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EDITORIAL

Motor activity is, next to cognitive and social, the activity that has accompanied humans through the evolution in a special way, defining man throughout as a unique earthly living being. Through the interaction of these three factors, an incredibly efficient and unrivaled system developed which perfectly meets the human need for work (imagine the work of a vascular surgeon, a neurosurgeon, a conservator, a pilot …), art and culture (picture a violin virtuoso, a painter or a sculptor, a dancer or an actor …), and sports (think of a gymnast's or a track and field athlete's command of their body; a skier's, or a tennis, basketball or soccer player's mastery of the necessary sports equipment …). However, the rapid development and diffusion of online technologies, communication via social media, and digitalization of society, the need for motor activity or, indeed, any kind of physical exertion has all but disappeared from daily life. The enormous increase in sedentary jobs (by no less than 83 percent since 1950) coupled with growing screen time (in children, adolescents and adults alike, which presently amounts to over 7.5 hours per day) is reflected in an ever more sedentary society (10 +/- 2h of sitting time per day) and seriously threatening human health. A sociology of sedentarism is dramatically on the rise and represents the new reality. It is safe to assume that the generations of children and adolescents who perceive this way of living as completely natural will be at even greater risk. The human organism may be uniquely flexible and plastic, but it is unrealistic to expect the physiological mechanisms established over millions of years to be able to change and adapt in such a short time. In ways unnoticeable and probably incomprehensible to most, physical inactivity is becoming public health enemy number one.

From the results of numerous studies based on these facts, we can conclude that we display safe and responsible health-related behavior when we engage daily in suitably intense physical activity for a sufficient amount of time, while allowing ourselves to be sedentary or physically inactive infrequently and for the shortest amounts of time possible. The ever emerging and progressively advanced studies in this field are aimed at discovering new possibilities and systemic solutions, shedding light on the grey areas, and proposing effective and systemic interventions, also by including the digitized world and modern technology. Their adaptability to an individual's role in modern society, one's profession, environment, and especially gender and age, is of the utmost importance. By studying the differences and mechanisms, as well as through a differentiation of selected interventions, and determination of the right intensity, length and content of exercise in real time, we can achieve better results, manage these factors better, and, above all, maximize their potential.

The first volume of this year's *Annales Kinesiologiae* journal provides fascinating views and new scientific facts that demonstrate the various aspects of the impact of motor activity, physical exercise and sports, both during childhood and adulthood, also highlighting the role of gender and, ultimately, the importance of defining the goal of the entire process. The latter can be achieving a target result in sports, enhancing the quality of a teaching process, or the reestablishment of functional balance – rehabilita-

tion. As always, the volume is rounded off by two reports: one introducing the Slovenian Mobile Brain/Body Imaging Laboratory (SloMoBIL), a new unit of the Laboratory of the Institute for Kinesiology Studies of the Science and Research Centre Koper, and the other presenting a recently published book: *Safe and with Joy on a Motorbike*. Even in these we can perceive the new horizons and fields where quality physical/sports activities can be a guarantee of health and success and, even more so, of safety and quality of life.

Rado Pišot, PhD, Editor-in-Chief

UVODNIK

Gibalna aktivnost je bila ob kognitivni in socialni tista, ki je človeka spremljala skozi evolucijo na prav poseben način in ga ves čas opredeljevala kot edinstveno zemeljsko živo bitje. V prepletu teh treh dejavnikov je človek razvil neverjetno učinkovit in edinstven sistem, ki je zadovoljeval njegove življenjske potrebe do dela (predstavljajmo si delo žilnega kirurga, nevrokirurga ali restavratorja, pilota …), umetnosti in kulture (virtuoz na violini, slikar ali kipar, plesalec, igralec …) ter športa (upravljanje z lastnim telesom telovadca ali atleta; z rekviziti smučarja, igralca tenisa; z žogo – nogometaša ali košarkarja …). S hitrim razvojem in razmahom spletnih tehnologij, komunikacije po socialnih omrežjih in digitalizacije družbe je potreba po gibalni aktivnosti in kakršnemkoli fizičnem naporu skorajda izginila iz vsakdanjega življenja. Enormen porast sedečih poklicev (kar za 83 % od leta 1950), ki se skupaj s povečanjem zaslonskega časa (otrok, mladostnikov in odrasle populacije – danes že več kot 7,5 ure dnevno) odraža v vedno bolj sedentrani družbi (čas sedenja okrog 10 ur), predstavlja resno grožnjo našemu zdravju. Sociologija sedentarizma je v grozljivem vzponu in predstavlja novo življenjsko realnost. Predvidevamo lahko, da bodo generacije otrok in mladostnikov, ki tak način življenja sprejemajo kot povsem naraven pojav, posledično še veliko bolj ogrožene. Človeški organizem je sicer edinstveno prilagodljiv in plastičen, vendar pa ni mogoče pričakovati, da bi se fiziološki mehanizmi, ki smo jih vzpostavljali milijone let, zmogli prilagoditi in spremeniti v tako kratkem času. Nezavedno in gotovo večini še nerazumljivo postaja tako gibalna neaktivnost prvi in največji sovražnik zdravja današnje družbe.

Upoštevajoč številne raziskave lahko na navedenih dejstvih zaključimo, da je varno in do našega zdravja odgovorno obnašanje takrat, ko skrbimo, da smo na dnevni ravni dovolj časa in ustrezno intenzivno aktivni, vendar moramo hkrati poskrbeti, da smo tudi čim manj časa in v čim krajših obdobjih sedeči oz. gibalno neaktivni. Vedno nove in naprednejše raziskave področja si za cilj med drugim postavljajo iskanje novih možnosti in sistemskih rešitev, osvetljevanje sivih con, odpiranje učinkovitih in sistemskih intervencij tudi z vključevanjem digitaliziranega sveta in sodobnih tehnologij. Gotovo je izredno pomembna prilagodljivost posamezni vlogi človeka v sodobni družbi, poklicu, okolju, predvsem pa spolu in starosti. S preučevanjem razlik in mehanizmov ter diferenciacijo izbranih intervencij, prilagojenega dimenzioniranja in vsebine vadbe v realnem času lahko iščemo večji učinek, lažje upravljanje omenjenih dejavnikov, predvsem pa njihov boljši izkoristek.

V prvem zvezku letošnje revije *Annales Kinesiologiae* nam avtorji ponujajo zanimive poglede in nova znanstvena dejstva, ki dokazujejo različne dimenzije vpliva gibalne aktivnosti, vadbe in športa tako v obdobju otroštva kot odraslosti, s pomembno vlogo spola in ne nazadnje opredeljenosti cilja samega procesa. Slednji je lahko podrejen športnemu rezultatu, kakovosti učnega procesa ali vzpostavljanju funkcionalnega ravnovesja – rehabilitaciji. Tudi tokratni zvezek zaključujemo z dvema poročiloma, in sicer predstavitvijo nove enote Laboratorija Inštituta za kineziološke raziskave ZRS Koper – Slovenian Mobile Brain/Body Imaging Laboratory (SloMoBIL) ter predstavitvijo

nove knjige *Varno in z veseljem na motor*. Tudi v slednjih lahko zaznamo nove širine in področja, na katerih kakovostna gibalna/športna aktivnost predstavlja zagotovilo za zdravje in uspeh, predvsem pa varnost in kakovostno življenje.

Prof. dr. Rado Pišot, odgovorni urednik

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TEACHING FEINTS TO HANDBALL BEGINNERS - PRELIMINARY RESULTS

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ABSTRACT

The aim of this preliminary research was the evaluation of a two-month program for improvement of the single forward feint to the left with passage to the right, and single forward feint to the right with passage to the left by "shifting" the opponent's hand. Sixteen young male handball players aged 9.64 ± 0.87 years participated in this study. The program was implemented over two months, during which 18 training sessions (35%) were conducted for the improvement of feint skills, from 52 training sessions overall. An initial video recording was made at the beginning of the period, and a final one at the end. Videos were analyzed by three experts, using a grading list and detailed grading criteria. The basic parameters of descriptive statistics were determined for both variables. The metric characteristics of the expert estimation contribution were analyzed through measures of reliability (Cronbach's α) and homogeneity (average item inter-correlation). The non-parametric (Wilcoxon t-test) method was used to analyze changes in the levels of feint performance at different times. The results indicate satisfactory reliability and homogeneity of the tests (α_1=0.90; r_1=0.80; α_2 =0.86; r_2=0.87). Through insight into the results, a significant difference was spotted between the initial and final states of both motor skills acquisitions (T_1 = 114.5, p= 0.01; T_2 =7.00; p= 0.01). The limiting factors of the study may be the sample size, as well as the absence of a control group and of a validated evaluation of the instrument.

Keywords: *motor skills, teaching methods, single feint, work program*

UČENJE »FINT« PRI ROKOMETAŠIH ZAČETNIKIH – PRELIMINARNI REZULTATI

IZVLEČEK

Cilj te začetne raziskave je bila ocena dvomesečnega programa za izboljšanje izvajanja enojnega lažnega koraka v levo s prehodom po desni ter enojnega lažnega koraka v desno s prehodom po levi in »odmikom« nasprotnikove roke. V raziskavi je sodelovalo šestnajst mladih rokometašev v starosti 9.64 ± 0.87 let. Program je trajal dva meseca, v tem času je bilo 18 od skupno 52 treningov (35 %) posvečenih izboljšanju izvajanja lažnih akcij oziroma t. i. fintiranja. Ob začetku izvajanja programa je bil posnet video, prav tako tudi ob koncu programa. Videoposnetka so analizirali trije strokovnjaki, ki so si pri ocenjevanju pomagali s podrobnim ocenjevalnim seznamom in kriteriji. Za obe spremenljivki smo določili osnovne parametre opisne statistike. Metrične vrednosti strokovnih ocen smo analizirali z vidika zanesljivosti (Cronbachov alfa) in skladnosti (povprečne interkorelacije med postavkami). Spremembe na ravni izvajanja lažnih akcij na različnih časovnih točkah smo analizirali z neparametrično metodo (Wilcoxonov test z rangi). Rezultati so pokazali zadovoljivo zanesljivost in skladnost preizkusov (α_1=0.90; r_1=0.80; α_2 =0.86; r_2=0.87). Pregled rezultatov je pokazal pomembno razliko med začetnim in končnim stanjem pri usvajanju obeh motoričnih sposobnosti (T_1 = 114.5, p= 0.01; T_2 =7.00; p= 0.01). Omejitve raziskave so velikost vzorca ter odsotnost kontrolne skupine in validacije instrumenta.

Ključne besede: *motorične spretnosti, učne metode, enojni lažni korak, delovni program*

INTRODUCTION

Since knowledge and skills can be taught and acquired in different ways, it is the task of a trainer, coach, or teacher to find the best one to achieve the defined goals. The modern handball game shows progress in this respect, as obligatory improvement of coaching competencies is being introduced in all aspects of teaching.

Despite the diversity of children's training programs, the role and the importance of playing the game is still a top priority in children's handball training sessions (Foretić, Burger, Rogulj, 2011). A game-focused approach could be an effective method when teaching team sports in which tactical solutions and decision-making periods on the court or in the field are rather short, as well as the periods of scoring in offensive and defensive games (Chatzipanteli, Digelidis, Karatzoglidis, & Dean, 2016; Hrynchenko, Tykhonova, Karpunets, & Chupryna, 2021).

Younger schoolchildren (6–10 years) take their first steps in organized handball training playing mini handball in handball schools. Mini handball is adapted for younger schoolchildren in many aspects: reduced playing field, soft small ball, a lower number of players on the team (4 plus the goalkeeper), shorter duration, the way of playing through individual tactical action in offences and defense, etc... For children included in this type of training activity, it is very important that their needs for security, belonging, and affection are met, as addressed by Milanović (2013), as well as their self-respect and self-actualization, which might be even more important than gaining motor knowledge and developing skills. The coach has a key role in creating such an environment. Often, a problem occurs because trainers treat children as if they are older than their actual age. Numerous authors have explained that the development of children has its principles and dynamics related to the specific developmental stages, which then, in turn, determine the pursued objectives (Balyi, Way & Higgs, 2013; Côté & Vierimaa, 2014; Lloyd et al., 2015). In this sense, creating and implementing a syllabus that is appropriate for a child's age and will, at the same time, foster high quality sports development, is a challenging task for handball coaches and teachers of beginners.

A shift from mini handball to team handball is not a simple process since the activity in question is complex. The game in the attack according to the playing positions in handball differs significantly from the free play throughout the field in mini handball. After playing defense individually in mini handball, it is necessary to learn how to function in an organized defending system. Focus on ball handling is more prominent than focusing on game stops due to body contact ('a foul'). To be more successful in the long run when playing defense, young handball players should begin learning new moving structures such as defense configurations 3:3 (zone formation) or 3+3 (combined formation) (Kanjugović, Ohnjec, Žnidarec Čučković, 2013). Malić and Dvoršek (2011) suggest that young players at that age should develop some basic elements of handball technique such as catching and passing, different shooting methods, as well as landing and using feints, whereas very detailed specialization is not yet desirable. The emphasis is on learning mostly technical, rather than tactical elements, so learning

feints and acquiring a habit of moving without the ball into an open area is extremely important to be able to deal with the situations in the game.

To teach methods of physical education and sport (PES) in classes, a teacher or a coach traditionally demonstrates certain elements and instructs the students on how to execute movements. This methodology has the theoretical basis in the cognitive approach, where the mind is the center of learning an activity (Raiola, 2017). The behaviorist and cognitivist theories suggest an exact and single solution model of a motor problem, and therefore are prescriptive in their nature (Raiola, 2017). Papić and Papić. (2014) mention the importance of adapting teaching methods to the children's needs and abilities by creating situations that enable a child to learn independently, without imitating a coach, and consequently without the need to be constantly corrected.

The aim of this study was the evaluation of a two-month program for improvement of a single forward feint to the left with passage to the right, and of a single forward feint to the right with passage to the left by "shifting" the opponent's hand.

METHODS

Sample

The sample consisted of 16 young handball players aged 8 to 11. All study participants were in their first year of actively competing in the national league for boys of their age. The parents of all the participants signed the program participation approval forms. The study used two variables for the evaluation of specific motoric skills:

1. a single forward feint to the left with passage to the right (FL), and
2. a single forward feint to the right with passage to the left by "shifting" the opponent's hand (FR).

Training program

The program was part of a regular training process (a total of 52 trainings) for two months. 18 sessions (35%) were focused on teaching feinting and structured exercises focused on repeating the new pattern of movement in the set conditions, then in situational exercises and during games of handball. The features of the feint teaching program included (Henigman & Ohnjec, 2021):

1. the learning of the two technical elements in a 50:50 ratio,
2. the use of the *kidGRID* sports equipment, a version of agility ladder (Papić & Papić, 2014) – a set for an independent learning of a movement,
3. repetition of a movement pattern in a real situation – after performing a moving structure by running through the *kidGRID* agility ladder; and after passing a passive hurdle immediately afterwards, a player was asked to implement this new

motor skill in the actual court situation by confronting an opponent in an attempt to score.

4. speed of performance – by adding a defending player who chased the attacker, the exercise was performed at almost maximum speed.
5. development of creativity – when confronting the opponent, the player had to perform a feint. However, this did not have to be the exact one performed on the agility grid since the player had to adapt to the real situation on the court.

It is important to add that after the application of the exercise, in every training session a game of handball was played.

An initial video recording was made at the beginning of the program, and a final one at the end. Four videos were analyzed by three experts using a grading list and detailed grading criteria. (grade 1 - inability to perform a feint, the player cannot catch the passed ball; grade 2 - the player breaks game rules when performing a feint – by walking, double dribbling or fouling the defending player; grade 3 - performing a feint in accordance with the game rules but with no accentuated change in movement direction; grade 4 – technically well but too slowly performed faint; grade 5 – technically well and swiftly enough performed feint). The criteria for the evaluation by the experts were formed according to a study conducted on students (Gruić, 2011) and adapted to the population of beginning handball players. The experts were coaches who had completed professional and university studies in kinesiology, licensed handball coaches, and coaches who have experience working with younger age athletes.

Statistical analysis

The basic parameters of the descriptive statistics were determined for both variables. The metric characteristics of the expert estimation contribution were analyzed by using measures of reliability (Cronbach's α) and homogeneity (average item inter-correlation). The non-parametric Wilcoxon t test was used to analyze changes in the levels of feint performance at different times.

RESULTS

Table 1 shows the basic metric characteristics of the expert estimation contribution when applying measures of reliability (Cronbach's α) and homogeneity (average item inter-correlation).

Table 1. Measures of internal agreement of expert evaluation criteria

		I	F	xα	xr
FL	Cronbach's α	0.93	0.87	**0.90**	
	Average item inter-correlation r	0.85	0.75		**0.80**
FR	Cronbach's α	0.88	0.84	**0.86**	
	Average item inter-correlation r	0.99	0.75		**0.87**

The results indicate a satisfactory reliability and homogeneity of the tests (α1=0.90; r1=0.80; α2 =0.86; r2=0.87). A somewhat lower reliability of the single forward feint to the right with passage to the left by "shifting" the opponent's hand tests (0.86) could be accounted for by a higher complexity of the feint, which subsequently caused more disagreement among the assessors.

The average values and standard deviations of the skill levels graph (Figure 1) demonstrate a total average improvement of both motor structures. An average grade of the basic feint rose from 2.88 to 3.52, and from 1.84 to 2 in the case of the more complex structure.

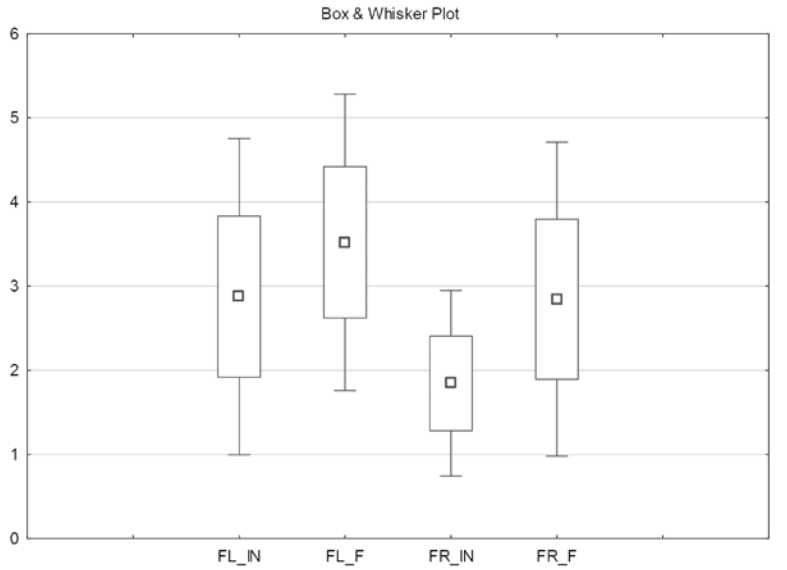

Figure 1. Average values and standard deviations of the level of knowledge in the initial and final states.

The table of Wilcoxon t-test results (Table 2) indicates a significant difference between the initial and final states of learning for both motor skills.

Table 2. Wilcoxon t-test

Pair of Variables	T	Z	p-value
FL_IN & FL_F	114.50	3.28	0.00
FR_IN & FR_F	7.00	4.46	0.00

** FL_IN - a single forward feint to the left with passage to the right - initial measurement*
FL_F - a single forward feint to the left with passage to the right - final measurement
FR_IN - a single forward feint to the right with passage to the left by "shifting" the opponent's hand - initial measurement
FR_F - a single forward feint to the right with passage to the left by "shifting" the opponent's hand - initial measurement

DISCUSSION

This preliminary study presents the effects of a two-month training program of teaching the two types of feints to handball beginners. Initial grading values, for the simple feint to the left with a passage to the right – basic feint (2.88), are slightly higher than for the feint to the right (1.84). An explanation for this could be in the "natural" way of performing the basic feint and its more frequent spontaneous application in the training process. The maximum grade in initial testing of the basic feint was 5, and minimum 1. After the training program was applied, the number of maximum grades increased, and the lowest grade was 2. Lower grades in the single forward feint to the right with passage to the left by "shifting" the opponent's hand assessment tests at both time points might be due to the more complex structure of this feint in comparison with the basic one. The level of coordination may be responsible for the success of this feint. In team-handball, optimal movement coordination is a main determinant of success in throwing performance (proximal-to-distal sequencing, upper body rotation, adaptations to different situations), jumping performance (block, jump throw, with one leg or both legs, with or without run-up) and specific agility (in offense and defense, short accelerations, changes in direction) (Wagner, Finkenzeller, Würth & Von Duvillard, 2014). When comparing the initial and final assessment results, the average grade for the simple feint with the passage to the right - basic feint, increased by 0.64 (from 2.88 to 3.52), while the difference between the average grade in the initial (1.84) and final tests (2.84) of the second feint passage was 1.00. Because of the young age and inexperience, the subjects made many technical mistakes that included dropping the ball, untimely run-up, or taking too many steps when performing the elements. In the initial measurement, the rate of performance with technical errors was 33% for the first

feint and 91% for the second. In the final measurement, the rate for performance with technical errors observed dropped to 17% for the first feint and 38% for the second. Although this resulted in relatively lower average grades, the program implemented on the given sample, nevertheless, confirmed that the ball feinting motor skills can be significantly improved in two months. T“he increase of the average grade in both skills (FL 2.88–3.52, FR 1.84–2.84), as well as statistically significant differences established between the initial and final performance of both body feints demonstrate the progress in the subjects' performance of the feints after the implementation of the training program. Fasold, Houseman, Noel, and Klatt (2020) presented similar results when researching specific handball skill acquisition using different instruction methods (step-by-step and analogy instructions). They concluded that both coaching strategies improved the young athletes' performances of the task at which they were relatively unexperienced (i.e., body feint).

CONCLUSION

Based on the results of this preliminary study, the conclusion is that the subjects improved their knowledge and skills after the applied training program. The limiting factors of the study might be the small sample size used, the absence of a control group, and the lack of a validated evaluation of the instrument. Due to the complexity of the assessment of technical elements in handball, it is not easy to include the whole of the application possibilities of these skills in situational conditions. Therefore, one of the recommendations for some future research is to find a way to establish a statistically relevant connection between the program for acquiring or improving a certain element, and its situational application in the game. The results of this preliminary study might also be encouraging, and inspire the coaches of young athletes, to both create new programs as well as to evaluate their efficiency.

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PREVALENCE OF DEPRESSION AND ANXIETY SYMPTOMS AMONG FEMALE FOOTBALL PLAYERS AND NON-PLAYERS

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ABSTRACT

Purpose: *Depression and anxiety are mental illnesses which affect many people worldwide. The purpose of this study is to determine the prevalence of depression and anxiety symptoms among Slovenian female football players and non-players.*

Methods: *The sample consisted of Slovenian female football players playing in the Slovenian 1st female football league or youth league (n = 78) and non-player peers (n = 120) with an average age of the total sample 22±4 years. The participants filled out a questionnaire including some general questions (age, physical activity levels, participation in competitive sports), Beck Depression Inventory (BDI-II), Beck Anxiety Inventory (BAI), and Depression, Anxiety and Stress Scale (DASS-21).*

Results*: The most commonly observed were normal and mild levels of depression and anxiety. According to the results of depression in BDI-II, 43.6% of athletes experienced moderate to severe depression compared to 15.8% of peers (p = 0.001). Results from DASS-21 show that 71.8% of athletes experience normal to mild symptoms of depression and 56.4% experience the same levels of anxiety. Similarly, 75% of peers experience normal to mild depressive symptoms and 56.7% reported normal to mild symptoms of anxiety. No statistical differences were found in these categories.*

Conclusion: *We have gained insight into the current prevalence of depression and anxiety among female football players and their peers but more research needs to be done.*

Keywords*: depression, anxiety, prevalence, female football players, adolescence*

PREVALENCA SIMPTOMOV DEPRESIJE IN ANKSIOZNOSTI MED SLOVENSKIMI NOGOMETAŠICAMI IN NJIHOVIMI VRSTNICAMI

IZVLEČEK

Namen: *Depresivnost in anksioznost sta duševni bolezni, ki prizadeneta večje število ljudi po vsem svetu. Namen raziskave je ugotoviti prevalenco simptomov depresije in anksioznosti med slovenskimi nogometašicami in njihovimi vrstnicami.*

Metode: *Vzorec predstavljajo nogometašice, ki nastopajo v prvi slovenski ženski nogometni ligi in ligi kadetinj do 17 let in njihove vrstnice. Povprečna starost znaša 22 let ± 4 leta. V raziskavi je sodelovalo 232 merjenk, 198 jih je v celoti izpolnilo vprašalnik (85,34 %), od tega 78 nogometašic. Vprašalnik je vseboval splošna vprašanja o starosti, stopnji aktivnosti, sodelovanju v tekmovalnem športu in stopnji izobrazbe ter Beckov vprašalnik depresivnosti (BDI-II), Beckov vprašalnik anksioznosti (BAI) in vprašalnik depresivnosti, anksioznosti in stresa (DASS-21).*

Rezultati; *Rezultati BDI-II kažejo, da je 43,6 % nogometašic občutilo zmerno do resno stopnjo simptomov depresije, v primerjavi s 15,8 % vrstnic (p = 0,001). Rezultati DASS-21 kažejo, da ima 71,8 % nogometašic normalne do blage simptome depresije in da jih 56,4 % občuti normalne do blage simptome anksioznosti. Podobno, 75 % vrstnic doživlja normalne do blage simptome depresije in 56,7 % anksioznost enake stopnje. V teh kategorijah nismo ugotovili statistično značilnih razlik med skupinama.*

Zaključek: *Z raziskavo smo dobili vpogled v trenutno stanje pojavljanja simptomov depresivnosti in anksioznosti med nogometašicami in njihovimi vrstnicami, vendar je za zanesljivejše sklepe potrebno dodatno raziskovanje področja duševnega zdravja.*

Ključne besede: *depresivnost, anksioznost, prevalenca, nogometašice, adolescenca*

INTRODUCTION

Depression is a common mental disorder which affects more than 300 million people worldwide and is a big risk factor for suicide. Prevalence of depression varies across countries, from 1.5% in Taiwan to 19% in Beirut (Bromet et al., 2011). In European countries the lifetime prevalence of major depression is 11.32% and the average 12-month prevalence is 5.2% (Gutiérrez-Rojas, Porras-Segovia, Dunne, Andrade-González, & Cervilla, 2020). The disorder manifests as constant sadness, loss of interest in activities that used to be enjoyable, and the inability to complete everyday chores, the condition lasting for at least two weeks. Common symptoms are lack of energy, changes in appetite or weight, disruptive sleep disorders, anxiety, lack of attention, feelings of guilt and self-harm or suicidal thoughts (World Health Organization, 2021). The first onset of depression occurs in adolescence with 5% in early adolescence and 20% in late adolescence. A high number of adolescents displaying some of these symptoms do not get diagnosed and are not treated, even though that increases the risk factors for depression in later life (Alaie et al., 2019). Throughout the history of depression research, there have been many explanatory theories, most widely known are biological ones claiming depression develops due to lack of noradrenaline, endocrine disorders, sleep disturbances, changes in brain structures, and genetics. Psychological theories explain depression through psychoanalysis, attachment theory, behavioral models, cognitive models, self-control models, interpersonal theory, stressful life events, and sociocultural models (Bernaras, Jaureguizar, & Garaigordobil, 2019).

High-risk groups for depression are suicide attempt survivors, and people with exceptional psychosocial stress, mental disorders (anxiety, psychosis, addictions), or family history of depression, those suffering from chronic conditions, people with an unexplained somatic syndrome, frequent users of health services, post-partum women, and people with diabetes mellitus (Konec Juričič, Roškar, & Jelenko Roth, 2016).

Depression disorders differ in the duration, intensity and periods during which they occur. Disruptive dysregulation mood disorder is a chronic condition characterized by highly expressed irritability. There are two clinical manifestations, the first is frequent outbursts of anger as a response to frustration which occur at least three times a week for at least one year in two different settings. Angry outbursts can be verbal or behavioral, e.g., aggression towards objects, the self or other people. The second manifestation occurs during outbursts of anger, when an individual is chronically irritated or angry and is present most days. The disorder first presents itself before the age of 10, symptoms changing during adolescence. Children and adolescents affected by disruptive dysregulation mood disorder are more prone to developing depression and anxiety in adult life (American Psychiatric Association, 2013).

Major depressive disorder or clinical depression is characterized by a depressed mood throughout the whole day most days, in children and adolescents manifested as irritability. Clinical depression causes a lack of interest in previously enjoyed everyday activities, extreme weight loss or weight gain, insomnia or hypersomnia, psychomotor agitation or retardation, tiredness or lack of energy, feelings of guilt, lack of ability to

think and concentrate, thoughts about death, suicidal thoughts without a plan, suicide planning, and suicide attempt (Bernaras et al., 2019). Clinical depression has a high mortality rate, mostly by suicide. The course of the disease is variable, some people never or very rarely experience remission while others can live without symptoms for years (American Psychiatric Association, 2013).

Dysthymia or persistent depressive disorder is defined as chronic clinical depression and dysthymic disorder and manifests as a depressive mood throughout most days for at least two years. The prevalence of this disorder in the US is 0.5% (Bernaras et al., 2019).

Premenstrual dysphoric disorder is diagnosed when during the majority of menstrual cycles at least five of the following symptoms are present: emotional lability, intense irritability, anger or interpersonal conflicts, depressive mood and/or anxiety symptoms, which can be accompanied by behavioral or somatic symptoms. Prevalence of this disorder is 1.8% among women, with 1.3% of women experiencing functional impairment (Bernaras et al., 2019).

Substance or medication-induced depression can be caused by substances or medication, as the appellations suggest. It is defined as the presence of depressive symptoms after usage of a certain substance that persist even after the physiological effects have disappeared. This type of depression can be induced by drugs, toxins, psychotropic drugs and others and it develops in the first month of use. Prevalence in the US is 0.26% (Bernaras et al., 2019).

Anxiety is a common name for many mental disorders which are usually exhibited as excessive fear and worry. Anxiety disorders are prevalent worldwide, ranging from 3.8 to 25%; furthermore their prevalence among people with chronic conditions is 70%. Anxiety is a feeling of fear, worry or nervousness and often includes feelings of distress, powerlessness and a somatically aroused central nervous system. It often prompts responses to perceived danger which can be real or imaginary. There are different types of anxiety disorders: generalized anxiety disorder, social anxiety, separation anxiety, panic disorder and others. Anxiety is correlated with risk factors for cardiovascular conditions (Freidl et al., 2017; Kandola et al., 2018). Anxiety disorders can have different causes but are often a consequence of temperament, early experiences and specific life events (Barlow, 2000). Among the causes is heightened sensitivity to negative events, threatening objects or information, which increases the risk of negative feelings. The anxiety disorder is characterized by increased physiological responses, including dry mouth, nausea, feeling unwell, chest pain and shortness of breath.

The second cause is the child's feeling of not being able to control things like behaviour of their parents or peers and the tendency to react negatively to stressful events. The third cause is specific life events and experiences, such as trouble in the child's parents' relationship, dangerous attachment, critical parents with high expectations or anxious parents (Dobnik Renko, 2020).

Anxiety disorders that develop in early childhood can become chronic and have a high probability of recurrence. The presence of anxiety during adolescence increases the likelihood of the individual developing anxiety in adult life by two to three times

and similarly increases the risk of developing depression in adult life. Adolescents that suffer from anxiety have trouble in different areas such as general health, schoolwork, and later in adult life physical and cognitive functions. Proven risk factors that are the same for the development of anxiety and depression are female gender and stressful life events. In addition, loneliness, emotional reliance and dysfunctional relationships in the family or with peers also increase the risk of developing depression and anxiety (Essau, 2003; Essau, Lewinsohn, Olaya, & Seeley, 2014; Lewinsohn, Rohde, & Seeley, 1998; Woodward & Fergusson, 2001).

Depression and anxiety are fairly present among athletes, especially younger ones - both disorders are prevalent in 15.6% to 21% of student-athletes who are more exposed to certain risk factors than the general population. These include injuries, unfulfilled expectations, and overtraining (Wolanin, Gross, & Hong, 2015). Important factors are various personal characteristics, including perfectionism, poor negative-stress coping skills, and internal attributions for failure, poorer performance than expected, guilt and shame (Nixdorf, Beckmann, Nixdorf, & Nicholls, 2020). In a female football team consisting of 18 to 26 players, 2 to 4 players (14%) show serious signs and symptoms of depression. Groups of second league players who are younger than 20 years old, have less competitive experience, who describe their health as average or poor, and less frequently start the games are at greater risk of developing depression and anxiety (Junge & Prinz, 2018). The main causes of anxiety among elite athletes are pressure from competition, media, career instability or dissatisfaction, and injuries. Female gender, younger age and less experience in competing increase risk factors for developing anxiety disorder (Rice et al., 2019; Rocha & Osório, 2018).

The prevalence of mild to severe depression among female athletes ranges from 9.8% to 36.5% (Gorczynski, Coyle, & Gibson, 2017).

The aim of this research is to determine the prevalence of depression and anxiety among Slovenian female football players and their non-player peers and compare the prevalence in order to find differences between the two groups.

METHODS

Participants

The sample consisted of Slovenian female football players who play in the Slovenian 1st female league or youth league and their non-player peers. The average age of subjects was 22±4 years. The upper age limit was 35 years, whereas the lower age limit was 15. The sample consisted of 232 subjects of which 198 filled out the questionnaires completely (85.34%), 78 of them were football players aged 19.3±3.9, and 120 were non-active peers aged 23.3±4.2. Football players were contacted through club and national team coaches and physical education teachers who invited them to participate. Non-players were selected from two sources: the same high schools as football players, reached via physical education teachers, and faculties of the University of Ljubljana,

via student organizations. All of the subjects decided to participate in the study voluntarily with no compensation.

Instruments

We used three questionnaires that were translated into the Slovenian language: Beck Depression Inventory-II (BDI-II), Beck Anxiety Inventory (BAI), and Depression, Anxiety and Stress Scale (DASS-21). We added general information questions about age, activity levels and participation in competitive football. All questionnaires are self-reported measures of depressive or anxiety symptoms. BDI-II is a 21-item questionnaire that assesses an individual's depressive symptoms over the course of 2 weeks. It uses a 4-level scoring scale from 0 (not at all) to 3 (severe). Scores are summed to derive depressive symptoms severity: scores between 0 and 13 represent minimal depression, between 14 and 19 mild depression, between 20 and 28 moderate depression, and between 29 to 63 severe depression. Cronbach's alpha of BDI-II is 0.844.

BAI consists of 21 questions about anxiety symptoms and its purpose is to distinguish anxiety from depression. It uses a 4-level scoring scale from 0 (not at all) to 3 (severe). Scores are calculated as a sum of all, where scores between 0 and 7 represent minimal anxiety, between 8 to 15 mild anxiety, 16 to 25 moderate anxiety, and 26 to 63 severe anxiety. Cronbach's alpha of BAI is 0.875.

DASS-21 is an abbreviated version of Lovibond and Lovibond's 42-item Depression, Anxiety and Stress Scale (DASS) and has been constructed to measure multiple dimensions of depression, anxiety and stress. It consists of 21 questions, 7 per dimension, which are scored on 4 levels: 0 (not at all) to 3 (severe). The maximal score in each dimension is 21. We only used scores for depression and anxiety (Lovibond & Lovibond, 1995). Cronbach's alpha of DASS-21 is 0.710 for the anxiety subscale and 0.804 for the depression subscale.

All of the questionnaires were translated into the Slovenian language as an internal tool by psychological office Brst psihologija.

Procedure

Before participating in the study, underage subjects needed to obtain a legal guardian's consent. The participants connected to an online call where they were sent a link to the questionnaires. They remained on the online call the whole time during answering in order to have the option to ask questions if needed.

Statistical analysis

Statistical analysis was conducted in IBM SPSS 25 (SPSS Inc., Armonk, NY, USA) and the data were edited in Microsoft Excel 2019 (Microsoft Corporation, Redmond, Washington, USA). Frequency distribution was calculated for descriptive variables, and averages and standard deviations were calculated for numerical variables. We used cross-tabulations to get prevalence among football players and non-players. As data were not normally distributed, we used the Mann-Whitney test to examine differences.

RESULTS

Results of the BDI-II presented in Table 1 show that 47.4% of football players have experienced minimal depression, 9% have experienced mild depression and 43.6% show symptoms of moderate to severe depression. In comparison, 64.2% of their peers report minimal depression, 20% mild depression, and 15.8% moderate to severe depression. In football players the mean score was 15.65±9.5 and for non-player peers the mean score was 11.32±8.4. The Mann-Whitney test revealed differences between the groups ($p = 0.001$).

Table 1. Depressive symptoms categories (BDI-II) in female football players and non-players

Group		BDI_II depressive symptoms categories			
		Minimal	Mild	Moderate to severe	Total
Football players	Count	37	7	34	78
	% of the group	47.4%	9.0%	43.6%	100.0%
Non-players	Count	77	24	19	120
	% of the group	64.2%	20.0%	15.8%	100.0%
Total	Count	114	31	53	198
	% of Total	57.6%	15.7%	26.8%	100.0%

Results of depression symptoms from the DASS-21 questionnaire (Table 2) show that 71.8% of female football players experience normal to mild levels of depression, while 10.3% show severe to extremely severe symptoms of depression. The same questionnaire gave similar results for the peer group – 75% of peers report experiencing

normal to mild levels of depression and 11.7% serious to severe depression. Football players' mean score was 9.13±7.5 and non-player peers' mean score was 9.33±8.4. The Mann-Whitney test revealed no differences between the groups (p = 0.703).

Table 2. Depressive symptoms categories (DASS-21) in female football players and non-players

Group		DASS-21 depressive symptoms categories			
		Normal to mild	Moderate	Severe to extremely severe	Total
Football players	Count	56	14	8	78
	% of the group	71.8%	17.9%	10.3%	100.0%
Non-players	Count	90	16	14	120
	% of the group	75.0%	13.3%	11.7%	100.0%
Total	Count	146	30	22	198
	% of Total	73.7%	15.2%	11.1%	100.0%

Results of the BAI (Table 3) show that 79.5% of female football players experience low levels of anxiety, similar to 75% of their peers. According to the results of this questionnaire, none of the football players shows symptoms of severe anxiety. Football players mean score was 14.36±8.5 and non-player peers mean score was 14.22±9.8. The Mann-Whitney test revealed no differences between the groups (p = 0.387).

Results of anxiety symptoms from the DASS-21 questionnaire (Table 4) show that 56.4% of football players experience normal to mild levels of anxiety, similarly to 56.7% of their peers. Results for moderate, severe and extremely severe levels of anxiety were similar in both groups – 21.8% of female football players report moderate levels of anxiety, as do 21.7% of their peers. Prevalence for severe to extremely severe anxiety were 21.8% in football players and 21.7% in their peer group. Football players' mean score was 9.13±7.5 and non-player peers' mean score was 9.9±7.6. The Mann-Whitney test revealed no differences between the groups (p = 0.973).

Table 3. Anxiety symptoms categories (BAI) in female football players and non-players

Group		BAI anxiety symptoms categories			
		Minimal	Mild	Severe	Total
Football players	Count	62	16	0	78
	% of the group	79.5%	20.5%	0.0%	100.0%
Non-players	Count	90	25	5	120
	% of the group	75.0%	20.8%	4.2%	100.0%
Total	Count	152	41	5	198
	% of Total	76.8%	20.7%	2.5%	100.0%

Table 4. Anxiety symptoms categories (DASS-21) in female football players and non-players

Group		Anxiety symptoms categories			
		Normal to mild	Moderate	Severe to extremely severe	Total
Football players	Count	44	17	17	78
	% of Football players	56.4%	21.8%	21.8%	100.0%
Non-players	Count	68	26	26	120
	% of Football players	56.7%	21.7%	21.7%	100.0%
Total	Count	112	43	43	198
	% of Total	56.6%	21.7%	21.7%	100.0%

DISCUSSION

Prevalence of depression and anxiety differ due to many factors: demographic variables, physical health variables, mental health variables, and sociocultural elements. We used only female football players who live in Slovenia and their non-player peers from the same environment. The response rate for our research was 85.34%. Slovenian female football players are not professionals, which means their primary income is not from playing football. Consequently, they are exposed to more risk factors for developing depressive or anxiety symptoms because their risk factors are combined from foot-

ball and everyday life. It is widely known that minor everyday problems or long-term stress create higher stress levels than major life events (Beable, Fulcher, & Lee, 2017). These risk factors can be the same as for their peers with the addition of stress coming from the football setting. We measured point prevalence for different levels of depression and anxiety and compared the groups.

This study focused on self-reported measures of depression and anxiety symptoms and was conducted during the COVID-19 pandemic, which could have affected the results of the study. The pandemic caused psychological and social problems for a major proportion of the world's population. 53.8% of Chinese residents described the effect of the pandemic as moderate to serious to their mental health. Strict lockdowns caused people to move away from each other, both physically and emotionally. Lack of interpersonal contact can cause or worsen depression and anxiety and also the symptoms of both disorders. In addition, women are more prone to developing depression thus there are more chances they have been more affected during the pandemic than males. Also, the period was more stressful for high school and college students who had more distance learning and more uncertainty about going back to school or college, which may be one of the reasons for the increased incidence of depression and anxiety. Younger generations are more likely to use social networks, which can contain incorrect information, which can trigger feelings of anxiety, as well as tabloids (Ustun, 2021). In Slovenia, sports competitions were limited and even cancelled for a while, for a certain amount of time group training was not allowed either. These measures have had different effects on athletes. Results of the questionnaires can differ depending on the part of the season; this research was conducted during the winter break of the 2020/21 season. Knowing that the pandemic is a state of emergency, this has to be taken into account while interpreting the results as every individual responds and adapts in their way.

Our study has found significant differences between groups in depressive symptoms according to the results of BDI-II, showing that moderate to severe depression was more present in a group of football players who have experienced additional stress compared to their peers due to stopped competition and limited training processes. People who experience exceptional psychosocial stress are more prone to developing depression and as mentioned, a pandemic is a state of emergency which triggers different responses in every individual and depressive symptoms can be one of them. Ustun (2021) found that 65.8% of the research subjects felt deprived of social life and entertainment, which can cause symptoms of depression especially among extroverted people. Differences can also be seen due to the high sensitivity of the questionnaire. Beck Depression Inventory and Beck Anxiety Inventory do not have validated translations in the Slovenian language, meaning that their results cannot be applied to the whole population. Still, the questionnaires are well-accepted self-report measures for depression and anxiety, in both clinical and research settings.

Most research about depression and anxiety among athletes is done on individual sports athletes, retired athletes, and student-athletes, especially in the US and UK (Lebrun, MacNamara, Rodgers, & Collins, 2018; Newman, Howells, & Fletcher, 2016). This research has studied females from a team sport and their non-player peers, which

is a less researched area. Junge & Feddermann-Demont (2016) found that 2.3 female football players experience at least mild symptoms of depression, which represented 13% of their sample. Similar to our study, they found that depression was similarly present in the general female population. Anxiety symptoms were present among 1.4% of the players and half of these had had accompanying symptoms of depression. According to this study, anxiety symptoms are less common among athletes than in the general population. Even though our research did not find statistically significant differences between most groups, depression and anxiety are conditions that are more common worldwide and the pandemic only increased the number of affected people. Due to this growth, it is important to talk about it to make the public aware and also scientifically support the findings in order to reduce the incidence of mental illness. In the future, we would like to see more research on this topic and thus alleviate the symptoms of individuals affected by these disorders.

CONCLUSION

In conclusion, this study has offered an insight into the current situation among Slovenian female football players and their peers. Despite the size of the sample, we have not reached strong conclusions. Most commonly observed were symptoms of normal to mild levels of depression and anxiety among both groups from the questionnaires, which is not concerning. This study provided a start of research during the COVID-19 pandemic and the outcomes, as mentioned before, are not too concerning. This area of research needs more attention, especially after the pandemic which has influenced individuals differently, and after strong scientific conclusions have been reached, recommendations need to be made in order to lower the prevalence and some of the risk factors of depression and anxiety. A very important factor is the identification of individuals prone to psychological disorders and the preservation or improvement of their mental health.

Limitations of the Study

A number of limitations can be noted. The standardized questionnaires that were used do not have a validated translation in the Slovenian language and the results cannot be generalized to the whole population. Participants completed the questionnaire online and this may have affected the results. The study could have been improved with a bigger sample size and with a randomized sample for both groups.

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INTEGRATING PHYSICAL ACTIVITY IN MATHEMATICS LESSONS – A PILOT STUDY

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ABSTRACT

Introduction: *The aim of the study was to investigate the effect of teaching mathematics through physical activity tasks in the sixth grade. With an accelerometer we measured the amount and intensity of physical activity and the time of physical inactivity during school hours and, particularly, during mathematics lessons.*

Methods: *Twenty-two sixth graders from a Slovenian primary school participated in the study. The experimental group consisted of 16 students and the control group consisted of 6 students. Mathematics lessons were planned together with the mathematics teacher. This was then carried out in the experimental group. In the control group, the mathematics lessons remained unchanged. The intervention lasted for one week. For the duration of the experiment, students wore an accelerometer on their right hip during school hours.*

Results: *We found that the experimental group engaged in moderate to vigorous intensity physical activity for 7.8 minutes more during mathematics lessons ($P < 0.001$) than the control group. In addition, the experimental group was less physically inactive during math lessons for 6.7 minutes ($P = 0.001$) than the control group. Physical activity during school hours did not differ between groups ($P = 0.284$). Nevertheless, the experimental group spent slightly more time at moderate to vigorous intensity during school hours than the control group and was less physically inactive.*

Conclusion: *This study showed that integrating physical activity with mathematics in the academic classroom results in increased moderate to vigorous physical activity compared to a traditional classroom. Further research should be conducted to deter-*

mine how integrating physical activity with various school subjects affects daily physical activity in children and adolescents.

Keywords: *children, sixth grade, moderate to vigorous intensity, accelerometer*

VKLJUČEVANJE GIBALNE AKTIVNOSTI V URE MATEMATIKE - PILOTNA ŠTUDIJA

IZVLEČEK

Uvod: *Cilj raziskave je bil ugotoviti učinek vključevanja gibalne/športne aktivnosti v ure matematike na količino in intenzivnost gibalne/športne aktivnosti učencev med šolskim časom in v času ur matematike.*

Metode: *V raziskavo je bilo vključeno 22 šestošolcev iz slovenske osnove šole. V eksperimentalno skupino je bilo vključenih 16 učencev, v kontrolno pa 6. Z učiteljico matematike smo načrtovali ure matematike z gibanjem, ki jih je izvajala le v eksperimentalni skupini. Kontrolna skupina pa je imela ure matematike nespremenjeno, na klasičen način. Raziskava je trajala en teden in v tem obdobju so učenci v času šolskega pouka okoli pasu nosili pripet merilnik pospeška.*

Rezultati: *Ugotovili smo, da so bili učenci eksperimentalne skupine deležni za 7,8 minut več srednje do visoke intenzivnosti gibalne/športne aktivnosti v času ur matematike ($P < 0.001$) v primerjavi z učenci kontrolne skupine. Prav tako so bili učenci eksperimentalne skupine pri urah matematike za 6.7 minut manj gibalno neaktivni ($P = 0.001$) kot učenci kontrolne skupine. Gibalna/športna aktivnost v celotnem šolskem času pa se med skupinama ni razlikovala ($P = 0.284$). Kljub temu se je eksperimentalna skupina v šolskem času zadrževala nekoliko več časa v srednji do visoki intenzivnosti ter bila manj gibalno neaktivna kot kontrolna skupina.*

Zaključki: *Raziskava je pokazala, da z vključitvijo gibalne/športne aktivnosti v ure matematike lahko povečamo čas zadrževanja v srednji do visoki intenzivnosti gibalne/športne aktivnosti med urami matematike. V prihodnje bi bilo potrebno narediti več raziskav o tem, kako vpliva vključitev gibalne/športne aktivnosti v različne šolske predmete na količino in intenzivnost gibalne/športne aktivnosti otrok v šolskem času.*

Ključne besede: *učenci, šesti razred, srednja do visoka intenzivnost, merilniki pospeška*

INTRODUCTION

Today, children worldwide are not getting enough physical activity (PA) and are not meeting the minimum recommendations for moderate to vigorous physical activity (MVPA) (Institute of medicine, 2013; NASPE, 2019; Szabo-Reed, Willis, Lee, Hillman, Washburn & Donnelly, 2017; WHO, 2019). There is compelling evidence of the benefits of regular PA for a variety of health outcomes, from prevention of cardiovascular disease (Penedo & Dahn, 2005; Warburton, Nicol & Bredin, 2006), diabetes (Warburton et al., 2006), hypertension (Warburton et al., 2006), to various cancers (Penedo & Dahn, 2005). Physical activity has benefits only if done regularly and at an appropriate intensity. It is recommended that children engage in physical activity at MV intensity for at least 60 minutes each day (Institute of medicine, 2013; NASPE, 2019; Szabo-Reed et al., 2017; WHO, 2019). Children spend a large amount of time at school each day being physically inactive (Szabo-Reed et al., 2017). One of the ways to increase physical activity in school is to integrate it into school learning (Institute of medicine, 2013; Szabo-Reed et al., 2017).

All over the world there are various programs that combine physical activity tasks with academic learning, such as "Energizers" (Mahar, Murphy, Rowe, Golden, Shields & Raedeke, 2006), "I-CAN!" (Bartholomew, Golaszewski et al., 2018; Bartholomew, Jowers et al., 2018; Bartholomew, Jowers & Golaszewski, 2019), "Move for Thought" (Vazou, Saint-Maurice, Skrade & Welk, 2018; Vazou & Skrade, 2016), "Move-to-Improve" (Dunn, Venturanza, Walsh & Nonas, 2012), "Take10!" (Goh, Hannon, Webster, Podlog & Newton, 2016; Reilly, Buskist & Gross, 2012; Stewart, Dennison, Kohl & Doyle, 2004), "Activity Bursts in the Classroom for Fitness" (Katz et al., 2010), "Instant Recess" (Whitt-Glover, Ham & Yancey, 2011), "Bizzy Break" (Murtagh, Mulvihill & Markey, 2013), "ExCiTE" (Innerd, Azevedo & Batterham, 2019), "FUNtervals" (Ma, Mare & Gurd, 2014; Ma, Mare & Gurd, 2015), "Physical Activity across the Curriculum" (Donnelly et al., 2009, Donnelly et al., 2017; Donnelly & Lambourne, 2011; Mullender-Wijnsma, Hartman, De Greeff, Bosker, Doolaard & Visscher, 2015a; Szabo-Reed et al., 2017), and "Happy 10" (Liu et al., 2007).

To increase PA during school time among Slovenian children, various programs have been used, such as "Aktivna pot v šolo in iz nje – Pešbus" (Institute for spatial policies, 2020), "Aktiven šolski odmor" (Jurak et al., 2016), "Minuta za zdravje" (Jurak et al., 2016), "Dodatna ura športa v podaljšanem bivanju" (Subotić, 2012), and "Fit Slovenija" (Fit Slovenia, 2019). However, there are few studies that have integrated physical activity into non-physically-active lessons (Bratož, 2015; Cotič, Ivanič & Žakelj, 2010; Rabuza, 2010; Volk, 2015).

Other countries (Donnelly et al., 2009; Innerd et al., 2019; Kibbe et al., 2011; Martin & Murtagh, 2015; Norris, Van Steen, Direito & Stamatakis, 2020; Vetter, Orr, O'Dwyer & O'Connor, 2020) have investigated the impact of integrating physical activity into school lessons on the quantity and intensity of children's physical activity. Many of these studies included PA in mathematics (Innerd et al., 2019; Kibbe et al., 2011; Martin & Murtagh, 2015; Vetter et al., 2020) or languages lessons (Innerd et al., 2019; Kibbe

et al., 2011; Martin & Murtagh, 2015). They indicated that active learning in the classroom successfully increased the amount, duration, and intensity of PA. Active learning could increase children's PA for 2.8 to 7.7 minutes (Bartholomew, Golaszewski et al., 2018; Daly-Smith, Zwolinsky, McKenna, Tomporowski, Defeyter & Manley, 2018; Donnelly et al., 2009; Innerd et al., 2019; Institute of medicine, 2013; Kibbe et al., 2011; Martin & Murtagh, 2015; Norris et al., 2020; Szabo-Reed et al., 2017; Vazou et al., 2018; Vetter et al., 2020). Similar results were obtained in studies from Slovenia. Ajdovec (2017) investigated the effect of integrating PA into non-physically active lessons on physical inactivity; on the other hand, Ovčjak (2016) integrated PA into music lessons and assessed the amount and intensity of PA during these lessons.

Many of these studies were conducted with children from 1st to 4th grade. Global trends suggest that PA decreases even further as children get older (Cox, Schofield, Greasley & Kolt, 2006; WHO, 2019a). Therefore, we were interested in the amount and intensity of PA of older children.

METHODS

Participants

A total of 22 children (mean age: 11.41; 12 boys and 10 girls) from the sixth grade of a primary school in Slovenia were recruited. We explained all the details to the headmaster, the mathematics teacher and the parents. The study involved a mathematics teacher who taught both groups - the experimental and the control group. 16 children participated in the experimental group, 6 children formed the control group. The parents of the children gave their written consent before the study was conducted.

Intervention

The study was conducted in May 2019. The intervention lasted five school days, from Monday to Friday. During the intervention, children had four lessons of mathematics. One lesson lasted 45 minutes. The teacher integrated PA in mathematics lessons of the experimental group. In the control group, the mathematics lessons remained unchanged. The children from both groups had the same mathematics lessons content. The mathematics lessons were planned together with the mathematics teacher. The PA tasks were of moderate to vigorous intensity, but relatively easy to perform. For example:

- True-or-false questions: if the statements were true, students did 5 jumps, if they were false, they did 3 squats;
- Fit box: We wrote different PA tasks on slips of paper and then put them in a box. The teacher chose a student to answer the questions. If she/he answered

correctly, she/he got to take a slip out of the box. The student read the task on the slip and the whole class performed that task.

Instruments

PA was measured using accelerometers (ActiGraph wGT3W-BT, ActiGraph, LLC) worn on the children's right hips. Data were collected for one week (five days) during school hours. Children's out-of-school PA data were not collected for this study. At the beginning of the study, we demonstrated how to properly fasten the accelerometer around the children's waists.

Data analysis

Accelerometer data were analyzed using activity counts of 15-second epochs. All sequences of 20 minutes or more with consecutive zero counts were excluded from each individuals' records. To distinguish between physical activity phenotypes, we considered the thresholds proposed by Freedson, Pober & Janz (2005):

- Physical inactivity (PI): < 100 cpm,
- Low PA: 100–1262 cpm,
- Medium PA: 1263–4135 cpm,
- Vigorous PA: > 4135 cpm.

Data were organized using the Microsoft Excel program (Microsoft Corporation, Redmond, USA) and processed using the SPSS statistical package (IBM Corp., Armonk, NY, USA). Differences between groups in vigorous PA during mathematics lessons were analyzed using the Mann Whitney U test. This test was used because the data were not normally distributed. For the other intensity levels, the independent samples t-test was used. All statistical decisions were considered at $p < 0.05$.

RESULTS

From the accelerometer data, we calculated the average of each PA intensity phenotypes during mathematics lessons for both groups (Table 1). The results showed that there were differences between the groups in all phenotypes of intensity. During mathematics lessons the experimental group was more PA in MV ($p < 0.001$; ES = 2.37), V ($p = 0.002$; ES = 1.48), M ($p < 0.001$; ES = 2.38) and L ($p = 0.005$; ES = 1.50) intensity compared to the control group. In addition, the experimental group was also less PI ($p = 0.001$; ES = 2.08) during mathematics than the control group.

Table 1. Comparing the levels of PA and PI between groups in mathematics lessons

	EG (mean ± SD)	CG (mean ± SD)	P (ES)
PA (cpm)	281.0 ± 104.1	69.9 ± 35.2	< 0.001 (2.72)
PI (minutes)	33.5 ± 3.7	40.2 ± 2.6	0.001 (2.08)
L PA (minutes)	8.5 ± 2.9	4.3 ± 2.3	0.005 (1.50)
M PA (minutes)	11.0 ± 3.5	3.6 ± 2.66	< 0.001 (2.38)
V PA (minutes)	0.5 ± 0.4	0.1 ± 0.1	0.002 (1.48)
MV PA (minutes)	11.5 ± 3.7	3.7 ± 2.7	< 0.001 (2.37)

Legend: EG – experimental group, SD – standard deviation, CG – control group, P (ES) – effect size, PA – physical activity, PI – physical inactivity, V – vigorous, M – medium intensity, L – low intensity, MV – medium to vigorous intensity.

We also compared the levels of PA and PI between groups during school time (Table 2). The level of physical activity during school hours did not differ significantly between groups. Nevertheless, the experimental group spent slightly more time in MV intensity ($p = 0.284$) than the control group during the whole school period and was less PI ($p = 0.284$) than the control group. The data showed that the experimental group spent 10.62 minutes more in MVPA than the control group. We believe that this difference is due to the integration of PA into mathematics lessons. We calculated the average level of PA during school time without PA during math lessons and the difference between the groups was only 2.9 minutes in MVPA. We found that students from both groups reached minimum recommendations for physical activity while still in school.

Table 2. Comparing the levels of PA and PI between groups during total school time

	EG (mean ± SD)	CG (mean ± SD)	P (ES)
PA (cpm)	415.7 ± 130.1	430 ± 108.4	0.814
PI (minutes)	180.9 ± 19.9	191.5 ± 20.9	0.284
L PA (minutes)	51.7 ± 12.6	41.6 ± 14.7	0.125
M PA (minutes)	73.8 ± 18.4	61.0 ± 19.7	0.169
V PA (minutes)	5.3 ± 3.1	7.5 ± 2.1	0.128
MV PA (minutes)	79.1 ± 19.9	68.5 ± 20.9	0.284

Legend: EG – experimental group, SD – standard deviation, CG – control group, P (ES) – effect size, PA – physical activity, PI – physical inactivity, V – vigorous, M – medium intensity, L – low intensity MV – medium to vigorous intensity.

DISCUSSION

The purpose of this study was to investigate the effect of teaching mathematics through PA tasks on PA. Using an accelerometer, we measured PA and PI of sixth-grade children during mathematics lessons and during school time.

The data for PI during mathematics lessons showed that the control group was 74.4% of the mathematics lessons PI, while the experimental group was only 14.9% of the lessons PI. Vazou et al. (2018) also found differences between the groups. They integrated PA in the mathematics lessons of fourth-grade children. During the experimental lessons, they were 40.44% of the lessons PI, in contrast, during control time they were 42% PI. Martin and Murtagh's (2015) study showed similar results. Children were at 46.49% less PI during the English and mathematics than during regular lessons. Ovčjak (2016) measured the PI of Slovenian children during active music lessons. She found that in the experimental group 23.9% of lessons were PI and in the control group 62.9%. We can conclude that the other studies found smaller differences between the groups compared to our results. We think that this difference is due to the fact that the other studies included younger children than ours. It is generally believed that PA decreases with age, so this may lead to an increased PI (Calvert, Mahar, Flay & Turner, 2018; Volmut, Pišot & Šimunič, 2013; Webster, Russ, Vazou, Goh & Erwin, 2015).

In this study, the experimental group spent 25.56% of lessons in MVPA, the control group 8.22%. Other studies have reported similar results (Vazou et al., 2018; Martin & Murtagh, 2015; Mullender-Wijnsma et al., 2015a, Ovčjak, 2016). Martin and Murtagh (2015) found that children in the experimental group were in MVPA 23.5% of the active lessons. From ours and other studies, we can see that the integration of PA into mathematics lessons can improve primary school children's MVPA level and reduce

PI during mathematics lessons. It is also interesting to compare our results with those of Pušnik (2013). He measured the effective time parameters of physical education and the time children spent in MVPA. He found that children spent 13.22 minutes in MVPA during physical education. This is very close to our results where the experimental group spent 11.5 minutes in MVPA during mathematics lessons. We can assume that the integration of physical activity during mathematics lessons may be closer to MVPA intensity during physical education lessons. However, as we know, children perform complex motor tasks during physical education, while only performing simple motor tasks during experimental mathematics instruction.

We also measured PA and PI of sixth-grade children during school hours. We found that the extent of MVPA during school hours did not differ significantly between the groups. The experimental group spent 79.1 minutes in MVPA during all school time and 180.9 minutes PI, while the control group spent 68.47 minutes in MVPA and 191.5 minutes PI. Nevertheless, we observed a slight trend in the differences between the groups in MVPA. Other studies found significant differences between groups in MVPA (Bartholomew, Jowers et al., 2018; Calvert et al., 2018; Erwin, Abel, Beighle & Beets, 2011), but some of them found no differences in PI (Bartholomew, Jowers et al., 2018). Bartholomew et al. (2018) measured PA during school hours when students received 10-15 minutes of active lessons. The results of his study showed that children in experimenting schools took more steps and moved more in percentage points during the school week than students in control schools, but there were no statistically differences in sedentary behavior. Another study (Riley, Lubans, Holmes & Morgan, 2016) reported that the experimental group engaged in PA significantly more and tended to spend more time in MVPA during school hours compared to the control group. Intervention effects were also found for sedentary behavior during school hours. The control group was PI 67.8% of school time, while the experimental group was PI 62.6% of school time.

Innerd et al. (2019) measured PA at baseline, at the end of the intervention, and 4 weeks after the intervention. The difference in average daily MVPA (experimental-control) was 2.8 minutes/day at 8 weeks and 7.0 minutes/day at follow-up. In addition, Donnelly et al. (2009) observed PA during the spring semester in each of the 3 intervention years. Children who participated in physically active classes had significantly higher levels of PA during the school day, on weekends, and also on weekdays compared to children in control schools. This could be explained by a change in children's attitude and their belief that they can be anywhere and in almost any situation PA. After this finding, we could predict that our intervention was too short to obtain reliable data on how the integration of PA into mathematics lessons affects the level of MVPA during school time.

This study also has some other limitations. One of them is the small sample size. The participants were only from the sixth grade, and we only included PA in the mathematics lessons. In the future, more research should be done on how the integration of PA into different school subjects affects children and adolescents' daily PA. Unfortunately, our study could not examine how the inclusion of PA tasks affected children's

academic performance - particularly in mathematics - cognitive ability, or on-task behavior, because the intervention program lasted only five school days, during which students in the experimental and control groups received only four hours of mathematics instruction. A larger effect would not necessarily have been a reflection of the intervention program only, but also of a higher motivation and concentration of students in learning mathematics. In addition, we should not neglect the fact that students learn at home (e.g., write math homework) and that teachers are in all likelihood better prepared for the intervention program when they teach math. Teachers are not used to on this type of teaching and therefore take more time to prepare than usual. We need to be careful when comparing our study with others as they may have used different methods to measure and analyze the data.

CONCLUSIONS

Finally, this study showed that integrating PA with mathematics in the academic classroom resulted in increased MVPA during lessons. In addition, we found that students in both groups achieved the minimum recommendations of PA while still on school time. Previous research has shown that physically active classes also improve academic performance (Ma et al., 2015; Mullender-Wijnsma et al., 2015a; Mullender-Wijnsma, 2015b; Mullender-Wijnsma, 2016; Vazou & Skrade, 2016). This should be an additional encouragement for teachers to integrate physical activity into their classes.

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PHYSICAL THERAPY RECOMMENDATIONS FOR INJURY PREVENTION IN ALPINE SKIING

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ABSTRACT

Introduction: *Alpine skiers face high speeds, significant forces, natural and unnatural obstacles, and various environmental conditions on the slopes. Thus, they are highly exposed to certain injuries, amongst which the most common are those to the knee followed by injuries to the spine, shins, head, as well as arm and thumb injuries.*

Purpose: *The purpose was to systematically review the scientific literature on injuries, risk factors, and prevention in competitive alpine skiing and to provide recommendations for injury prevention in the field of physical preparation, kinesiotherapy, and/or specific exercises, and to determine which exercise program would be most appropriate for an alpine ski racer.*

Methods: *PubMed, Web of Science, and COBISS databases were used with PRISMA method to review the physical therapy recommendations for injury prevention in alpine skiing.*

Results: *10 studies were included in the final systematic review. We have not found any evidence-based prevention programs that are not older than 10 years on the topic of physical preparation for alpine ski racers. We found that most often, the literature describes prevention in terms of equipment, course preparation, course safety awareness, and the experience of the skier.*

Conclusions: *The recommendation for the most efficient prevention according to the current literature is to follow the above preventive measures in combination with*

appropriate physical preparation, where we recommend relying on research evidence in other (non-contact) sports that have similar injury mechanisms as alpine ski racing.

Keywords: *sports medicine, injury prevention, physiotherapy, alpine skiing*

FIZIOTERAPEVTSKA PRIPOROČILA ZA PREPREČITEV POŠKODB PRI ALPSKEM SMUČANJU

IZVLEČEK

Uvod: *Smučarji se na progah soočajo z visokimi hitrostmi, velikimi silami in različnimi okoljskimi pogoji. Posledično so izpostavljeni določenim poškodbam, med katerimi so najpogostejše poškodbe kolena; sledijo poškodbe hrbtenice, golenice, glave in poškodbe roke ter palca.*

Cilji: *Namen je bil sistematično pregledati znanstveno literaturo na temo poškodb, dejavnikov tveganja in preventive pri tekmovalnem alpskem smučanju in podati preventivna priporočila pred nastankom poškodb na področju telesne priprave, kinezioterapije in/ali specifičnih vaj ter ugotoviti, kakšen program vaj bi bil najprimernejši za preventivo pred specifično poškodbo alpskega smučarja tekmovalca. Ugotavljamo pomanjkanje preventivnih programov za izboljšanje telesne pripravljenosti smučarjev saj prevladujejo izsledki o preventivi z vidika smučarske opreme, priprave proge, ozaveščenosti o varnosti na progi in izkušenj smučarja.*

Zaključek: *Priporočila za najučinkovitejšo preventivo glede na trenutno literaturo so upoštevanje zgoraj omenjenih napotkov v kombinaciji z ustrezno telesno pripravo, pri kateri priporočamo opiranje na dokaze raziskav v drugih (nekontaktnih) športih, ki imajo podobne mehanizme poškodb kot alpski smučarji tekmovalci.*

Ključne besede: *športna medicina, preprečevanje poškodb, fizioterapija, alpsko smučanje*

INTRODUCTION

Alpine skiing as an activity was not popular before the 18th century. It took another 100 years for it to establish itself as a sport (Pfister, 2001). Today, skiing and snowboarding are among the most popular winter sports in the world and the organisation of alpine skiing competition is at the highest level (Schoenhuber, Panzeri, & Porcelli, 2018). Injury trends have been increasing in recent years, and the current incidence suggests that as many as one in three elite skiers may be injured in a single season (Tarka et al., 2019). Almost half of all injuries require the skier to be absent from training and competition for more than a month (OSTRC, 2019). As in any sport, prevention programs play an important role, preparing the skier physically to reduce the risk of injury. The team of physiotherapists and other health professionals is crucial for the physical preparation of a top alpine skier, and needs to take into account the specificities of each individual and the mechanisms of injury specific to skiing (Spörri, Kröll, Gilgien, & Müller, 2017). In addition to good physical fitness, suitable and safe ski equipment, properly prepared slopes, knowledge and experience, awareness of the skier and, above all, good psychological preparation are important for the prevention of alpine skiing injuries. In 2006, the International Ski Federation (FIS), in cooperation with the Oslo Sports Trauma Research Centre (OSTRC), developed the injury Surveillance System (ISS) to monitor injuries in different skiing disciplines and collect data for more detailed research into the causes of these injuries. The primary aim of the organization is to reduce injuries among skiers, and to propose preventive measures that have not yet been tested in clinical practice (OSTRC, 2019).

Skiing injuries

In the World Cup, the highest level of competition, the incidence of injuries ranges from 23% to 37% in a single season. Almost half of all injuries occur during competition, *despite the majority of runs being taken during training* (Tarka et al., 2019).

According to the Oslo Sports Trauma Research Centre (OSTRC) (2019), a total of 1083 injuries were recorded in the Alpine Skiing World Cup seasons between 2006 and 2019 among the 3329 competitors interviewed. As many as 40% of the injuries were those that required the competitor to be absent from training and competition for at least 28 days. The most common type of injury was a joint or ligament injury, followed by bone fracture, muscle or tendon injury, concussion, bumps and contusions, skin injury, and various others. Injuries to the knee accounted for the largest proportion of body part injured (41.3%), followed by injuries to the hand, finger and thumb (9.7%), and injuries to the head or face (9.4%) (OSTRC, 2019). In their study Tarka et al. (2019) also cite the knee as the most commonly injured part of adult competitive skiers, followed by back and tibia injury, then head and upper limb injury. In younger skiers, the knee is also the most common place of injury, followed by the upper limb, spine and lower limb injuries. Anterior cruciate ligament (ACL) injury is cited as the most common

specific diagnosis in both adult and younger skiers. This is followed by a concussion and tibia fracture.

Most injuries occur in downhill, followed by supergiant slalom (SG), then giant slalom (GS), and the fewest injuries occur in slalom. In the World Cup, knee injuries, the most common, account for 37.7% of injuries. There are at least 5 times as many injuries in the World Cup as there are in the European Cup. There are almost 7 times more knee joint injuries in the World Cup compared to the European Cup (OSTRC, 2019).

METHODS

This article is based on a literature review. Data were extracted from Slovenian and other sources (PubMed, Web of Science, and COBISS databases) throughout the world during the period from March 14, 2020 to July 30, 2020. The inclusion criteria for the peer-reviewed literature included ski injury and/or prevention, Slovenian or English language, and research that is less than 10 years old. The following keywords were used: alpine skiing, ski injuries, prevention of ski injuries, prevention program, risk factors in alpine skiing. The exclusion criteria were prevention measures that applied to other sports and did not include recommendations aimed at preventing injuries in alpine skiers. We also excluded studies where the full text was not available, studies with fewer than 15 subjects or where subjects withdrew from the study for various reasons, and studies with no conclusion. We reviewed the research summaries, narrowed the selection using inclusion and exclusion criteria, and critically analyzed the selected literature.

RESULTS

The search for the keywords listed above returned 102 hits, and an additional search yielded one additional hit. By screening the titles we first eliminated duplicates and then excluded studies older than 10 years (only keeping those from the 2011–2021 period). Forty-three studies remained, from which we additionally excluded studies not related to sports injuries and/or alpine skiing by reviewing abstracts thus ultimately arriving at 16 studies for full-text review. After the content review, we excluded 6 studies that did not relate to injury prevention. 10 relevant studies were thoroughly analyzed with conclusions described in the discussion. The systematic review process is presented in Figure 1.

The characteristics of the included studies are shown in Figure 1.

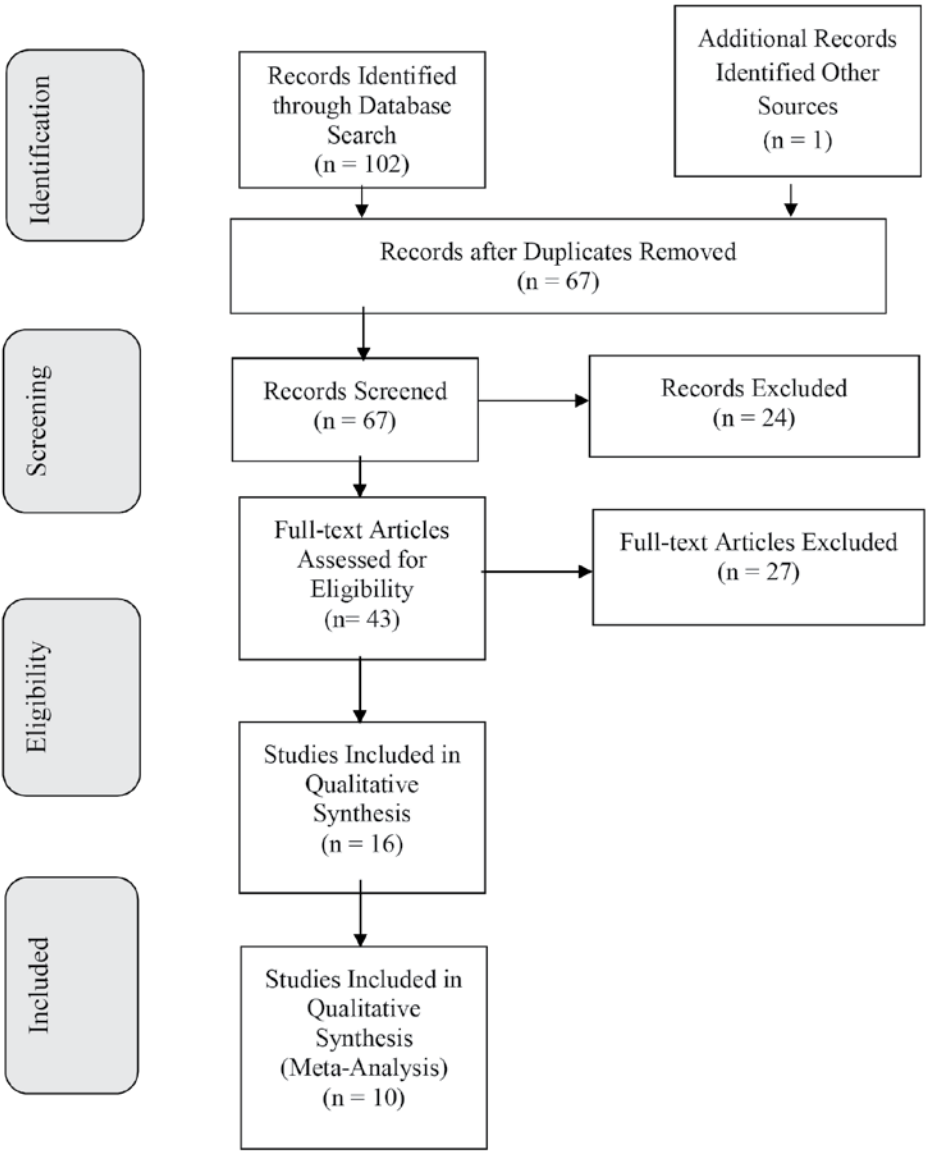

Figure 1.: The characteristics of the included studies (PRISMA flow diagram).

DISCUSSION

The incidence of sports injuries, especially in team sports, can generally be reduced through fitness training and prevention programs. On this basis, we hypothesized that there are evidence-based prevention interventions based on pre-injury fitness level in alpine ski racers and derived prevention programs that could be incorporated into the training process of competitive skiers.

Spörri et al. (2017) in their literature review presented injury prevention for elite alpine skiers through a four-stage model, according to the epidemiology and aetiology of the injury. Based on these, they formulated an idea for preventive measures, followed by a test of the effectiveness of the preventive measure or program. They found that the risk factors directly associated with injury were insufficient lower trunk stabilization, gender, skiing difficulty, genetic predisposition and the combination of longer, narrower skis with a smaller radius. Otherwise, the review did not provide any specific recommendations related to physical fitness, exercise program, training or kinesiotherapy as parts of an injury prevention program. Of all the studies included, this was the only one that linked skiing injury to the strength of insufficient trunk stabilization and not only to equipment, skills and behavior on the slopes. In contrast, Audet et al. (2019) described risk factors for injury in skiers in terrain parks, where injuries to skiers and snowboarders occur mainly due to factors such as the level of difficulty of the skiing, listening to music during the sport, previous injury, temperatures between –10°C and 0°C, night skiing and snowboarding, and performing more demanding maneuvers. Both studies found that risk factors differed according to the type of skiing but were consistent with the level of difficulty of the skiing, i.e., a higher level of difficulty was associated with a higher risk of injury in terrain park skiing or a competition slope. Hébert-Losier and Holmberg (2013) traced more than 80 methods for preventing musculoskeletal injuries and divided them into five groups - equipment, education and knowledge, caution and behavior, experience, and other factors. They found that most of the recommendations related to ski equipment or other factors, while none related to physical fitness, exercise, or training. They also highlighted the problem of this under-researched area. Audet et al. (2019) found that skiing and snowboarding carry a high risk of head, neck and back injury. Cusimano and Kwok (2010) found a 15% to 60% reduction in head injuries and a drastic reduction in concussions owing to helmet use. However, they did not associate helmet use with a reduction in the neck or cervical spine injuries. Also, Bailly et al. (2017) later found that the majority of injured skiers did not use a helmet. In more than half of the cases, the mechanism of injury was a fall. This was followed by, in order of frequency, collision with another skier, a jump, and collision with an obstacle, which also caused serious concussions. Sulheim, Ekeland, Holme, & Bahr (2017) found that despite increased helmet use among skiers and boarders, the incidence of head injuries decreased by only 2.2 per cent. They suggest as a possible reason for this the dramatic change in alpine skiing over the last decade due to new, faster and thus more dangerous ski designs, and unsafe slope layout in ski parks. According to the findings of Cusimano, Luong, Faress, Leroux, & Russell (2013), it could be suggested that the use

of a video with instructions and recommendations for safe skiing on the slopes could contribute to safety. Contrary to Sulheim et al. (2017), Haaland, Steenstrup, Bere, Bahr, and Nordsletten (2016), who studied the effects of newly introduced rules in skiing and ski equipment on the severity and type of injuries, found that the number of injuries per 100 skiers in a season decreased from 36 to 27 in the period after the new rules were introduced. Upper limb injuries decreased for women, while upper and lower limb injuries decreased for men. The most important contributor to the reduction in injuries was the introduction of the rule to combine longer and narrower skis with a smaller radius. Ruedl et al. (2011) found that injury onset was independent of average skiing time before the injury, and that injured men were taller, heavier, and skied at higher levels than uninjured men. The main conclusion of this study was that there are no significant gender differences in the mechanisms of anterior cruciate ligament (ACL) injury.

After a systematic review, we conclude that the best-researched areas for injury prevention are equipment, education (awareness rising) and knowledge, as well as caution and behavior on the ski slope. The results of our systematic review indicate a lack of evidence and, in particular, a lack of research into physical fitness as injury prevention for alpine skiers, as well as a lack of research on prevention programs. The topic of physical fitness as injury prevention for competitive alpine skiers has been poorly researched and even somewhat forgotten (overlooked), as we have not seen any research addressing this type of prevention in alpine skiing in the last two years.

Based on a systematic review, we found that there are evidence-based injury prevention measures for alpine ski racers that relate to equipment, skills, and experience in critical or unpredictable situations on the ski slope. In this respect, reference can also be made to Hébert-Losier and Holmberg (2013), who found that preventive measures related to equipment dominate instead of prevention in the form of physical training. More than half of the included studies concerned the choice and use of ski helmets. The importance of the role of equipment in injury prevention in alpine skiers is particularly clear when viewed from a sports biomechanics perspective. With the development of alpine skiing, athletes are exposed to greater forces and reaching higher speeds, which require increasing improvement and modernization, even in adapted equipment. With the advancement of technology and materials, there is more sophisticated, aggressive and higher quality ski equipment on the market. The advertising of extremely high-quality equipment can be deceptive, leading the recreational skier to exceed his/her technical abilities and consequently putting him/her at a greater risk of injury. In addition to the use of protective equipment, dealing with critical situations on the slopes, attending ski courses and training, developing skiing skills and experience in order to be able to react more appropriately to unpredictable events play a major role in prevention.

Given the underresearched area, there is still the possibility that well-designed research focused on the question presented could also lead to important conclusions in the intended direction. In this respect, we hope to build on the research of Spörri et al. (2017), which highlights, among other things, the insufficient strength of trunk stabilization and genetic predisposition as risk factors for injury. However, we could also refer in part to the research of Langran and Selvaraj (2002) and McKenna and Hammond

(2007) on an individual's level of fitness, which found that skiing (and snowboarding) ability, skill level, and experience are important for injury prevention. Furthermore, Hébert-Losier and Holmberg (2013) focused their study on the mechanism of injury to the ACL. In most cases, it is a backward or forward fall combined with the rotation of the tibia on the femur. As early as 1995, studies by Ettlinger, Johnson, and Shealy had developed a method of interactive training which included a video, an instructor, and group and individual training dedicated to backward falls in combination with the rotational mechanism, and the link between the mechanism and the knee injury. The effectiveness of this method was successfully demonstrated, with a 62% reduction in the number of serious knee injuries. Three years later, Jørgensen, Fredensborg, Haraszuk, and Crone (1998) showed that the number of injuries was reduced by 30% in cross-country skiers who watched a ski instruction video. A study by Cusimano et al. (2013), however, did not show that watching a safety instruction video reduced the number of injuries. Still, it did show that skiers were more aware of safety on the slopes, highlighting another very important preventive measure. The research by Ettlinger et al. (1995), Langran and Selvaraj (2002), McKenna and Hammond (2007) show that the central role in prevention is not only occupied by equipment, but also by strategies related to other domains, which may include, in part, specific exercises and physical training programs. In 1987, Morrissey, Seto, Brewster, and Kerlan proposed a series of specific movements, stretches and cardiovascular training to reduce the risk of many musculoskeletal injuries in alpine skiers. Their proposals are based on the physiological and biomechanical forces experienced by alpine skiers during skiing. For example, knee flexion and extension against resistance, internal rotation of the tibia, stretching of the posterior thigh and calf muscles have been suggested as exercises to prevent knee joint injuries. These exercises are still useful in practice today, even though the nature of alpine skiing has changed considerably since 1987, especially in terms of speed, forces, slopes, conditions, and equipment. For this reason, modern recommendations on training are adapted to the new developments in field, according to Koehle, Lloyd-Smith, and Taunton (2002). This can be seen when comparing the shape and length of skis. In the 1980s, skis with a side bow were not used. At that time, the most common mechanism of injury to the ACL was a backward fall with knee rotation (Natri, Beynnon, Ettlinger, Johnson, & Shealy, 1999; Beynnon, Ettlinger, & Johnson, 2007). However, as the use of carving skis became more widespread, and forward fall with rotation became the most common mechanism for ACL injury (Ruedl et al., 2009; Ruedl et al., 2011). With advances in skiing, equipment, and technology, understanding of human physiology and its response to sport and exercise has also evolved. In parallel, exercise methodology and concepts have evolved. Over the last two decades, deep trunk stabilization exercises have become a predominant component of training programs for a wide variety of sports. According to McGill (2010), the effective activation of the transversus abdominis, the paraspinal muscles, and the pelvic floor muscles is considered to be the key component for effective sports performance and injury prevention. In addition, neuromuscular activation training has also been identified as effective in preventing knee joint injuries in non-contact sports (Hewett, Lindenfeld, Riccobene, &

Noyes, 1999; Sugimoto et al., 2012a). The inclusion of a physiotherapeutic program of exercises for the neuromuscular junction is recommended for recreational alpine skiers, particularly in this direction, as different forces and variations have different effects on the recruitment patterns of the quadriceps femoris muscle (Kröll, Wakeling, Seifert, & Mueller, 2010; Kröll, Müller, Seifert, & Wakeling, 2011).

Musculoskeletal training and deep trunk stabilization training are included in most preventive kinesiotherapy programs for different types of injuries (Wilk, Macrina, Cain, Dugas, & Andrews, 2012). In addition to strength, flexibility is also important to reduce the risk of injury. A prevention program should also include stretching. Stretching has the effect of lengthening muscles and reducing muscle tension, resulting in corrected pelvic and spinal positioning, which reduces lumbar back pain (Coburn & Malek, 2012). However, mobility has not always been one of the most important components of lumbar prevention programs. In 1984, Biering-Sørensen found that lumbar mobility can also worsen current lumbar conditions or pain. Hewett, Ford, Hoogenboom, & Myer (2010) found that prevention programs that include strength training have the greatest effect on reducing the number of ACL injuries. Sugimoto, Myer, McKeon, & Hewett (2012b) demonstrate a lower risk of developing an ACL injury if the athlete adheres to a prevention program more than 66% of the time. In theory, the simultaneous development of the biomechanics of sport and the understanding of human physiology should be used in favor of designing specific exercises aimed at injury prevention. This would require updating programs developed more than 30 years ago by scientists such as Morrissey et al. (1987) and defining new recommendations for recreational and competitive alpine skiers. For example, in 2010, Kiani, Hellquist, Ahlqvist, Gedeborg, & Byberg investigated the effectiveness of an injury prevention program for female football players aged between thirteen and nineteen years, that included motor skills, control and activation training. The result showed a 77% reduction in the incidence of knee injuries in the group that underwent the injury prevention training program compared to a control group that did not undergo the same training program. Even if the percentage reduction in incidence in alpine skiers using a similar program would be much lower, it would have the potential to significantly reduce the health system costs and morbidity associated with participation in winter sports. Boden and Prior (2005), however, attribute a different role on the slopes to fatigue, which can lead to serious injuries and even fatalities; and the effects of endurance training on injury prevention in alpine skiers should also be investigated. For example, in recreational skiers, a significant decrease in glycogen stores and an increase in blood lactate could lead to negative effects such as fatigue, inflammatory processes, and reduced neuromuscular function leading to injury (Boden & Prior, 2005). Endurance training can be used to better utilize glycogen stores, reduce lactate production and increase circulating anti-inflammatory cytokines at a given intensity (Walsh et al., 2011). In addition to neuromuscular training, trunk stabilization training and endurance training, plyometric training, which focuses on correct joint performance and mechanics, is also mentioned in the literature (Pfeiffer, Shea, Roberts, Grandstrand, & Bond, 2006). A preventive exercise program that includes several different correctly dosed and graded training components is more

effective than a program that includes only one training component, such as strength or stabilization training alone (Grimm, Jacobs Jr, Kim, Denney, & Shea, 2014; Sugimoto, Myer, Foss, & Hewett, 2014).

Our literature review revealed that the area of prevention in terms of fitness and as a risk factor for injury in alpine skiing is poorly/under researched. Many studies have been written on the mechanisms of injury, which, although providing a good starting point for the design of prevention programs, did not follow through in this vein, nor could we find any that did. Among recommendations for injury prevention in alpine skiing prevails the use of appropriate ski equipment. Although sports medicine experts encourage prevention programs that include sport-specific exercises, none of the studies reviewed put forward specific recommendations that could be highlighted.

The incidence of injuries in competitive alpine skiing estimated by Tarka et al. (2019) is extremely high. In competitive alpine skiing in addition to a head coach, assistant coaches and a fitness coach, a well-structured team of medical professionals is essential to provide athletes with injury prevention and treatment before, during and after the season. This team consists of a physiotherapist, an orthopaedic specialist or traumatologist, a psychologist, a sports nutritionist, a kinesiologist, and others, among whom close professional collaboration is highly desirable. The role of the physiotherapist, which is essential at this level, is to provide high-quality physiotherapy treatments and knowledge-based rehabilitation at the onset of injury and to provide preventive kinesiotherapy measures. In sports practice, prevention is most often carried out through individually tailored pre-injury prevention programs, based on training to improve fitness levels, which athletes can incorporate into their training process.

CONCLUSIONS

Conclusions can be drawn regarding preventive measures and recommendations, including the use of appropriate ski equipment - especially suitable helmets, skill and experience in critical or unpredictable situations on the ski slope, and the use of evidence-based preventive training programs from other non-contact sports with similar injury mechanisms. At the same time, we can highlight an area that we have identified as problematic, but for which there exist no evidence-based solutions yet. We would like to encourage researchers to conduct research into risk factors and injury prevention measures in alpine skiing, focusing on the two factors already mentioned (trunk stabilization and genetic predisposition) and definitively confirm or reject them. Otherwise, they should be guided by the desire to determine findings that would serve to design prevention programs for the most common injuries to alpine ski racers. As the area of causes and mechanisms of injury is more researched than the area of prevention, the latter should be a prerequisite for more extensive research. Further research should investigate the role and effects of targeted prescribed exercises to improve fitness that would reduce the incidence and complexity of musculoskeletal injuries. Research to demonstrate the effectiveness of prevention programs at the highest level of skiing is

complex, requiring a large number of subjects, and accurate recording and analysis of data, as well as accurate identification and consideration of other factors that may influence the occurrence of injuries, regardless of an athlete‘s fitness level. The findings are relevant to alpine skiers, physiotherapists, other health professionals, coaches and anyone else involved in the competition or preparation of alpine skiers.

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REPORTS AND REVIEWS
POROČILA IN OCENE

REPORTS AND REVIEWS/POROČILA IN OCENE, 59–66

Diego Celin, Rado Pišot: SAFE AND WITH JOY ON A MOTORBIKE. Psychophysical preparation for recreational motorcyclists

Annales ZRS, 2021, 152 pages.

Many recreational motorcyclists are lured onto the roads by warmer days, but often forgetting the importance of psychophysical preparation after the winter break. This can lead to dissatisfaction, fatigue and feeling unwell after the first trips, and can also contribute to unforeseen incidents, accidents and injuries.

The importance of psychophysical fitness for the safety and enjoyment of recreational motorcycling is discussed in the handbook SAFE AND WITH JOY ON A MOTORBIKE by Diego Celin and Rado Pišot, both experts in the field of sports and kinesiology and both motorcycling enthusiasts in spirit and experience. The handbook is published by Annales ZRS, the scientific publishing house of ZRS Koper.

While the first, theoretical, part of the manual summarizes important information on the movements and stresses of motorcycling and the importance of motorcyclists' motor skills, the second part is purely practical and designed to help every motorcyclist physically prepare themselves before the season. We cannot ignore the fact that the good physical fitness of the rider is paramount to master riding and thus to ensure greater safety on the roads and racetracks.

The first part of the book analyzes the movement and psychophysical stresses placed on the body while riding a motorcycle and provides guidance on how to properly prepare for the road, including in terms of diet and fluid replacement and their influence on the physiological responses of the body while riding. The second part is devoted to general and specific sports training for recreational riders of all types of road motorcycles. These guidelines will also be useful for young motorcycle riders.

"We start from the fact that recreational motorcyclists usually take to the roads with long gaps between rides, forgetting the importance of psychophysical preparation for such a demanding task. This manual fills a gap in the comprehensive treatment of psychophysical preparation of motorcyclists, on which there is a lack of adequate Slovenian literature," said Rado Pišot.

The book was accompanied by experts from the world of motorcycling:

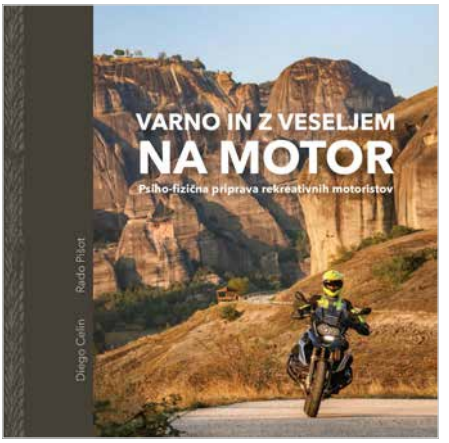
– Brane Legan, Safe Riding Course instructor at the Slovene National Automobile Association (AMZS) "When I became actively involved in motorcycle safety more than 20 years ago, I was also learning about this important element, good psychophysical condition to control and operate a motorcycle. At some points, it was the only thing that allowed me to be able to work with a motorcycle or just ride without any problems or dangers..."
– Andrej Jereb, multiple rally champion: "I notice that drivers in general do not put enough emphasis on this important area, which not only helps us to be safer, but above all to achieve better control and therefore more driving satisfaction..."
– Miran Stanovnik, multiple Dakar Rally participant: "It is necessary to take the first step and realize that we can only enjoy driving if we are psychophysically fit for it and have at least the basic skills necessary, which we can build on with proper practice... My sporting career might also have been more successful if I had been introduced to the contents of this book some three decades ago..."
– Miodrag (Mišo) Kralj, a long-time recreational motorcyclist: "I would definitely have been spared a lot of trouble if I had taken some time to prepare for the new season. I'm sure the first and all the following kilometers would have been much more relaxed..."
– Niko Peroša, professional motorbike tour guide: "Even when riding touring motorbikes, you need to know your body's reactions, take them into account, prepare for them and then maintain the condition you've acquired. That's why I think this book is the ideal winter read for anyone who considers themselves a serious motorcyclist. Finally, one practical book for motorcyclists in Slovenian."

Nika Štravs

REPORTS AND REVIEWS/POROČILA IN OCENE, 59–66

Diego Celin, Rado Pišot: VARNO IN Z VESELJEM NA MOTOR. Psiho-fizična priprava rekreativnih motoristov

Annales ZRS, 2021, 152 str.



Toplejši dnevi zvabijo na ceste številne rekreativne motoriste, ki pa velikokrat pozabijo na pomembnost psiho-fizične priprave po zimskem premoru. Zadnje v najboljšem primeru vodi v nezadovoljstvo, utrujenost in slabo počutje po prvih izletih, lahko pa tudi pripomore k neželenim dogodkom, nesrečam in poškodbam.

O pomenu psiho-fizične pripravljenosti za varnost in užitke v rekreativnem motociklizmu sta v priročniku Varno in z veseljem na motor spregovorila avtorja, strokovnjaka s področja športnih in kineziooloških ved, Diego Celin in Rado Pišot, ki sta po duhu in izkušnjah tudi sama velika ljubitelja motociklizma. Priročnik je izšel pri Annales ZRS, znanstveni založbi ZRS Koper.

V prvem delu priročnika so povzete pomembne informacije o gibanju in obremenitvah motorista med vožnjo ter pomenu gibalnih sposobnosti motorista, drugi del pa je praktične narave in je nastal za to, da se lahko motoristi pred sezono samostojno ustrezno pripravijo. Ne moremo namreč prezreti dejstva, da je predvsem dobra fizična priprava voznika nepogrešljiva za obvladovanje vožnje ter s tem za večjo varnost na cestah in dirkališčih.

Knjiga se tako v prvem delu posveča analizi gibanja in psiho-fizičnih obremenitev na telo med vožnjo motocikla ter daje napotke za dobro pripravo na potovanja tudi z vidika prehrane in nadomeščanja tekočin ter njunega vpliva na fiziološke odzive telesa med vožnjo. Drugi del je namenjen vsebini o splošni in posebni športni vadbi za rekreativne voznike vseh vrst cestnih motorjev. Napotki bodo uporabni tudi za mlade voznike koles z motorjem.

»Izhajamo iz dejstva, da se rekreativni motoristi običajno podajo na ceste z velikimi časovnimi razmiki med vožnjami in pozabljajo na pomen psiho-fizične priprave na tako zahtevno nalogo. Priročnik zapolnjuje vrzel na področju celostne obravnave psiho-fizične priprave motoristov, o kateri primanjkuje primerne slovenske literature,« je povedal Rado Pišot.

Knjigo so na pot pospremili tudi strokovnjaki iz motorističnega sveta:

– Brane Legan, inštruktor varne vožnje AMZS: »Ko sem se pred dobrimi 20 leti začel aktivno ukvarjati z varnostjo motoristov, sem spoznaval tudi ta pomembni element, dobro psiho-fizično pripravljenost za obvladovanje in upravljanje motorja. V nekaterih trenutkih je bilo le to tisto, kar mi je omogočalo, da sem lahko opravljal delo z motorjem ali pa le vožnjo brez težav in nevarnosti …«
– Andrej Jereb, večkratni prvak relija: »Opažam, da vozniki na splošno dajemo premalo poudarka temu pomembnemu področju, ki nam ne pomaga samo pri večji varnosti, ampak predvsem pri doseganju boljšega obvladovanja in s tem večjega zadovoljstva v vožnji …«
– Miran Stanovnik, večkratni udeleženec Relija Dakar: »Treba je storiti prvi korak in se zavedati, da lahko uživamo le tedaj, ko smo za vožnjo psiho-fizično primerno pripravljeni in obvladamo vsaj osnovne veščine, ki so za to potrebne in jih lahko s primerno vadbo nadgradimo … Tudi moja športna kariera bi mogoče lahko bila uspešnejša, če bi se z vsebino knjige seznanil pred kakšnimi tremi desetletji …«
– Miodrag (Mišo) Kralj, dolgoletni rekreativni motorist: »Veliko tegob bi mi bilo vsekakor prihranjenih, če bi si vzel nekaj časa za pripravo na novo sezono. Prepričan sem, da bi bili prvi in vsi nadaljnji kilometri veliko bolj sproščeni …«
– Niko Peroša, profesionalni turistični vodnik na motorju: »Tudi pri vožnji potovalnih motorjev je treba poznati odzive telesa, jih upoštevati, se nanje pripraviti in pozneje pridobljeno stanje vzdrževati. Prav zato mislim, da je ta knjiga idealno zimsko branje za vsakogar, ki se ima za resnega motorista. Končno ena praktična knjiga za motoriste v slovenščini.«

Nika Štravs

REPORTS AND REVIEWS/POROČILA IN OCENE, 59–66

SLOVENIAN MOBILE BRAIN/BODY IMAGING LABORATORY (SloMoBIL)

On 8 July 2021, the Institute for Kinesiology Research of the Science and Research Centre Koper (ZRS Koper) acquired a new laboratory. Slovenian Brain/Body Imaging Laboratory (SloMoBIL), is equipped with the latest technology for investigating neuromuscular efficiency, which will significantly help in conducting research aimed at in-depth understanding of our brains during movement. SloMoBIL laboratory is one of the few laboratories in the world to use such technology and approaches to investigate brain processes during movement and in connection with the movement information yielded. A comprehensive understanding of the brain dynamics associated with real-life in non-static conditions, will provide insight into the complex processes of embodied cognition.

The establishment of the SloMoBIL laboratory represents one of the key milestones of the international project "TwinBrain: TWINning the BRAIN with machine learning for neuro-muscular efficiency (ID 952401)," which will be implemented between 2020 and 2023. In addition to ZRS Koper, the lead partner of the TwinBrain project, the consortium consists of the Technical University Berlin (Tehnische Universität Berlin), the University of Geneva (Université de Genève) and the neurology department of the Cattinara Hospital in Trieste (Università degli Studi di Trieste). As a key element of the partnerships, the members of SloMoBIL made the first transfer of knowledge at

the Technical University of Berlin, and in the future, a visit to Geneva and a study on Parkinson's patients in Trieste are also expected.

At the opening ceremony speeches were delivered by prof. dr. **Rado Pišot**, director of ZRS Koper, prof. dr. **Boštjan Šimunič**, Head of the Institute for Kinesiology Research ZRS Koper, Assoc. prof. dr. **Uroš Marušič**, head and principal investigator of the TwinBrain project, prof. dr. **Klaus Gramann**, TwinBrain project partner, and keynote speaker, prof. dr. **Jadran Lenarčič**.

Accompanied by musician David Kocmur, dancer Urša Rupnik presented part of the newly acquired equipment of the SloMoBIL, the Full Body Kinematics, which detects body movements via high-frequency cameras and inertial sensors positioned around the limbs, torso, and head, and projects the dancer's avatar in real time on the screen.

After the ceremony, SloMoBIL Laboratory opened its doors. Within, the working groups prepared interactive presentations of electroencephalography (EEG) and its application in the field of neurofeedback, the use of virtual environments (VR) for rehabilitation after unilateral upper limb injury, and investigation of motor unit activation by electromyography (EMG) on the example of balance training.

The tour of the laboratory was followed by socializing and refreshments.

In addition to the above-mentioned people, we would like to thank Maja Maša Šömen, Daša Gorjan, Nina Omejc, Luka Šlosar, Miloš Kalc, Aleksandar Miladinović, Teja Ličen, Nika Štravs and the entire ZRS Koper team, as well as Matej Sukič, David Nik Lipovac and Draško Golubar.

The video of the opening ceremony is available at the following link:

https://www.regionalobala.si/novica/spremljali-smo-v-zivo-otvoritev-novega-laboratorija-slomobil-video.

Uroš Marušič and Manca Peskar

REPORTS AND REVIEWS/POROČILA IN OCENE, 59–66

SLOVENIAN MOBILE BRAIN/BODY IMAGING LABORATORY (SloMoBIL)

8. julija 2021 je Inštitut za kineziološke raziskave Znanstveno-raziskovalnega središča Koper (ZRS Koper) pridobil nov laboratorij. SloMoBIL, akronim za Slovenian Brain/Body Imaging Laboratory, je opremljen z najnovejšo tehnologijo za raziskovanje živčno-mišične učinkovitosti, ki bo pomembno pripomogla k izvajanju raziskav za poglobljeno razumevanje naših možganov med gibanjem. Laboratorij SloMoBIL je eden redkih laboratorijev na svetu, ki uporablja tako tehnologijo in pristope za raziskovanje možganskih procesov med gibanjem in v povezavi z gibalnimi informacijami. Približevanje oz. posnemanje okoliščin iz resničnega življenja omogoča celovito razumevanje možganske dinamike v nestatičnih pogojih in daje vpogled v kompleksne procese utelešene kognicije.

Vzpostavitev laboratorija SloMoBIL je eden glavnih mejnikov mednarodnega projekta TwinBrain: TWINning the BRAIN with machine learning for neuro-muscular efficiency (ID 952401), ki se izvaja med letoma 2020 in 2023. Ob ZRS Koper so projektni partnerji še Tehniška univerza v Berlinu (Tehnische Universität Berlin), Univerza v Ženevi (Université de Genève) in nevrološki oddelek bolnišnice Katinara v Trstu (Università degli Studi di Trieste). V sklopu partnerstev so člani SloMoBIL-a opravili prvi prenos znanja na Tehniški univerzi v Berlinu, v prihodnosti pa se obeta tudi obisk v Ženevi in izvedba raziskave na bolnikih s Parkinsonovo boleznijo v Trstu.

Na slavnostni otvoritvi so sodelovali **prof. dr. Rado Pišot**, direktor ZRS Koper, **prof. dr. Boštjan Šimunič**, predstojnik Inštituta za kineziološke raziskave ZRS Koper, **izr. prof. dr. Uroš Marušič**, vodja projekta TwinBrain**, prof. dr. Klaus Gramann**, partner projekta TwinBrain, in slavnostni govorec **prof. dr. Jadran Lenarčič.**

Na otvoritvi je plesalka Urša Rupnik ob glasbeni spremljavi Davida Kocmurja predstavila del novopridobljene opreme SloMoBIL-a, natančneje Full Body Kinematics, ki z visokofrekvenčnimi kamerami ter inercialnimi senzorji okoli okončin, trupa in glave zaznava premike telesa in v realnem času projicira na zaslon plesalkin avatar.

Po slavnostni otvoritvi je laboratorij SloMoBIL odprt svoja vrata. V njem so delovne skupine pripravile interaktivne predstavitve elektroencefalografije (EEG) na primeru nevrofeedbacka, uporabe virtualnih okolij (VR) za rehabilitacijo po unilateralni poškodbi zgornje okončine in raziskovanje aktivacije motoričnih enot z elektromiografijo (EMG) na primeru treninga ravnotežja.

Po ogledu laboratorija sta sledila druženje in pogostitev.

Za izvedbo dogodka se ob zgoraj omenjenih osebah zahvaljujemo še Maji Maši Šömen, Daši Gorjan, Nini Omejc, Luki Šlosarju, Milošu Kalcu, Aleksandru Miladinoviću, Teji Ličen, Niki Štravs in celotni ekipi ZRS Koper ter Mateju Sukiču, Davidu Niku Lipovacu in Drašku Golubarju.

Videoposnetek z otvoritve je dostopen na spletni povezavi

https://www.regionalobala.si/novica/spremljali-smo-v-zivo-otvoritev-novega-laboratorija-slomobil-video.

Uroš Marušič in Manca Peskar

GUIDELINES FOR AUTHORS, 67–70

GUIDELINES FOR AUTHORS

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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

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Conference proceeding contributions

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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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