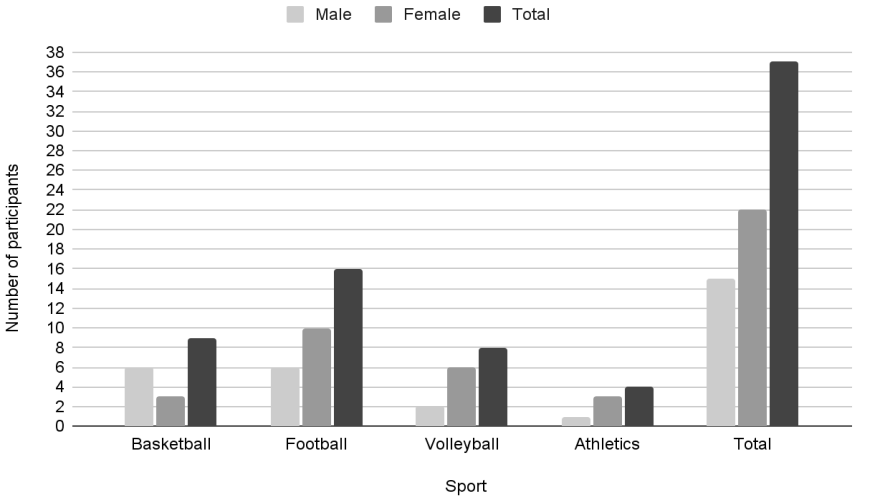

Figure 1. Prevalence of FHP according to engagement in different sports

DISCUSSION

The purpose of the current study was to determine the prevalence of FHP in children involved in sports. Additionally, the study aimed to examine differences in CVA based on gender, age, presence of neck pain, and the sports in which they participate. The results indicated that the mean CVA for the total sample was 51.30° ± 6.20°, while 24.03% of participants exhibited FHP. Studies by Kang and Lin (2023) and Veseta, Upeniece, Onzevs, Liepina, and Lice (2020) concluded that a low level of physical activity has no effect on head posture in young adults. However, the results of the present study significantly differ from those reported in previous studies on the population of schoolchildren. In these studies, it was found that 53.5% (Batistão et al. 2016), 63% (Verma et al. 2018), and 51.78% (Wiguna et al. 2019) of participants exhibited FHP. This could be due to the frequency and intensity of their physical activity. Children who are involved in sports have more intense and regimented physical activity compared to those who only participate in physical education classes or engage

in free play. This assumption is confirmed by the study of Guedes and Amado João (2014), who found that adolescent basketball players have a significantly higher CVA than adolescents who only participate in curricular physical activities up to twice a week.

Generally, female participants exhibited significantly lower CVA compared to males ($p = .021$). Specifically, female football players and volleyball players showed significantly lower CVA values than their male counterparts ($p = .009$ and $p = .005$, respectively) Additionally, a greater number of females (22) exhibited FHP compared to males (15). These results confirm the findings of Verma et al. (2018), who found that FHP is more prevalent among female students (71.1%) compared to male students (55.7%). Studies by Ruivo et al. (2014) and Anand, Singhal, Kulshrestha, and Raj (2021) also found that females had a lower CVA. Ruivo et al. (2014) attribute that to psychosocial problems, such as stress, or the development of secondary sex characteristics in females.

No significant differences were observed in CVA concerning the age of the participants ($p = .437$). Shaheen and Basuodan (2012) also did not find significant differences in CVA regarding the age of the participants, with CVA being nearly the same for children aged 7 to 8 years and those aged 8 to 9 years. A study conducted by Batistão et al. (2016) found that the prevalence of FHP was higher in the 13–15 age group compared to the 6–9 and 10–12 age groups. Although there was a study that found that FHP progresses with age, it was conducted on elderly women (Nemmers, Miller, & Hartman, 2009).

There were no significant differences in CVA based on the presence or absence of neck pain ($p = .986$). Interestingly, the neck pain group showed higher CVA (51.32° ± 4.68° in the neck pain group, compared to 51.30° ± 6.55° in the group without neck pain), but it is not significant ($p = .986$). These findings correspond to the findings of Cheung, Shum, Tang, Yau, and Chiu (2010), who also found that adolescents with neck pain have higher CVA values (60.03° ± 9.05°) compared to adolescents without neck pain (57.10° ± 5.00°). Contrary to this, Ruivo et al. (2014) found lower CVA values in adolescents with neck pain (46.46° ± 5.60°) compared to those without neck pain (47.96° ± 4.79°). However, a systematic review by Mahmoud et al. (2019) confirms the findings of the present study that there is no association between FHP and neck pain in adolescents. It is worth mentioning that an increase of 1° in CVA has a 9.5% decrease in the odds of needing medical help for neck pain (Dolphens et al., 2012).

There were no significant differences in CVA relating to the sports in which participants were involved ($p = .974$). A recent study by Snodgrass, Ryan, Miller, James, and Callister (2021) examining football players aged 18.3 ± 3.3 years reported that 60.3% of players exhibited FHP, a finding somewhat consistent

with the present study. The relatively lower CVA value and a higher number of participants with FHP observed in football players may be attributed to their frequent downward gaze at the ball, particularly among youth players, leading to neck flexion. Conversely, volleyball players demonstrated the highest CVA values, possibly due to the predominantly overhead nature of volleyball, where players direct their gaze forward or upward at the ball. Basketball players had similar results (51.32 ± 5.23) to what Guedes and Amado João (2014) found (51.45 ± 5.33 on the right and 52.54 ± 5.79 on the left side) for CVA values in male adolescent basketball players. However, the existing research does not provide sufficient evidence to establish whether head posture varies across different sports or if sports participation significantly impacts head posture.

Study limitations and future research

The study did not consider the duration of children's engagement in sports. Additionally, data regarding the height and weight of the participants were not collected. Furthermore, the participants' posture may have been influenced by the awareness that they were being watched, but this problem seems to be difficult to avoid. Future research endeavors may consider incorporating longitudinal designs to capture the dynamic nature of postural changes over time, and collect comprehensive anthropometric data, including height and weight, to provide a more nuanced understanding of the relationship between body composition and head posture.

CONCLUSIONS

The study revealed that FHP was observed in 24.03% of children engaged in sports, with a higher prevalence among females. Furthermore, no significant differences were identified in CVA based on the specific sports in which participants were involved. Regular posture assessments and active participation in sports are crucial factors in cultivating good posture among children. These insights, particularly the higher susceptibility of females to head and neck postural disorders, underscore the importance of targeted interventions and awareness campaigns. Future research endeavors should explore tailored interventions aimed at enhancing posture in children, taking into consideration gender-specific factors and the impact of different sports.

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HOW TO CREATE A NATIONAL SPORT STRATEGY: A SUBSTANTIVE AND METHODOLOGICAL PERSPECTIVE

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ABSTRACT

***Purpose**: Due to its numerous positive effects on individuals and society as a whole, sport has become an important socio-economic subsystem of the national environment. To regulate, develop, and monitor the impact of sport at national, regional, and local levels, countries often develop and adopt various strategic documents, which can be found under the name of national program or strategy for sport development at the national level. Due to the importance of understanding the substantial comprehensiveness of national sports strategies (NSS) and the precision of the methodological-processual approach, the purpose of the present paper is to present a methodological and substantive view of the process of creating NSS and to develop a comprehensive concept (model) that appropriately places the substantive part in the phases of the process.*

***Method**: The methodology of writing conceptual research papers was used. This approach provides a bridge or link between different concepts and scientific disciplines. The methodological approach was the "model paper" which aims to provide a theoretical framework that predicts relationships between concepts. A model paper identifies connections between constructs and introduces new constructs.*

***Findings:** The development of the substantive model for the preparation of the NSS revealed that the comprehensive sport system at the national level can be understood within the framework of five substructures (financial, organizational, developmental,*

material, and program) that contribute significantly to the development and implementation of activities related to sport and physical activity. They are interconnected and interdependent and are surrounded by a so-called integrity framework that protects the sport system from the deviations of modern society. The methodological process model reveals that for the implementation of the process of NSS preparation, the most appropriate is the strategic management methodology, which enables accurate and efficient management of planning, organization, implementation, and control of the NSS. The combination of both perspectives (substantive and methodological) enables the development of a comprehensive concept (model) of NSS preparation.

Conclusions: *The developed concept (model) of the NSS preparation comprehensively covers the issue of the NSS preparation management and is dialectical, open, flexible, and repeatable, enabling future users to manage the NSS preparation in a substantive-holistic and process-effective manner.*

Keywords: *Methodological perspective, national sport strategy, preparation, substantive perspective.*

KAKO OBLIKOVATI NACIONALNO ŠPORTNO STRATEGIJO: VSEBINSKI IN METODOLOŠKI POGLED

IZVLEČEK

Namen: *Šport je zaradi številnih pozitivnih učinkov na posameznika in družbo kot celoto postal pomemben družbenoekonomski podsistem nacionalnih okolij. Za urejanje, razvoj in spremljanje učinkov športa na nacionalni ravni, države pogosto pripravljajo in sprejemajo različne strateške dokumente, ki jih imenujejo nacionalni program oziroma strategija razvoja športa na nacionalni ravni. Zaradi pomembnosti razumevanja vsebinske celovitosti nacionalnih strategij športa (v nadaljevanju: NŠS) in natančnosti metodološko-procesnega pristopa je namen prispevka predstaviti metodološki in vsebinski pogled na proces oblikovanja NŠS in razviti celovit koncept (model), ki bo vsebinski del ustrezno umestil v faze procesa.*

Metoda: *Uporabljena je bila metodologija pisanja konceptualnih raziskovalnih člankov. Ta pristop zagotavlja povezavo med različnimi koncepti in znanstvenimi disciplinami. Metodološki pristop je bil »razvoj modela«, ki poskuša zgraditi teoretični okvir, ki napoveduje odnose med koncepti. »Razvoj modela« opredeljuje povezave med konstrukti in uvaja nove konstrukte.*

Ugotovitve: *Razvoj vsebinskega modela za pripravo NŠS je pokazal, da je celovit sistem športa na državni ravni mogoče razumeti v okviru petih podstruktur (finančne, organizacijske, razvojne, materialne in programske), ki pomembno prispevajo k razvoju in izvajanju dejavnosti, povezanih s športom in telesno aktivnostjo. Podstrukture so med seboj povezane in soodvisne ter obdane z integritetnim okvirom, ki varuje športni*

sistem pred deviacijami, povezanimi s sodobno družbo. Metodološko-procesni model razkriva, da je za izvajanje procesa priprave NŠS najprimernejša metodologija strateškega menedžmenta, ki omogoča natančen in učinkovit management načrtovanja, organizacije, izvajanja in nadzora NŠS. Povezava obeh vidikov (vsebinskega in metodološkega) omogoča razvoj celovitega koncepta (modela) priprave in uveljavitve NŠS.

Zaključek: *Razvit koncept (model) priprave NŠS celovito pokriva problematiko menedžmenta priprave NŠS ter je dialektičen, odprt, fleksibilen in ponovljiv. Prihodnjim uporabnikom omogoča, da pripravo NŠS vodijo vsebinsko celostno in procesno učinkovito.*

Ključne besede: *metodološki pogled, nacionalna strategija športa, priprava, vsebinski pogled.*

INTRODUCTION

Sport has many definitions and can be defined in different ways, depending on the different views and orientations of the author of the definition (Hudson, 2003). However, no definition of sport is so complete that it does not leave out some important function of sport. In 1992, the Committee for the Development of Sport at the Council of Europe adopted the European Charter on Sport, which defines the key principles regarding the general development of sport. This document provides a definition of sport that often appears in the strategic guidelines of different national government documents and defines sport as: "*all forms of physical activity, the purpose of which, through occasional or regular participation, is to express or improve physical fitness and mental well-being, create social relationships or obtain results in competitions of all levels*" (Council of Europe, 1992).

Sport enriches the quality of peoples' lives and has an important influence on society through its various impacts. Sport can be understood as a social, economic, and media phenomenon (Larive, 1994; De Knop et al., 1996). Its role and position in society are contingent upon the level of societal needs development, the perceived value attributed to sporting activities, and the prevailing social attitudes towards them (Tušak & Tušak, 2001). The social role of sport is based on the scientific evidence on the significance of sport for health (physical, mental, and social), socialization and economy (Vuori et al., 1995). Sports activity has various functions and goals, such as winning a competition, learning sports skills, relaxation, maintaining health, rehabilitation, generating financial income, entertainment and, above all, a way of life that contains the substantive concept of "*quality of life*" (Chelladurai, 1992; De Knop et al., 1996). Among the most important functions or goals of sport are those that represent benefits on the most general level: such as physical, mental, social, and material.

In developed countries, lifestyle changes have led to increased subcutaneous fat (Strel, Kovač, & Jurak, 2004), a greater proportion of overweight people (Currie et al., 2004; Wedderkopp et al., 2004; Ng et al., 2014), and reduced physical capabilities, particularly in terms of endurance and strength (Beunen et al., 1992; Boreham & Riddoch, 2001; Craigie et al., 2009). According to the Global Obesity Observatory (Lobstein et al., 2023) in 2020 more than 2.6 billion people were overweight (BMI ≥ 25 kg/m2) and 0.99 billion people were obese (BMI ≥ 30 kg/m2), accounting for 38% of the global population. Global estimates indicate that by 2035, more than 4 billion people will be overweight or obese (BMI ≥ 25 kg/m²), accounting for over 50% of the world's population. The rising prevalence of obesity is also expected to be steepest among

children and adolescents (ages 5 to 19 years old), ranging from 10% to 20% of the global boy's population and from 8% to 18% of the girl's population from 2020 to 2035. The study by Craigie et al. (2009) provides good evidence that 12-year-olds classified as overweight or obese according to their BMI had more than a 4 times higher risk of becoming obese by the age of 33 than their normal-weight counterparts. Projected figures for the economic impact of overweight and obesity show that the $1.96 trillion cost in 2020 will increase to more than $4 trillion in 2035, based on constant US$ value. Here, the economic impact includes both medical costs of treating obesity and its consequences and the impact of a high BMI on economic productivity, to which a high BMI contributes absenteeism, presenteeism (reduced productivity during work) and early retirement or death. The economic impact is estimated to reduce global gross domestic product (GDP) by 2.4%, rising to 2.9% by 2035, which is comparable to the impact of COVID-19 on the global GDP shrinking in 2020. The problem of an overweight population is most acute in the entire American region (32% of men and 37% of women) and in the European region (26% of men and 28% of women). These trends highlight risk factors for cardiovascular diseases, which are one of the most common causes of mortality.

An additional economic risk is represented by the demographic characteristics of the developed world (Zubiashvili & Zubiashvili, 2021). For example, the shape of the demographic pyramid of the European Union can be described as a "constrictive pyramid", which is characteristic of developed societies with low birth and death rates and a relatively elderly population. The population aged 15–65 represents almost two thirds (63.9%) of the total population, while more than one-fifth (21.1%) of the total population is over 65 years of age. Children up to 14 years old represent only 15% of the population. Trends show accelerated population aging and much longer life expectancies in the future (EUROPOP, 2023). The above indicates a triple risk effect on future public financial expenditures. We can expect (1) higher expenditures from pension funds, (2) lower revenues to state budgets (less active population), and (3) higher public costs related to the health risk of the elderly population.

Even more worrying is the fact that a sedentary lifestyle and increasingly prolonged periods of physical inactivity are insidiously and aggressively taking over modern people's lives – at school, at work, at home, and even during leisure time. It may be difficult for many to comprehend and accept, but physical inactivity is becoming the foremost and most significant threat to health in today's society (Pišot, 2022).

The connection between physical activity in general and health is well documented in number of studies (Cabane & Lechner, 2015; Humphreys et al.,

2013; Marques et al., 2020; World Health Organization, 2018). Kohl and Cook (2013) state that physical inactivity is a key determinant of health across the lifespan and that a lack of activity increases the risk of heart disease, colon and breast cancer, diabetes mellitus, hypertension, osteoporosis, anxiety, depression, and others diseases. The positive impact on individuals directly expands to economic and social conditions of the community: for example, lower total healthcare costs generated at the state level (Coughlan et al., 2021; Prudky, 2022). Sports participation also has a positive association with the *subjective wellbeing* of the population, as measured by happiness (Downward & Rasciute, 2011). Given that sport has different functions and goals, different sports activities and programs (elite sports programs, developmental sports programs, sports programs for everyone, etc.) have also been developed, which are adapted to fulfil these functions and goals of the participants. One of the key functions of elite sports is the *promotion of the country and the nation*; sport is an important factor in *national identity and national identification* (Kovač et al., 2004). In the 20th century, national identification found new means of expression, with sports and mass media playing a key role. Major sporting events, such as the Olympic Games and World Championships, help individuals become aware of their membership in the nation-state (Hobsbawm, 1993). Public expenditures on high-performance sport are typically justified on the grounds that successes in elite sports produce such virtuous outcomes as the "feel good effect" and enhanced *national pride*, a positive *national image abroad*, and increased *sports participation among citizens* (Grix & Carmichael, 2012). Kolar (2010) found that all effects – both those that measure *quantitative growth* (e.g., the number of athletes in national competition systems, the share of the population active in sports) and those that measure *qualitative development* (e.g., the number of medals at major international competitions) – of sports are statistically significantly related to each other, either directly or indirectly. An analysis of the connections between the effects shows the extreme importance of holistic treatment and simultaneous public investment in all aspects of the growth and development of the field of sports (Škorić & Obadić, 2022). The analysis also showed that the growth and development of the qualitative and quantitative effects of sports activity are explained to a large extent by all aspects of *sports financing* (public and private expenditures), which are positively correlated. Furthermore, each euro of public financial expenditure stimulates an additional 5 euros of private expenditure on sports products and services (Jurak, Bednarik, Kolenc, & Kolar, 2010). Nazarov, Kalantarly, Hajiyev, Hasanova, and Hashimova (2023) argue that the global sports industry is valued between

400 and 500 billion US$, experiencing an annual growth of 6–8%. It has become a significant source of revenue for state and local budgets.

Sport, owing to its many positive effects on both individuals and society, has become an important socio-economic subsystem of national environments. To regulate, develop, and monitor the effects of sports at the national, regional, and local level, states often develop and adopt various strategic documents. These are often known as national programs (e.g., Slovenia, Croatia, Ireland) or strategies (e.g., Australia, United Kingdom) for the development of sport at the national level. The documents define different development time periods, but in principle the applied strategic period is defined between eight (e.g., Croatia) and ten years (e.g., Slovenia, Australia). National sport strategies (NSS) usually address sport comprehensively, and in this way emphasize the intertwining of sport with various socio-economic areas (e.g. healthcare, education, economy, environment, tourism, culture, and transportation). Therefore, they define strategic goals and measures that integrate sports with other social areas, because only in this way can they ensure the conditions for the comprehensive development of sports, physical activity, and promoting a healthy lifestyle among citizens. NSS are intended primarily for public, state, regional and local administrations, educational organizations at all levels, non-governmental sports organizations in the entire hierarchy, and are of a principled, orientational, and political nature.

In accordance with what was stated in the introductory chapter, the purpose of this paper is to present a conceptual framework of creating NSS. The subsequent sections will initially establish sport as a public good, serving as the essential foundation for public funding of sports and physical activities. Then, the content and methodological elements of the NSS will be defined.

RESEARCH DESIGN AND METHOD

We adopted the methodology proposed by Gilson and Goldberg (2015) for writing a conceptual paper, aiming to establish a connection between distinct concepts and scientific disciplines like public affairs, strategic management, and kinesiology. The method approach used was the “model paper” approach, which seeks to construct a theoretical framework that predicts relationships between concepts, identify connections between constructs, introduce new constructs, or explains why elements of a process lead to a particular outcome (Jaakkola, 2020).

Through a literature review, we have defined five key aspects: (1) the risks associated with contemporary lifestyles and the undeniable positive impact of sport and physical activities on both individuals and society as a whole, (2) the significance and relevance of NSS for nations, (3) the role of sport as a public good, (4) the essential components of NSS design, and (5) the utilization of strategic management methodologies and tools in the preparation of NSS. In the end, everything is connected in a comprehensive conceptual framework.

SPORT AS A PUBLIC GOOD

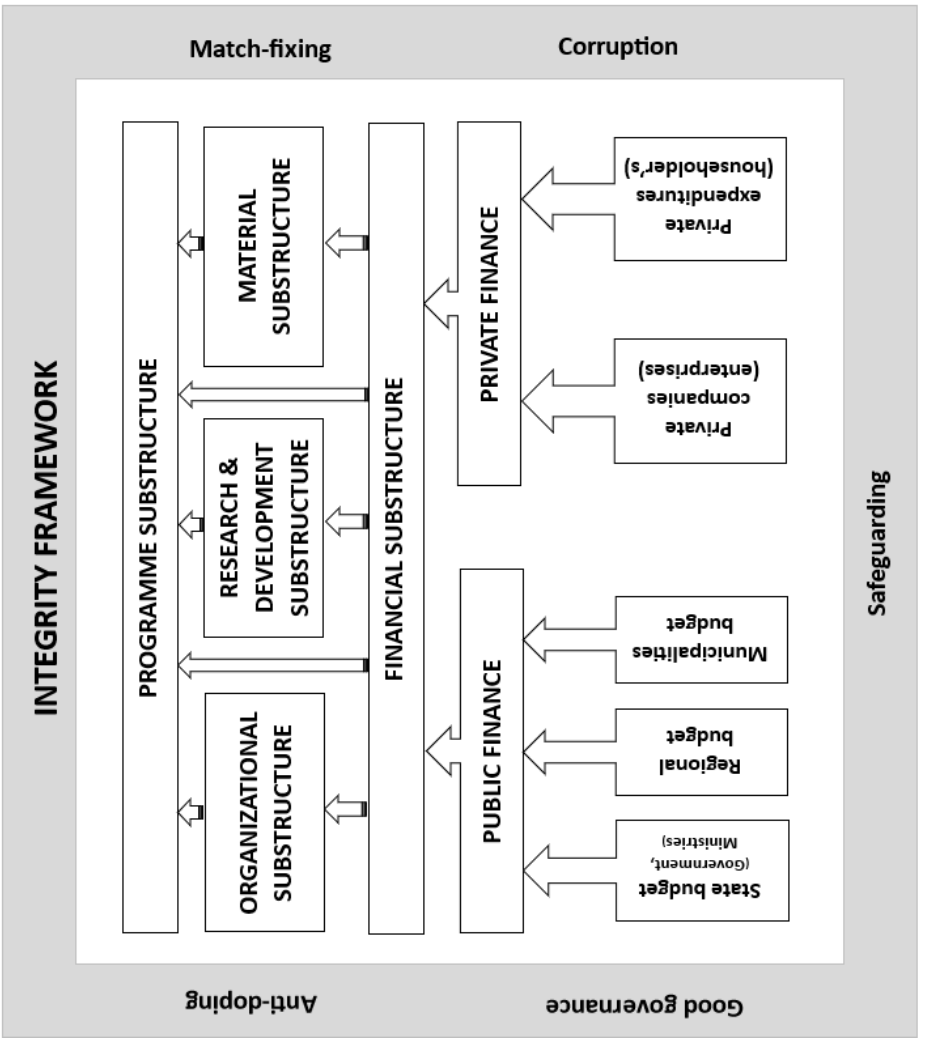
Since the benefits of sport for society are greater than the benefits for the individual (the person who is involved in sport), sport is classified as a *public good* and is therefore in the *public interest*. According to Andrijašević (1999), a public good is an economic activity that more or less contributes to the well-being of each individual and society as a whole. Public goods are characterized by the *principle of non-competition* in consumption, which means that when an individual consumes a good, this does not hinder others from consuming the same good. For public goods is also characteristic *principle of in-eliminability*, which states that the consumption of the good cannot be disabled or prohibited; i.e., it is not possible to limit the benefits of the commodity to only a select group of individuals. The state (government) solves the problem of in-eliminability by collecting enough money through taxes to co-finance the optimal amount of public goods. There is a public interest in the provision of such goods, which ensures public financing. Examples of such goods include healthcare, education, and social insurance services. The inclusion of these goods in public financing can be explained by the *paternalism* of the state, where the state decides what is good for its citizens, and *specific egalitarianism*, whereby the state opposes too much social stratification in the provision of these goods and therefore provides them through the public sector (Kolar, Bednarik, Jurak & Rajšter, 2010). The paternalistic aspect is understood as the state's legitimate attempt to influence people's behavior with the intention that their decisions will improve their lives and that these people's lives will be longer, healthier, and better (Thaler & Sunstein, 2022). through these efforts, the state endeavors to encourage people to engage in sports and make productive use of their free time, thereby promoting better health, productivity, and resilience against the adverse effects of modern society, such as sedentary lifestyle, substance abuse, crime, and excessive digital media consumption. These are functions of sport that are beneficial for society as a whole. Athletes and sports professionals

working in the field of sports are primarily concerned with the accessibility and affordability of sports, rather than the source of funding. State co-financing ensures that sports are more affordable and thus more accessible (Bednarik, Simoneti, Kolenc, & Šugman, 2000). Several authors have also demonstrated the positive impact of governmental (public) funding of sports on performance in international competitions (Škorić & Obadić, 2019; 2022; Pauna, Pintea, Lazar, & Maiar, 2020), as well as on life expectancy and population health (Pauna et al., 2020). For all the above reasons, sports represent a public good should therefore be co-financed from public finances at all levels; national, regional, and local.

THE CONTENT PERSPECTIVE OF NATIONAL SPORT STRATEGIES

The content perspective of the NSS is related to those segments of the comprehensive structure (system) of sports that have a significant impact on its growth and development. The entire field of sport can be divided into five substructures of sport (Kolar, Bednarik, Kovač, & Jurak, 2010), which have an important influence on the development of sport in all types of environments (national, regional, local): financial substructure, organizational substructure, research and development substructure, material substructure, and program substructure. Figure 1 shows the five substructures, as well as their interconnections, influences, and interdependencies.

Figure 1: Comprehensive sport structure (system) and its substructures (substantive perspective)



Financial substructure

One of the fundamental substructures of the sports system is the financial substructure, which consists of *public* (state, regional, municipality or local budget expenditures) and *private expenditures* (private company and household expenditures) for sports and physical activity. The financial substructure provides the basic conditions for the implementation of sports activities by providing financial resources for the operation of all other substructures or subsystems of sports. The presented comprehensive financial substructure of sports is consistent with the European model of sports financing, developed by Andreff et al. (1994; 2009) which enables a comparison of the shares and scope of public financial expenditures for sports between individual countries. The average structure of the European model of sports finance consists of 36.2% public expenditures (government sports budget: 11.9%; local authorities' sport budget: 24.3%) and 63.8% private expenditures (household expenditures: 49.7%; company expenditures: 14.1%) for sports and related activities (Eurostat, 2022). In 2021, public expenditures across the EU on recreational and sporting goods and services amounted to €56 billion or 0.7% of the gross domestic product (GDP). The highest shares of expenditure on recreational and sporting services in GDP were recorded in Hungary (1.8%), Estonia (1.6%), the Netherlands and Sweden (both 1.2%), and Luxembourg (1.1%), and, among EFTA countries, in Iceland (3.3%). The lowest shares in total expenditure were observed in Ireland (0.3%), and Slovakia (0.4%) (Eurostat, 2022). Public expenditures represent an important part of the means for financing the operation and implementation of sports programs of non-governmental sports organizations (NGOs), but depending on the development of these organizations, they represent different shares in the structure of their revenues. Jurak, Andreff, Popović, Jakšić, and Bednarik (2014) found that the dependence on public financial revenues is highest (31.6% of the revenue structure) in grassroots NGOs, somewhat lower in semi-professional NGOs (27.5% in the revenue structure) and the lowest in professional NGOs (23.6% of the revenue structure). Given that the total average income of grassroots NGOs (median around €3000) is approximately 12 times lower than that of semi-professional NGOs (median around €35,000) and 200 times lower than that of professional NGOs (median around €600,000), it can be inferred that any reduction in public financial revenues would pose a greater threat to the operation of grassroots NGOs (which represent the majority of all NGOs) compared to semi-professional or professional NGOs. The latter obtain the majority of their funds from the market (sales revenues, TV rights, membership fees, sponsorships, etc.) and, due to their professional structures, size and

available resources, are much more flexible and able to find alternative sources of funds than grassroots NGOs. On average, EU countries allocate €124 per year of public funds per inhabitant to activities related to sports and recreation, with large differences between countries (e.g., €302/inhabitant in Sweden and €23/inhabitant in Bulgaria). From an economic perspective, public financial expenditures on the sports market act as a booster and multiplier, as they make sports (mainly the consumption of sports services/programs) cheaper and more accessible, which in turn encourages greater participation of the population and consequently, greater sales of sports products (sports clothes and equipment). The aforementioned has a positive impact on (1) the operations of companies in the sports industry, (2) the financing of sports organizations and (3) the tax inflow into local and national budgets (Jurak et al., 2010; Nazarov et al., 2023).

Organizational substructure

The next important substructure of the sports system is the organizational substructure. A sports organization is a social entity involved in the sport industry; it is goal-oriented, with a consciously structured activity system and relatively identifiable boundary (Eksteen, 2014). The discussion about the structural characteristics of sports organizations has considered various kinds of organizations among those existing in the world of sports: (1) public, private and voluntary organizations; (2) for-profit and non-profit organizations; (3) organizations producing sporting goods; (4) organizations delivering sporting activities; (5) organizations creating competitive sports opportunities and (6) broadcasting sports events as well as many other organizations related to the sports industry (Bednarik et.al., 2013). According to Gómez, Opazo and Marti (2008), sports organizations are all connected to sporting activities, differing in their goals and means, but all serving the overarching mission of promoting and developing sports in society. While public sports organizations (ministries, regions, municipalities, educational institutions, and other public entities) primarily play supportive and regulative roles (financing, providing sports infrastructure, knowledge development and dissemination, and creating regulative formal rules), sports activities (or sports programs) are mainly carried out in the voluntary sector (societies, clubs, national and other sports associations/federations, National Olympic Committees), and partially in private companies (gyms, wellness centers, and ski resorts), as well as in public sports organizations (public sports schools). Gómez et al. (2008) called organizations that primarily deliver sport programs "sport delivery entities" and public organizations

"sport governing bodies". Public and voluntary sports organizations are mainly non-profit organizations, while the private ones are mostly for-profit organizations. The main task of the national sport organizational substructure is to establish and develop an organizational structure that enables (1) the implementation of all forms of *sports activities* (programs), (2) the designing and organizing of *national competition systems*, (3) *integration* into the international sports environment (European and international sport federations), (4) the *establishment of general conditions* for the development of sports in the country and (5) *promotion* of sport and physical activity.

Research and development substructure

The research and development substructure is the substructure of the comprehensive system of sport that enables (1) the achievement of a national sporting competitive advantage in the international sporting arena, (2) ensures the humanization and greater safety of sporting activities, (3) increases the quality of work with athletes and the physically active population in sport activities and (4) enables the monitoring of the effects of sport on individuals and society as a whole through the development and use of information and communication technologies. The main tasks of the research and development substructure are therefore related to (1) the comprehensive development of *knowledge* in the field of sports, which is in the narrower sense related to the education, training, and licensing of experts working in various sports professions and, in a broader sense, to perform research work that enables the development of new methods and approaches in ensuring excellence at the applied level. The research and development substructure is also responsible for (2) the establishment of an *information system* that enables the collection, processing and evaluation of key data related to (a) the performance of athletes and sports organizations, (b) talent identification, (c) the determination of the general status and trends of the morphological and motor development of children and youth in a country, (d) the state and the development of sports infrastructure and equipment and (e) the economic effects of sports and sports-related activities (sports competitions, sports tourism, etc.) on the national, regional, and municipality levels. The implementation of tasks of the research and development substructure is mainly in the domain of higher education and scientific-research institutions in the field of sports in cooperation with other organizational segments of the educational system (primary and secondary schools), national sports federations and the National Olympic Committee.

Material substructure

An important factor in sports activities is also the material substructure (Sallis, Prochaska & Taylor, 2000), which is represented by all *sports infrastructure* and its *equipment*. Dallmeyer, Wicker and Breuer (2018) argue that consistent investment in sports infrastructure is key for the government to promote population participation in sports and physical activity. The term "sports infrastructure" encompasses all indoor and outdoor facilities for sports and physical activities, including (1) events sports facilities, (2) training sports facilities, (3) school sports facilities, (4) indoor and outdoor swimming pools, (5) outdoor training and competition areas (athletic, football stadiums, ski slopes, etc.), (6) multi-purpose outdoor sports areas, (7) outdoor equipped urban sports areas (outdoor fitness centers, skating areas, futsal playgrounds and maintained natural swimming pools) and (8) other natural sports areas (running pats, hiking trails, etc.). A special segment of the infrastructure related to physical activity is also (8) the organized and safe urban network of bicycle paths, which enable the population to exercise daily in the sense of sustainable and healthy daily migration (commute to work or school, and other daily migrations). All the listed types of sports infrastructure and the possibilities of its safe use (equipment) are a fundamental condition for sports and physical activity of all categories of the population, and they also have a direct impact on the development of tourist destinations (active tourism, ski tourism, sports events, etc.) and thus on the economic effects of sport and physical activity. A number of studies have also shown that a proximity to sports space is associated with an increase in physical activities and has a positive impact on population health (Huston, Evenson, Bors & Gizlice, 2003; Roux et al., 2007).

Program substructure

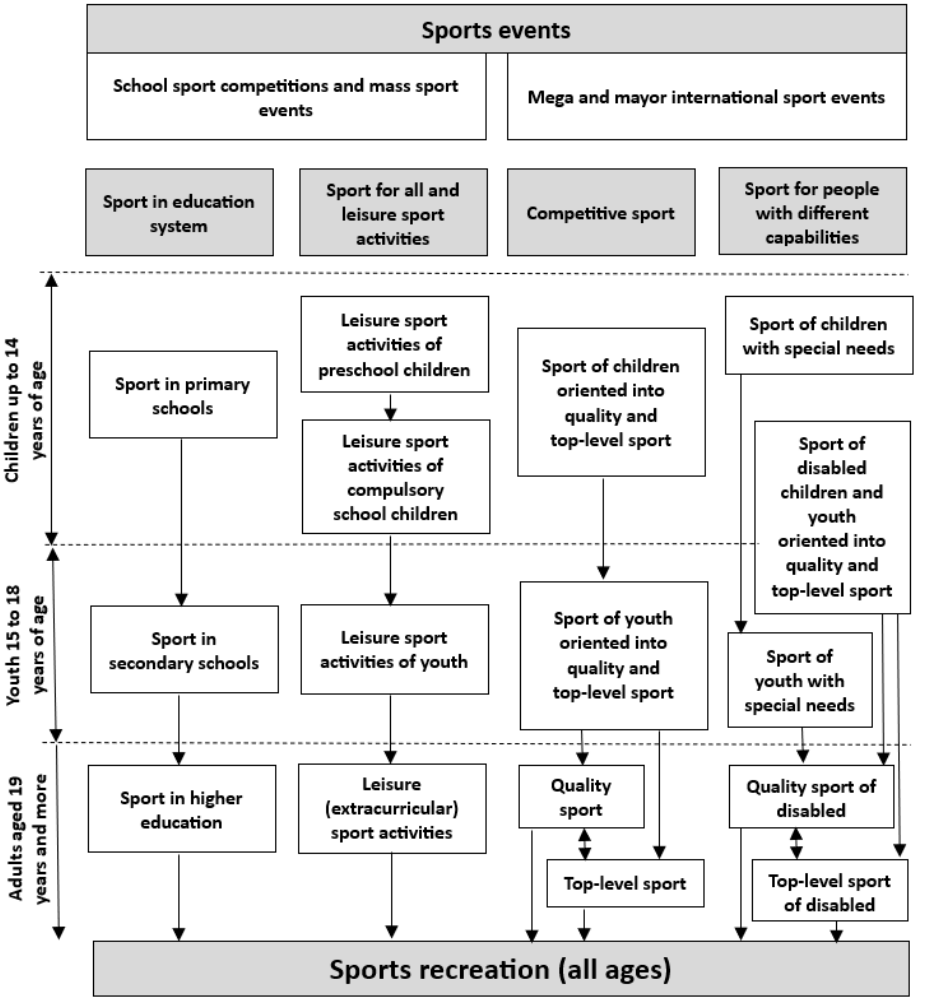
The program substructure is represented by *various types of sports programs*, which are the substantive basis for sports and physical activity and also the most visible part of sport. Program substructure is generally represented by professionally organized and managed sports and physical exercise, known by the term "*organized sports programs*" (the exception is unorganized sports recreation). Individual forms of sports and physical activity have different goals (as mentioned in introduction section) and, in terms of programs, are tailored to different groups of people, their abilities (knowledge, skills, attributes, and

motivation), and their age. For an easier overall understanding of the sports program substructure, refer to Figure 2. As depicted, the entire program substructure of sport can be divided at the highest level into five types of sports programs, which coincide relatively well with the modern division of sport according to Kristan (2002) and Guo (2022). Thus, the program substructure of sports includes sports in the education system, sports for all, and leisure sport activities, competitive sports, sports for people with different capabilities and sports recreation. Among the main basic goals of all organized forms of sports activity are *education for sports*, a *healthy and fun way of spending free time*, and the *motivation for an active lifestyle* in later periods by choosing organized or unorganized regular sports recreation.

Sports in the education system represent the only regular sports activities for the whole population of children and for a large proportion of young people in secondary and high schools. Thuse, the extent and quality of sports programs in the education system (especially in primary schools) are of the utmost importance for a healthy morphological and motorically development, for the creation of a healthy lifestyle and for proper socialization of children and youth. One of the key channels for increasing activity during childhood and adolescence is schools. School-based sports tend to be compulsory, and so reduce the importance of self-selection. Schools not only provide opportunities for children to be physically active, but can also aid the development of sports skills, knowledge and enthusiasm for physical activity that can be carried into adulthood (Black, Johnston, Propper & Shields, 2019; Morton, Atkin, Corder, Suhrcke, & Van Sluijs, 2016), and which reduce the prevalence of health risks in adulthood (Steele, Brage, Corder, Wareham & Ekelund, 2008). For these reasons, it is important that governments ensures that all children and young people in the education system receive the same quality and quantity of sports programs, regardless of which school and in which city or region they are included in the public or private school system. School-based physical education (sport) is the most widely available source to promote physical activity among young people. Therefore, every effort should be made to encourage schools to provide physical activities on a daily basis in all grades, inside or outside of the curriculum and in cooperation with partners from the local community, and to promote an interest in life-time physical activities in all pupils (EUPAG, 2008). An important factor for high-quality sports in schools is accessible, safe, and sufficient sports infrastructure. Attending a school with inadequate sports facilities not only limits opportunities for children and youth to be physically active but also leads to a statistically significant, decrease in the likelihood of physical activity participation during adulthood (Black et al., 2019). In financial terms,

sports within the education system usually fall under the purview of the ministry responsible for education.

Figure 2: Comprehensive sports programs substructures



Sports for all (also extracurricular sport activities) and *sports recreation* (also leisure sports activities) is a type of sports activity that is non-competitive in its content and pursues goals such as well-being, learning different movements, developing motor skills, socializing and getting healthy. These forms of sports programs are implemented either in an organized form (extracurricular sports activities at schools or sports clubs, gyms, etc.) or as unorganized forms of self-activity of people of all age groups (running, hiking, jogging, biking, going to the gym, skiing, etc.). This form of sports programs can also be found under the term ”mass sports”, which is characterized by the fact that participation is higher in clusters with a relatively higher standard of living and income, better opportunities for sports (accessibility and infrastructure), and higher public and household expenditures for sports (Nessel, 2021). The characteristics of mass sports permeate throughout society. While some games may have loose regulations, the primary emphasis in mass sports lies on participation and enjoyment (Guo, 2022). The most important indicator of (1) acceptance and awareness of the importance of physical activity for healthy lifestyle and better quality of life and (2) the success of sports promotion at the national level is the *share of the population actively engaged in sports activities*. The proportion of Europeans that never exercise or play sport has continuously risen over the past decade. Almost half of Europeans (46%) aged 15 or above report never exercising or playing sport, while 54% exhibit some degree of sports activity, with 14% participating infrequently, 40% engaging with at least some regularity, and 7% adhering to a consistent regimen (European Commission, 2018). However, there exist notable disparities in these figures across European nations. Finland, Sweden, and Denmark stand out with the highest rates of active population participation, with 87%, 85%, and 80% respectively. In contrast, Bulgaria, Greece, and Portugal present the lowest rates, with only 32% of their populations actively engaging in sports or exercise (European Commission, 2018). Extracurricular sport activities hold a special importance in increasing the level of physical activity among children and youth. Schools offering organized extra-curricular physical activity several times a week showed a higher proportion of pupils reporting daily participation in recess physical activity (Haug, Torsheim, & Samdal, 2009). Sport for all programs and extracurricular sports programs have been shown to decrease the prevalence of physical inactivity among young people, thereby reducing risk factors for cardiovascular disease, cancer, and osteoporosis in later life (WHO, 2004). These programs also contribute to a decreased BMI and lower rates of obesity (Craigie et al., 2009).

Competitive sport is that type of sport in which the participants, under the guidance of qualified coaches and teams of experts, systematically develop their abilities and, in the training process, transform and adapt them to the requirements and needs of the individual sport. Sport-specific motor knowledge and skills acquired during the training process are evaluated, in comparison with others, within the framework of national and international competition systems prescribed by the relevant national and international sports federations. The successfulness of an individual athlete is determined based on the results achieved in each competition. Within the competition systems, the competitions are divided and structured according to the age categories of the participants, which ensures that the result of the athlete does not primarily depend on the biological development associated with the age of an athlete, but in a dominant part on the effectiveness of the implemented training process and micro (athlete's family) and macro (accessibility of infrastructure and equipment for individual sports) socio-economic status. In Figure 2, competitive sport is divided into three (3) age categories and two (2) levels of competitive sport. The first two age categories are defined as *competitive sports for children and youth*, which, by participating in this form of sports programs, are aimed and directed at achieving quality and top-level sports results, while in the category of adult athletes are two types of competitive sports programs (*quality and top-level*). The development and prevalence of competitive sports in the country is usually perceived according to the number of *registered athletes* in all age categories, whereby a registered athlete is defined as any individual who has a recorded competitive result achieved at least within the national competition system up to the level of the national championship. For the needs of the accuracy of the collected data and the evaluation of individual sports federations and sports disciplines from the point of view of competitive sports prevalence, countries usually establish appropriate information systems that facilitate the relevant collection of data on registered athletes in all age categories (national register of "registered athletes"). The collected data on the number of registered athletes often represent an important criterion for the distribution of public money (financing of competitive sports), both at the national and local levels. In order to properly and above all objectively evaluate the achieved results of athletes within the international and national competition systems, countries establish a system of *athletes' categorization* based on the achieved result. The athlete categorization system usually categorizes athletes into different performance classes (categorization ranks) based on (1) the place achieved at the competition, (2) the rank (level) of the competition and (3) the competitiveness of the environment in which the result was achieved

(Ministry of Education, Science and Sport, 2022). On the basis of the obtained categorization rank, the athlete acquires status rights in the system of public finances and services (education, healthcare, employment, awards, etc.), which they can exercise as an individual during the duration of the individual categorization rank or after the end of their sports career (dual career opportunities). Data on the categorization rank of individual athletes are usually also collected in the national information system (national register of "categorized athletes"), which among other things, is also used by national and local authorities in the process of evaluating sports federations and sports disciplines, when they determine the amount of annual public funding of programs and the operating of sports federations and sports disciplines. Athletes in the adult category (Figure 2) who have higher international categorization ranks are classified in the "*top-level sports*" category, while all others with national categorization ranks and other registered athletes are classified in the "*quality sports*" category. In this way, the registration system represents a *quantitative parameter* that measures the prevalence of an individual sports discipline and, consequently, a sports federation and a categorization system, a *qualitative parameter* for measuring the successfulness (performance) of an individual sports discipline and, consequently, a sports federation in the national environment. Both criteria enable objective evaluation and relevant comparability between individual sport disciplines in prevalence (registration) and results achieved at (1) different levels of competitions, (2) between individual sports disciplines and in (3) different competitive environments (categorization) (Kolar, 2005). Nessel (2021) wrote that high elite (top-level) sports successes have a great impact on the development of sports and the recognition of the country and important external effects on the entire society; however, they do not require only good sports opportunities, but also depend to a large extent on public financial support (Škorić & Obadić, 2019).

Sports for people with different capabilities in all its forms has an important psychosocial effect, and it also enables participants in these programs to participate in various sports events (possibility of achieving top results and recreational events). This kind of programs are intended mainly for the preservation of motor abilities, health, revitalization, resocialization, entertainment, and competition of disabled people who voluntarily engage in sports. Due to its interdisciplinary nature, sports programs for people with different capabilities intertwined are with various social fields, the most important of which are healthcare and education. The sports activities of children and youth with special needs during the period of growing up are primarily aimed at adequate care for integration into everyday life. Success in sports activities

affects successful social integration, leading to a fuller and richer life. The forms of activity can be organized as sports training, competition and courses, as well as special programs for specific types of deficits or obstacles. This sports programs can take place both within the sports programs in the education system (schools for people with special needs or regular schools), as well as within the activities of the so-called Special Olympics World Games. In the field of competitive sports for people with special needs, the same guidelines apply as in the field of competitive sports. Some forms of competition in the sports of people with special needs are dominated by the distinct achievement of top-sport results (e.g., Paralympic sports, Deaflympics), while in other places more psychosocial aspects are in the foreground (e.g., Special Olympics World Games). Both of them focus on sports for athletes with a disability and are run by international non-profit organizations. Apart from that, the Special Olympics and the Paralympics differ in three main areas: (1) the disability categories of the athletes that they work with, (2) the criteria and philosophy under which athletes participate, and (3) the structure of their respective organizations (Special Olympics Australia, 2024). But there are also others forms of sports for the disabled under the umbrella of non-Paralympic sports. The aspirations and orientations of international sports authorities are to integrate as much as possible the training processes and competitions of disabled into the national sports federations of (relevant) sports disciplines, as well as the equal evaluation of the achieved competitive results and the resulting status rights of disabled athletes.

A special part of the sports program substructure is the programs related to the *organization of sports events*. Sports events are the main part of the organizational culture of sport with an impact on the promotion of the environment in which they take place (local, regional, and national), and on the development of tourism and other economies. At the same they are of great importance for the development and nurturing of sports culture as they can promote motivation for sport and physical activity and therefore represent the most important form of sports promotion. While the organization of *school sports competitions* is primarily the responsibility of the ministries responsible for education and/or sports, the organization of *competitions up to the level of national championships* in individual sports disciplines is the responsibility and competence of national sports federations. Organization of other sports events (international mass sports events, mega and major sports events) largely depends on the successful integration of all types of resources (financial, infrastructure, staff, etc.) of the state and local communities, national sports organizations, local sports clubs, the private tourism-economic

sector, and volunteers. The benefits of organizing sports events can be broadly divided into economic and non-economic benefits. *Economic benefits* represent the additional spending in the economy due to the organizations of sporting events, and *non-economic benefits* represent the socio-economic, promotional, sports, cultural, environmental, and infrastructural benefits that may arise from organized events (Kolar & Zaletel, 2013). *International sporting events* in the narrower sense include "*mega-sporting events*" (Olympic Games, European Games, World and European Football Cups) and "*major sporting events*" (World Championships, European Championships, World Cups, European Cups, Universiade, EYOF), but, in a broader sense, also competitions of *senior national teams and clubs competing in team sports* championship leagues, *international mass sports events* (e.g., recreational marathons, recreational triathlon) and *international sports congresses and symposia*. However, sporting success and sport events can also create positive arousal (Uhm, Lee, & Han, 2020) among spectators and television viewers, bringing different people together to celebrate (Green & Chalip, 1998) and socialize (Pfister, Mintert, & Lenneis, 2018), which can have a positive effect on the mental dimension of health (Storm & Jakobsen, 2024).

Integrity framework

The comprehensive sport structure is framed within an integrity framework, which in a symbolic and practical sense protects the sports system from various deviations, which are all too often imposed from other social systems and appear at all levels of sports. In the context of understanding integrity in sport, this term can be perceived (1) as the *antithesis of corruption* (e.g., doping, match fixing, and event and/or sponsorship bribery), (2) as the *principle of good governance* (Chappelet & Mrkonjic, 2013; Kihl, 2019), and (3) as a *safeguarding principle* that makes sport an inclusive, safe and fair environment for all participants (particularly for children and youth). The integrity framework focuses on morals, norms and values that help determine right or wrong in different contexts. The meaning of sport integrity incorporates both perspectives, where integrity relates to (1) ensuring honest competitions and outcomes (anti-doping, match-fixing), and (2) governance and management practices (good governance, safeguarding and corruption), representing a range of moral values and norms that should be respected by sport stakeholders and organizations in different contexts such as sporting and administrative behaviors, decision-making, and governance systems (Kihl, 2019). Pope

(1996) argued that "*the long-term success of integrity and the fight against corruption depends on comprehensive and not partial reforms*", which means that the enforcement of integrity in the field of sport must be approached (1) comprehensively, (2) systematically, and from the (3) level of highest national sports authorities. The sports integrity system is also important to maintain the public's trust in sport.

METHODOLOGICAL PERSPECTIVE OF NATIONAL SPORT STRATEGIES

The methodological perspective for creation of the NSS is based on the *strategic management* approach, which recommends a series of steps in preparation of such documents (Kolar, Bednarik, Kovač, & Jurak, 2010). Even if there are many different definitions of *strategy*, the fundamental value of a strategy should be that it provides the organization with a way to coordinate activities, communication and decisions across groups and individuals towards achieving shared long-term goals (Mackay, Arevuo, Mackay, & Meadows, 2020). A strategy makes sure that an organization will go in the direction the strategy creators want it to go, that it will reach its goals on time, and create its own future (Williams, 2009). In contrast to the individual goals of an organization, the strategy is a comprehensive set of activities that respond to perceived challenges, whereby a good strategy has a core logical structure consisting of three elements: *diagnosis*, *guiding policies,* and *coherent activities* (Rumelt, 2013). *Strategic management* is intended for those who implement or want to implement the first step in the development and enforcement of strategic changes. It is also a tool for creating successful strategic decisions and consists of the processes of *analyzing* the organization and its environment, *planning* strategic orientations and *implementing* strategic changes. Strategic management skills are useful for all those who plan and manage organizations, regardless of the size and scope of the business, activity or sector of operation: private, public, or voluntary (Williams, 2009). Rigby and Bilodeau (2018) conducted a survey of 1,268 managers worldwide to identify the 25 most popular strategic management methods and the associated level of satisfaction with their use. They found that the number of tools and methods used in the strategic management process has had a marked negative trend over the last 15 years (16 methods used in 2002 and 7 methods used in 2017) and that *strategic planning* is still the most popular tool used worldwide in strategic management (Rigby & Bilodeau, 2018). Strategic planning is defined as a formalized and systematic strategic

process, with a high level of analytical stringency. Strategy formation occurs as a completely conscious process with controlled, rational thinking (Müller-Stewens, 2020). In addition to the above, it is also necessary to emphasize the fact that the process of planning does not end with the determination of strategies and appropriate strategic measures, but also includes the path to their realization (i.e. action plan). In this way, strategic planning is part of strategy formulation while *operational planning* is part of strategy implementation. The concept (model) of the process of preparation of NSS can be seen in Figure 3. The model in its upper part represents the phases of strategic management; i.e., (1) the strategic *planning* phase of NSS creation, (2) the planning and implementing phase of the *organization* for implementation of NSS, (3) the strategy *implementation* phase, and the (4) strategy implementation *control* phase. The middle part of the model shows the phases of the strategic planning process (*mission, analysis, vision, goals,* and *measures*) and operational planning process (*projects* and *activities*). Brief definitions and fundamental strategic questions (*why, what,* and *how*) are added to the individual phases, which strategy creators must answer in the process of preparing NSS (Kolar & Jurak, 2014; Kolar, 2023). In continuation, the basic tasks that strategies creators must perform in each individual phase and a content (substantive) part of NSS planning is added. The content part shows the necessary elements of analysis and planning (strategic and operational) for a comprehensive strategic consideration of the sports system in the process of preparing NSS. The lowest part connects the successive phases of the process and shows the results of the process implementation in the form of *two documents*: (1) a strategic plan or NSS and (2) an action plan for NSS implementation.

As is shown in Figure 3, the process of *strategic planning* begins with the definition of the mission and values of NSS, where the *mission* should define the permanent purpose of the NSS and the reason for its creation, which should be implemented in accordance with the organizational culture defined by the *values* (Planellas & Muni, 2020). In the *strategic analysis* processes, all substantive elements (substructures) of a holistic sports system should be analyzed. For analyzing the substructures, a relevant set of *measurable variables* must be created for each of them, with which we can find out (1) the level of development of individual substructures, (2) the connections and their mutual influences on the past development of sports in the country, and (3) draw appropriate conclusions, which we use to create a SWOT matrix. The findings from the strategic analysis form the basis for defining the vision and strategic goals of the future development of sport at the national level.

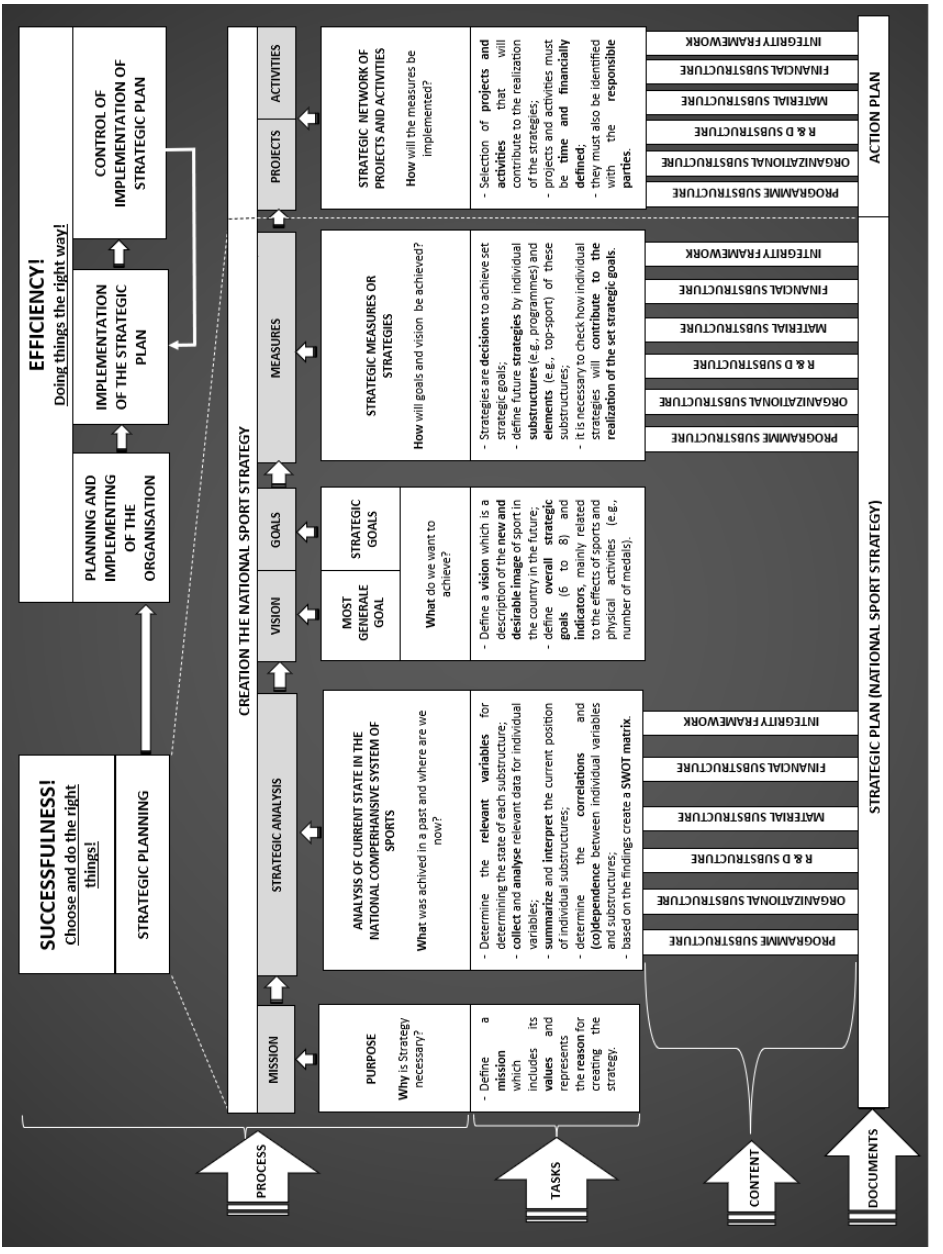
The most general goal is the vision, which represents a description of the new and desirable image of the national sport system in the future, which can easily be spread throughout the sporting (sports organizations in a wider sense) and non-sporting (other important stakeholders) national environment. Mackay et al. (2020) stated that strategic goals are the long-term aims of an organization. They need to be coherent, which means that they should make sense individually, and also as a combined set. In this sense, we can understand goals as targets to which a strategy will lead us. The primary tasks of the strategy development process are: (1) the formulation of various strategies or measures, (2) the evaluation of their potential for the realization of goals, and finally, (3) the decision on which strategies are expected to best realize the strategy's vision and goals, and implement the mission. As Planellas and Muni (2020) states "strategies are decisions; without a decision there are no strategies". With the decision on the selection and placement of strategies (measures) by individual (content) substructures of the sports system, the document (NSS) is completed and the operational planning process begins.

Operational planning, implementation, and controlling are no longer a part of the strategic decision-making process in a narrow sense, but of the newly established operational decision-making process. The implementation of selected strategies (measures) is the phase that comes after strategy selection, and if these measures are not implemented, the strategy will have no impact on the future development of a national sports system. If strategy-makers in the strategic planning are concerned with "choosing the right things" (successfulness), in the strategic implementation they will be primarily concerned with "how to do things right" (effectiveness). During the implementation phase, all the conditions and resources (organizational, personnel, financial, material, etc.) are created, which enable the transition from strategies to actions and the realization of the planned strategic impacts on the field of sport (Planellas & Muni, 2020). Hickson, Miller and Wilson (2003) conclude that the way decisions (strategies) implementation is managed appears to be vital for strategy success.

The implementation phase begins with the planning of strategic projects and activities (Rozman & Stare, 2008) or strategic initiatives (Mackay et al., 2020; Müller-Stewens, 2020) for measures in the individual content substructures of a sports system, which must to the greatest extent possible, ensure the implementation of selected strategies and the realization of strategic goals. This process consists of three steps, namely: (1) variation, in which proposals for projects, activities or initiatives are generated, (2) selection, in which a selection of the most promising proposals is made, and (3) retention, in which the selected proposals are appropriately structured in an action plan (Müller-Stewens,

2020). All projects, activities and initiatives need to be quantified in terms of the associated budget, time frame and organizational responsibility (Mackay et al., 2020). Once the action plan is in place, the organizational structure and its internal processes must be check and find out if they are in line with the comprehensive idea as it is written in the NSS. In the sense that "structure follows strategy", the organizational structure must be aligned to support the implementation of the strategy (Müller-Stewens, 2020). The above means that it must be determined whether it is necessary to restructure the organizational structure and, in the process of implementing the new organizational structure, carry out a reorganization that ensures the adequacy of organizational roles and their interrelationships and delegate responsibility, duty and authority for the expedient and effective implementation of the strategy. In terms of process, all the conditions for starting the implementation of the strategy are now provided. The implementation of the projects, activities, and initiatives collected in the action plan represents the beginning of the implementation of the NSS, since the strategy is not implemented directly, but indirectly through the implementation of the action plan. In the process of implementing the action plan, the planning process is re-established, but this time it is about planning projects, activities or initiatives, the planning of which mainly involves the use of project management methodology and the management of a strategic multi-project environment. The process of strategic control is primarily aimed at determining performance, whereby, in a comparison between the planned and actually realized, we determine to what extent we achieve the set strategic goals through the implementation of the strategy and also whether, in the planning process, we have chosen the right goals and strategies for realizing the mission and achieving the vision of NSS (Kolar, 2023).

Figure 3: Concept (model) of the process of creating the NSS (a methodological perspective)



Source: Adapted from: Kolar, Bednarik, Kovač & Jurak, 2010.

CONCLUSIONS

In the present paper, the authors holistically analyze the process of preparing NSS, which should represent a fundamental document for the development of sports and physical activity within the population of a given country. A modern NSS should answer many questions, related not only exclusively to the development of sports results of national sports heroes, but also or especially to those related to modern lifestyles and the changing demographic image of the population in developed societies. The developed and presented conceptual framework of NSS combines the content elements that are specific to the science of kinesiology with the methodological approach inherent to the scientific discipline of strategic management. In this way, it enables comprehensive management of the preparation and implementation process, as well as the substantive integrity of NSS. The process of preparing such a document usually takes at least one year, which largely depends on (1) the interdisciplinary nature of the approach, (2) the extensiveness of the analytical part of the process, (3) the availability of the necessary data for the evaluation of individual measured variables, and to a large extent also (4) on the regulatory process of confirmation and acceptance of the document within the government-legislative structures of the country's political system. Due to the typically lengthy preparation process, the authors recommend that the strategic validity period of a NSS is between 7 and 10 years, which enables the implementation of the required organizational changes, the provision of the necessary resources, and the effective implementation of a large part of the strategic projects and activities.

The presented model of the preparation and implementation of the NSS in the presented form meets the basic requirements of the system theories, according to which models should enable (1) the organization of the management process of the preparation and implementation of NSS, (2) the establishment of the necessary connections between individual phases (elements of the model) and the entire management process (overall model), (3) substantive comprehensive collection, organization, and analysis of relevant variables for analytical and strategic purposes, (4) testing the meaningfulness of the mission and goals of the NSS and (5) repeatable applicative use of the model in reality. The model comprehensively covers the issue of management of NSS preparation and is therefore (1) *dialectical*, as it takes into account all substantive and methodological essential aspects, (2) *open*, as it can be supplemented with new relevant methodological steps or perceived relevant content during the implementation process, (3) *flexible*, since it can be used, at least in a methodological-processual sense, in the management of other strategic documents at the national,

regional, or local level, and (4) *repeatable*, since its definition is precise and allows direct multiple use by different types of users.

Given that we used a conceptual approach to the issues presented in the article, one of the fundamental limitations of the study is related to the bounded rationality of the authors and biases that could guide our assessment of the relevance of the used literature and the reevaluation of our own applied experience gained in the preparation of this type of strategic documents. Future research in the field of creating national policies in the field of sports should be primarily aimed at determining the connection and causality that determine the relationships between the substantive substructures of sport presented in the model.

The NSS represent a unique opportunity to present the importance of sports for the development of a healthy, resilient, and sustainable society, the economic development of the country and its impact on its international standing. Because of the above, wide accessibility to sports activities must be a fundamental guideline for the realization of the public interest in the field of sports, and the NSS must guarantee that sport becomes a fundamental human right of every individual.

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REPORTS AND REVIEWS
POROČILA IN OCENE

REPORTS AND REVIEWS/POROČILA IN OCENE, 97–106

A SBI 2023 BEDREST STUDY

The study focused on the deterioration of neuromuscular and metabolic health during prolonged physical inactivity in both young and older men, as well as the subsequent restoration of health. Various models were employed to study the effects of physical inactivity, with bedrest (BR) being the gold standard. This model, which few institutions have managed to develop in a complex hospital setting, is also used as a ground-based simulation to study the consequences of space flight. Thus, the study design holds significant appeal for numerous research groups and stakeholders. BR is not only used to evaluate the effects of physical inactivity but also to examine the efficacy of various methods, including various countermeasures, interventions and rehabilitation measures, in addressing muscle atrophy and inactivity-induced dysfunction.

A Bed Rest Centre of Science and Research Centre Koper is being led by the Institute for Kinesiology Research. Since 2006 we have organized 6 BR studies, with 10 cohorts, including 97 participants, being in bed between 10 to 35 days. We were one of the first in the world to conduct the Bedrest Study in 2012 on a balanced sample of two groups of elderly subjects to investigate the effects of an intervention (nutrition and cognitive ability) on reducing participants' functional decline in participants. The latest study, in 2023, was of great relevance as it was one of the rarest studies that also included aged participants (> 65 years of age) to be compared with younger counterparts. Specifically, the study included 3 groups:

Group Y: Nine young males (18–35 years) that underwent 21-day BR, without interventions, followed by 21-day recovery.

Group E: Ten older males (65–75 years) that underwent 10-day BR, without interventions, followed by 21-day recovery.

Group Ex: Ten older males (65–75 years) that underwent 10-day BR, with 3 interventions, followed by 21-day recovery. For interventions, participants: (1) performed 2-month prehabilitation to elevate their fitness levels before the BR; (ii) performed virtual reality-driven mental training to prevent decline in motor control during the BR; and (iii) were given extra proteins and amino acids to maintain their metabolism during the BR.

A study was conducted following ethical approval from the National Medical Ethics Committee of the Republic of Slovenia (No. 0120-123/2023/9, issued on 21 June 2023). The first 2 participants joined the study on 21 August 2023, and the last 2 participants completed the study on 25 October 2023. As in our previous studies, all participants successfully completed all examinations.

A total of 43 researchers from 9 organizations (various European scientific, research and health institutions) participated in the study. On 29 March 2023, we organized a scientific meeting where we presented the main findings of the study, which will be published in scientific journals.

The project was co-financed from:

ARIS J5-4593 Physical inactivity induced neuromuscular impairment: comparison of younger and older adults.

INTERREG SLO-ITA X-Brain.net – Network per la cooperazione transfrontaliera finalizzata alla riabilitazione del paziente post-ictus con tecnologie innovative.

PRIN NeuAge – Neuromuscular Aging: Mechanisms and functional implications.

PRIN InactivAge – Inactivity induced neuromuscular impairment through different ages: from children, to young and middle age adults.

PRIN ReActiveAge – The countermeasures to the neuromuscular impairments induced by inactivity and disuse across different ages.

Boštjan Šimunič, Rado Pišot

REPORTS AND REVIEWS/POROČILA IN OCENE, 97–106

ŠTUDIJA BEDREST SBI 2023

Študija je bila osredinjena na poslabšanje živčno-mišičnega in presnovnega zdravja med dolgotrajno gibalno neaktivnostjo pri mladih in starejših moških in na poznejše izboljšanje zdravja. Za proučevanje učinkov gibalne neaktivnosti so bili uporabljeni različni modeli, pri čemer je ležanje v postelji (BR) zlati standard. Ta model, ki ga je v kompleksnem bolnišničnem okolju uspelo razviti le malo institucijam, se uporablja tudi kot zemeljski model za proučevanje posledic vesoljskega poleta, številne ugotovitve pa lahko prenašamo tudi na področja razumevanja mehanizmov propadanja pri zasedeni, gibalno neaktivni populaciji ter procesov staranja. Zato je zasnova študije zelo privlačna za številne raziskovalne skupine in udeležence. BR se ne uporablja le za nadzorovano ocenjevanje učinkov gibalne neaktivnosti, temveč tudi za proučevanje učinkovitosti različnih intervencij, vključno s protiukrepi in rehabilitacijo, za odpravljanje strukturnega in funkcionalnega propada ter disfunkcije, ki jo povzroča neaktivnost.

BED REST Center Znanstveno-raziskovalnega središča Koper vodi Inštitut za kineziološke raziskave. Od leta 2006 smo organizirali šest študij BR, v katerih je sodelovalo 10 kohort in 97 udeležencev, ki so bili v postelji od 10 do 35 dni. Bili smo prvi v svetovnem merilu, ki smo leta 2012 izvedli študijo na uravnoteženem vzorcu dveh skupin starejših subjektov z namenom preučevanja vpliva intervencije - v tem primeru kognitivnega treninga, na zmanjšanje funkcionalnega propada. Zadnja študija, izvedena leta 2023, je bila zelo pomembna, saj je bila ena redkih, ki je vključevala tudi starejše udeležence (starejše od 65 let), da bi jih primerjali z mlajšimi. Študija je vključevala tri skupine:

Skupina Y: devet mladih moških (18–35 let), ki so prestali 21-dnevni BR brez intervencij, čemur je sledilo 21-dnevno okrevanje.

Skupina E: deset starejših moških (65–75 let), ki so prestali 10-dnevni BR brez intervencij, čemur je sledilo 21-dnevno okrevanje.

Skupina Ex: deset starejših moških (65–75 let), ki so prestali 10-dnevni BR s tremi intervencijami, čemur je sledilo 21-dnevno okrevanje. Med intervencijami so preiskovanci: 1. izvajali 2-mesečno predpripravo za izboljšanje svoje telesne pripravljenosti pred BR; 2. izvajali mentalni trening z uporabo virtualne resničnosti za preprečevanje upada motorične kontrole med BR; ter 3. dobivali dodatne beljakovine in aminokisline za vzdrževanje presnove med BR.

Študija je bila izvedena po etični odobritvi, ki jo je 21. junija 2023 izdala Komisija Republike Slovenije za medicinsko etiko (št. 0120-123/2023/9). Prva preiskovanca sta se študiji pridružila 21. avgusta 2023, zadnja pa sta jo končala

25. oktobra 2023. Kot pri naših prejšnjih študijah so vsi preiskovanci uspešno opravili vse preglede.

V študiji je sodelovalo skupno 43 raziskovalcev iz devetih organizacij (različnih evropskih znanstvenoraziskovalnih in zdravstvenih inštitucij). 29. marca 2023 smo organizirali znanstveno srečanje, na katerem smo predstavili glavne ugotovitve študije, ki bodo objavljene v znanstvenih revijah.

Projekt je bil sofinanciran iz:

ARIS J5-4593 Upad živčno-mišičnega sistema po gibalni neaktivnosti: primerjava mlajših in starejših odraslih,

INTERREG SLO-ITA X-Brain.net – Mreža čezmejnega sodelovanja rehabilitacije bolnikov po možganski kapi z uporabo inovativnih tehnologij,

PRIN NeuAge – Neuromuscular Aging: Mechanisms and functional implications,

PRIN InactivAge – Inactivity induced neuromuscular impairment through different ages: from children, to young and middle age adults,

PRIN ReActiveAge – The countermeasures to the neuromuscular impairments induced by inactivity and disuse across different ages.

Boštjan Šimunič, Rado Pišot

REPORTS AND REVIEWS/POROČILA IN OCENE, 97–106

CONFERENCE REPORT: 2024 PADUA – 5 DAYS ON MUSCLE AND MOBILITY MEDICINE (2024PDM3)

Padua, Italy, 27 February–2 March 2024

The International Scientific Conference entitled "Padua Days on Muscle and Mobility Medicine in Padova (Pdm3)" was held at the Petrarca Hotel in the Spa of the Euganean Hill (Padova), Italy, in the San Luca Hall of the Convent of Santa Giustina in Prato della Valle, Padova, Italy. Pdm3 was led by prof. Ugo Carraro and prof. Sandra Zampieri. This series of international meetings on the biology, anatomy, physiology, management, and rehabilitation of muscles was first held in 1985. Over five days, presentations were given by scientists and medical staff from Argentina, Austria, Belgium, Brazil, Canada, Denmark, Egypt, France, Germany, Iceland, Ireland, Italy, Romania, Russia, Slovenia, Switzerland, the United Kingdom, and the United States. Among all participants, four colleagues from the Institute for Kinesiology Research, Science and Research Centre Koper presented their work: Prof. Rado Pišot (*Simulating weightlessness with inactivity models on Earth: research experience of the Bedrest Centre in Koper*), Prof. Boštjan Šimunič (*The relevance of Tensiomyographic results in disuse studies*), Assoc. prof. Uroš Marušič (*Sensorimotor adaptations during bed rest: insights from high-density electroencephalography*) and Kaja Teraž (*Muscle sparing effect of high-protein diet with excess leucine in short-term bed rest*).

From all scientific sections, a section of *Impact of inactivity on human physiological systems* was almost entirely dedicated to the presentation of results obtained in our latest bed rest campaign (SBI 2023 bed rest study). Authors presented the differences in bed rest consequences between younger and older male participants at the level of muscle oxidative metabolism, muscle molecular impairment of neuromuscular junction, protective role of protein supplements during the bed rest period, deterioration of muscle function, muscle activation at the level of motor units and muscle-tendon system, deterioration of central nervous system, and change in muscle tension.

Kaja Teraž, Boštjan Šimunič

REPORTS AND REVIEWS/POROČILA IN OCENE, 97–106

POROČILO S KONFERENCE: DNEVI MEDICINE MIŠIC IN MOBILNOSTI V PADOVI (2024PDM3)

Padova, Italija, 27. februar–2. marec 2024

Mednarodna znanstvena konferenca Dnevni medicine mišic in mobilnosti v Padovi (Pdm3) je potekala v hotelu Hotel Petrarca Terme Montegrotto Padova, Italija. Konferenco sta vodila prof. Ugo Carraro in prof. Sandra Zampieri. Mednarodno srečanje o biologiji, anatomiji, fiziologiji, upravljanju in rehabilitaciji mišic je prvič potekalo 1985. Letos so v petih dneh potekale predstavitve znanstvenikov in zdravstvenega osebja iz Argentine, Avstrije, Belgije, Brazilije, Kanade, Danske, Egipta, Francije, Nemčije, Islandije, Irske, Italije, Romunije, Rusije, Slovenije, Švice, Združenega kraljestva in ZDA. Med udeleženci so svoje delo predstavili tudi sodelavci z Inštituta za kineziološke raziskave Znanstveno-raziskovalnega središča Koper, in sicer prof. dr. Rado Pišot (ang. *Weightlessness with inactivity models on Earth: research experience of the Bedrest Centre in Koper*), prof. dr. Boštjan Šimunič (ang. *The relevance of Tensiomyographic results in disuse studies*), izr. prof. dr. Uroš Marušič (ang. *Sensorimotor adaptations during bed rest: insights from high-density electroencephalography*) in Kaja Teraž (ang. *Muscle sparing effect of high-protein diet with excess leucine in short-term bed rest*).

V sklopu konference je potekala sekcija *Impact of inactivity on human physiological systems*, v kateri so se posvečali predvsem predstavitvi rezultatov iz zadnje kampanje BEDREST (študija gibalne neaktivnosti SBI 2023). Avtorji so predstavili razlike v posledicah gibalne neaktivnosti med mlajšimi in starejšimi moškimi udeleženci na ravni oksidativnega metabolizma mišic, molekularne okvare živčno-mišičnega spoja, vloge beljakovinskih dopolnil v prehrani, poslabšanja mišične funkcije, mišične aktivacije na ravni motoričnih enot in skeletno-mišičnega sistema, poslabšanja centralnega živčnega sistema in drugih.

Kaja Teraž, Boštjan Šimunič

REPORTS AND REVIEWS/POROČILA IN OCENE, 97–106

REPORT FROM THE 5TH INTERNATIONAL SPE BALKAN SKI CONFERENCE

Rogla Ski Centre, Slovenia, 17–21 March 2024

The 5th international scientific and professional conference was held on home soil, at the Rogla Ski Centre in Slovenia. The conference was organized by the Slovenian Institute for Kinesiology Research, Science and Research Centre Koper, in co-organization with the Ski Instructors Association of Slovenia (SITAS) of Slovenia and the Faculty of Sport and Physical Education, University of Niš, Serbia.

The professional level of the conference was raised to the highest level by the members of the demo groups from Bosnia and Herzegovina, Bulgaria, Serbia, Montenegro, San Marino and Slovenia, who deepened their theoretical knowledge with practical work on snow in the mornings. Another important event of the conference was the "Demo Team Show", where the audience could admire the perfect skiing techniques of the demo teams from the national ski schools. The high level of the scientific conference was further enhanced by seven invited speakers, who are renowned experts in the field of alpine skiing and snowboarding. In the afternoon, we heard speakers such as Prof. John Seifert, PhD (USA), Prof. Matej Supej, PhD (Slovenia), Prof. Martino Franchi, PhD (Italy),

Prof. Ron Kipp, PhD (USA), Prof. Siniša Kovač, PhD (Bosnia and Herzegovina), Saša Pišot, PhD (Slovenia), Pete Allison, PhD (USA) and Matjaž Vogrin, PhD (Slovenia).

Current topics were also presented through scientific and expert contributions from conference participants from ten countries. In more than twenty papers, the participants elaborated on the main idea of the conference, "Science, Practice and Education", and the main theme of the conference, "Fun and Safety in Today's Skiing - The New Role of Ski Instructors/Coaches in Winter Sports and Society". The abstracts published for this event present the latest perspectives on the sensitive areas of safety and injuries, ski technique preparation and development, as well as contemporary possibilities and approaches in the methodology and didactics of ski teaching. These abstracts will be published in the Book of Abstracts.

The conference also hosted honorary members, such as Slovenian skiing legends Bojan Križaj, Jure Košir, Mateja Svet and others, who further enhanced the value of the event.

Despite the spring-like days in March, the sunny weather did not affect the conditions on the ski slopes. The good weather additionally contributed to an excellent conference.

The conference was therefore a success and participants are already looking forward to the next one to be held in March 2026.

Kaja Teraž and Rado Pišot

REPORTS AND REVIEWS/POROČILA IN OCENE, 97–106

POROČILO S 5. MEDNARODNE KONFERENCE SPE BALKAN SKI

Smučarski center Rogla, Slovenija, 17.–21. marec 2024

Peta mednarodna znanstvena in strokovna konferenca je bila tokrat organizirana na domačih tleh, v smučarskem centru Rogla v Sloveniji. Organiziral jo je Inštitut za kineziološke raziskave Znanstveno-raziskovalnega središča Koper v soorganizaciji z Združenjem učiteljev smučanja (ZUTS) Slovenije ter Fakulteto za šport in telesno vzgojo Univerze v Nišu iz Srbije.

Strokovni nivo konference so na vrhunsko raven postavili člani demoskupin iz Bosne in Hercegovine, Bolgarije, Srbije, Črne gore, San Marina in Slovenije. Parktične delavnice na snegu so dodatno poglobile novo pridobljeno teoretično znanje. Pomemben dogodek konference je bil tudi Demo Team Show, na katerem je lahko občinstvo občudovalo dovršeno tehniko smučanja demoekip nacionalnih smučarskih šol. Visoko raven znanstvene konference je postavilo sedem vabljenih predavateljev, ki so priznani strokovnjaki s področja alpskega smučanja in deskanja na snegu. V popoldanskih urah smo tako prisluhnili priznanim predavateljem, kot so prof. dr. John Seifert (ZDA), prof. dr. Matej Supej (Slovenja), prof. dr. Martino Franchi (Italija), prof. dr. Ron Kipp (ZDA),

prof. dr. Siniša Kovač (Bosna in Hercegovina), dr. Saša Pišot (Slovenija), dr. Pete Allison (ZDA) in dr. Matjaž Vogrin (Slovenija).

Aktualne teme so bile obravnavane tudi v znanstvenih in strokovnih prispevkih udeležencev konference iz 10 držav. V več kot 20 prispevkih so udeleženci predstavili glavno idejo konference Znanost, praksa in izobraževanje ter glavno temo te Zabava in varnost v sodobnem smučanju - nova vloga smučarskih učiteljev/trenerjev v zimskih športih in družbi. Ob tej priložnosti objavljeni povzetki so izšli v e-zborniku ter prinašajo najnovejše poglede na občutljiva področja varnosti in poškodb, priprave in razvoja smučarske tehnike ter sodobne možnosti in pristope v metodologiji in didaktiki poučevanja smučanja.

Konferenca je gostila tudi častne člane, kot so slovenske smučarske legende Bojan Križaj, Jure Košir in Mateja Svet, in druge, ki so še dodatno povečali vrednost dogodka

Kljub pomladnim marčevskim dnem sončno vreme ni vplivalo na razmere na smučiščih. Lepo vreme in odlično urejene proge so še dodatno prispevali k odlični konferenci.

Ta je bila tako uspešno izpeljana, sodelujoči pa so se poslovili že s pričakovanjem naslednje, ki bo marca 2026.

Kaja Teraž in Rado Pišot

GUIDELINES FOR AUTHORS, 107–110

GUIDELINES FOR AUTHORS

1. **Aim and scope of the journal:**
Annales Kinesiologiae is an international interdisciplinary journal covering kinesiology and its related areas. It combines fields and topics directed towards the study and research of human movement, physical activity, exercise and sport in the context of human life style and influences of specific environments. The journal publishes original scientific articles, review articles, technical notes and reports.

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e) The authors are obliged to prepare two **abstracts** – one short abstract in English and one (translated) in Slovene language. For foreign authors translation of the abstract into Slovene will be provided. The content of the abstract should be structured into the following sections: purpose, methods, results, and conclusions. It should only contain the information that appears in the main text, and should not contain reference to figures, tables and citations published in the main text. The abstract is limited to 250 words.

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g) The **main text** should include the following sections: Introduction, Methods, Results, Discussion, Conclusions, Acknowledgement (optional), and References. Individual parts of the text can form sub-sections.

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i). Captions are required for all **figures** and shall appear on a separate manuscript page, under the table captions. Each figure should be saved as a separate file without captions and named as Figure 1, etc. Files should be submitted in *.tif or *.jpg format. The minimum figure dimensions should be 17x20 cm and a resolution of at least 300 dpi. Combinations of photo and line art should be saved at 600–900 dpi. Text (symbols, letters, and numbers) should be between 8 and 12 points, with consistent spacing and alignment. Font type may be Serif (Times Roman) or Sans Serif (Arial). Any extra white or black space surrounding the image should be cropped. Ensure that participant-identifying information (i.e., faces, names, or any other identifying features) should be omitted. Each figure should be saved as a separate file without captions and named as Figure 1, etc. The preferred location of the figure in the main text should be indicated preferably in a style as follows: *** Figure 1 somewhere here ***.

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The journal uses the Harvard reference system (Publication Manual of the American Psychological Association, 6th ed., 2010), see also: https://www.apastyle.org). The list of references should only include work cited in the main text and being published or accepted for publication. Personal communications and unpublished works should only be mentioned in the text. References should be complete and contain up to seven authors. If the author is unknown, start with the title of the work. If you are citing work that is in print but has not yet been published, state all the data and instead of the publication year write „in print".

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Examples of reference citation in the text

One author: This research spans many disciplines (Enoka, 1994) or Enoka (1994) had concluded...

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Seven or more authors:
Only the first author is cited: Di Prampero et al. (2008) or (Di Prampero et al., 2008).

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Examples of reference list*:*
The style of referencing should follow the examples below:

Books
Latash, M. L. (2008). Neurophysiologic basis of movement. Campaign (USA): Human Kinetic.

Journal articles
Marušič, U., Meeusen, R., Pišot, R., & Kavcic, V. (2014). The brain in micro- and hypergravity : the effects of changing gravity on the brain electrocortical activity. European journal of sport science, 14(8), 813–822. https://doi.org/10.1080/17461391.2014.908959

Šimunič, B., Koren, K., Rittweger, J., Lazzer, S., Reggiani, C., Rejc, E., … Degens, H. (2019). Tensiomyography detects early hallmarks of bed-rest-induced atrophy before changes in muscle architecture. Journal of applied physiology, 126(4), 815–822. https://doi.org/10.1152/japplphysiol.00880.2018

Book chapters

Šimunič, B., Pišot, R., Mekjavić, I. B., Kounalakis, S. N. & Eiken, O. (2008). Orthostatic intolerance after microgravity exposures. In R. Pišot, I. B. Mekjavić, & B. Šimunič (Eds.), The effects of simulated weightlessness on the human organism (pp. 71–78). Koper: University of Primorska, Scientific and research centre of Koper, Publishing house Annales.

Rossi, T., & Cassidy, T. (in press). Teachers' knowledge and knowledgeable teachers in physical education. In C. Hardy, & M. Mawer (Eds.), Learning and teaching in physical education. London (UK): Falmer Press.

Conference proceeding contributions

Volmut, T., Dolenc, P., Šetina, T., Pišot, R. & Šimunič, B. (2008). Objectively measures physical activity in girls and boys before and after long summer vacations. In V. Štemberger, R. Pišot, & K. Rupret (Eds.) Proceedings of 5th International Symposium A Child in Motion "The physical education related to the qualitative education" (pp. 496–501). Koper: University of Primorska, Faculty of Education Koper, Science and research centre of Koper; Ljubljana: University of Ljubljana, Faculty of Education.

Škof, B., Cecić Erpić, S., Zabukovec, V., & Boben, D. (2002). Pupils' attitudes toward endurance sports activities. In D. Prot, & F. Prot (Eds.), Kinesiology – new perspectives, 3rd International scientific conference (pp. 137–140), Opatija: University of Zagreb, Faculty of Kinesiology.

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5. For additional information regarding article publication, please do not hesitate to contact the secretary of Annales Kinesiologiae.


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