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DEAR READER,

The COVID-19 pandemic, which has frozen the entire world and imposed a completely different lifestyle, has affected absolutely all areas of the human environment, including sport. The lifestyle habits and routines which were standardised have, in a short period of time, assumed new patterns of behaviour, creating new models which may be temporary now, but in the future, we will surely witness some new phenomena and forms of life design. The area of sports suffers extreme changes regulated by the new rules, new organisation methods as well as new styles and training process technologies, all of which have assumed a different dimension in which people who are invested in sports struggle mightily for its survival. From this issue, we publish the results of research arising due to the COVID-19 pandemics which will surely affect the creation and modelling of sports systems, regardless of whether they deal with organisation, the training process or sports education.

This issue contains papers from 10 countries, and we are grateful to all authors, reviewers and members of the Editorial Board who have, despite the situation we are in, succeeded in completely organising and providing the journal with its continuity in publishing, in a professional and responsible manner.
The papers published in this issue belong to the fields of sports medicine, sports management, and education, the training process, sports and recreation, encompassing a diverse population which participated in the implemented research of the published papers.

Publishing the research results arising during the pandemic, which is present in this issue, marks a new era and a new chapter in which we will encounter some new models and patterns, serving as inspiration for researchers in the following period. Our journal will certainly, in line with the stated trends, open up new chapters for researchers who will submit their papers.

We strive to be at the centre of new findings which will create new models of the sports environment, and which is only possible through scientific research and scientific thought which, connected with the profession and practice, has the power to offer this. That is why we would like to invite you, readers, to become a part of our team and participate in our work so that, together, we can create a different future based on qualitative changes and directed towards the global development of sports in the spirit of the new environment and new behavioural patterns.

Nihad Selimović, MD, MSc
Editor in chief

DRAGI ČITATELJU,

Pandemija COVID-19, koja je zaledila cijeli svijet i nametnula potpuno drugačiji način života, dotakla je apsolutno sve prostore čovjekovog okruženja pa tako i sport. Životne navike i rutine koje su bile standardizirane u vrlo kratkom roku poprimile su nove obrasce ponašanja iz kojih su nastali novi modeli koji za sada mozda jesu privremeni, ali u budućnosti ćemo sigurno svjedočiti nekim novim pojavama i oblicima životnog uređenja. Oblast sporta trpi ekstremne promjene koje regulišu nova pravila, nove metode organizacije, nove stilove i tehnologije trenažnih procesa i sve je poprimilo drugu dimenziju u kojoj se ljudi iz sporta grčevito bore za njegov opstanak. Od ovog broja objavljujemo rezultate istraživanja koja su nastala uslijed pandemije COVID-19, a što će sigurno uticati na kreiranje i modeliranje sportskih sistema bez obzira da li se radi o organizaciji, trenažnom procesu ili sportskom obrazovanju.

U ovom broju imamo radove iz 10 zemalja i zahvalni smo svim autorima, recenzentima i svim članovima Uredničkog odbora koji su i pored stanja u kojem smo se svi našli, uspjeli na profesionalan i odgovoran način urediti kompletnu organizaciju i obezbijediti da časopis ima svoj kontinuitet u objavljivanju.
Radovi koji su objavljeni u ovom broju su iz područja sportske medicine, sportskog menadžmenta, obrazovanja i edukacije, trenažnog procesa, sportske rekreacije i obuhvataju vrlo raznoliku populaciju koja je učestvovala u provedenim istraživanjima objavljenih radova.

Objavljivanje rezultata istraživanja koja su nastala u uslovima početka pandemije, a što imamo već od ovog broja, označava novu eru i novo poglavlje u kojem ćemo se susresti sa nekim novim modelima i obrascima koji će biti inspiracija istraživača u narednom periodu. I naš časopis će sigurno, u trendu kretanja sa navedenim, otvarati nova poglavlja za istraživače koji će aplicirati sa svojim radovima.

Želimo biti u centru novih saznanja koja će kreirati nove modele sportskog okruženja, a to je jedino moguće kroz naučna istraživanja i naučnu misao, koja povezana sa strukom i praksom, ima moć da to ponudi. Zato pozivamo sve Vas, čitatelje, da budete dio našeg tima, da učestvujete u našem radu i da svi zajedno stvaramo neku drugu budućnost koja će biti zasnovana na kvalitativnim promjenama i usmjerena na globalni razvoj sporta u duhu novog okruženja i novih obrazaca ponašanja.

Mr. sci. dr. Nihad Selimović
Glavni urednik

COMPARING VISUAL SEARCH STRATEGIES IN SUCCESSFUL AND UNSUCCESSFUL ONE-ON-ONE DEFENSIVE SITUATIONS IN SOCCER: A CASE STUDY OF ELITE JUNIOR FEMALE PLAYERS

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ABSTRACT

Investigating perceptual skills within sports performance has focused primarily on comparisons between expert and novice performers with limited research assessing differences in successful and unsuccessful patterns of play. By monitoring an individual's gaze behaviour, such observational strategies can be assessed. The purpose of the current study, therefore, was to compare differences in visual search strategies between unsuccessful and successful one-on-one defensive situations in soccer. Following institutional ethics approval, three (n = 3) female junior soccer players (mean: age = 14; mass = 51.6 5.9 kg; height = 1.66 0.06 m), from an English Premier League team, were recruited. A one-on-one zone consisting of an attacker-defender dyad was utilised to analyse visual search strategies in successful and unsuccessful tackles. The defender's search strategies were recorded using a head-mounted gaze tracking device. Mean number of fixations per trial, mean duration of fixation per trial, and mean number of fixation locations per trial were examined. The results showed significant differences between trials in the mean number of fixations ($P = 0.001$), and mean fixation duration ($P < 0.001$). The search rate of successful tackles was characterised by more fixations of a shorter period, compared to the unsuccessful tackles. The results suggest an increase in focus on an opponent's postural orientation leads to a subconscious ability to activate scene schemas, thus enhancing detection and recollection of object functionality. Defenders should therefore be encouraged to alternate their gaze away from focusing on the ball, placing greater focus at the hips of their opponent.

Keywords: soccer, football, vision, search strategies,

INTRODUCTION

Successful performance in soccer is ultimately determined by the number of goals scored within match play (Hughes & Franks, 2005; Tenga et al., 2010). In order to be successful, teams must create goal-scoring opportunities, whilst preventing the opposition from generating them (Delgado-Bordonau et al., 2013). Therefore, the overall tactics of football entail a permanent interrelationship between attacking and defensive patterns of play (Barreira et al., 2014). The players interact directly and concomitantly within these units to achieve an objective that involves team members facilitating movement of the ball (Garganta, 2009). Based on this, a team can be described as a self-organised system searching for order and shape. While the opposing team aims to cause disorder in this organisation, with attacking play used to disturb and disrupt the opponent's balance, defensive play is utilised to ensure their own team's stability and organisation (Garganta, 2009).

The majority of published research in soccer has focused on offensive play, with markers such as scoring indicators and performance indicators within the final third of the pitch predominantly being analysed (Barreira et al., 2014). In contrast, according to Gabel, Riedmiller and Trost (2008), defensive playing capabilities have almost been neglected. However, the ability of the defensive line to block penetration through to the final third of the pitch can be considered important for attacking plays, as it can provide an opportunity to regain possession and stabilise the system (McLean et al., 2017). Effective defence set-ups are therefore critical as it is when possession is lost that the most goal and risk situations occur (Casal et al., 2016). The defensive transition of a team after it has lost possession is vital to the course of play (Casal et al., 2016) and this is why ball recovery is considered the main purpose of the defensive phase; it is also a key initiator for the first phase of an attack (Barreira et al., 2014).Regaining possession across the field can be achieved in a variety of ways, including set-plays, goal kicks and fouls. However, the most frequently observed are ball interceptions, defensive behaviours, and tackles in defensive zones (Barreira et al., 2016). One-on-one interactions, consisting of an attacker-defender dyad is the most commonly observed scenario for this to take place. Indeed, the game can be considered a continual transition of these 1v1 confrontations (Pulling, Twitchen & Pettefer, 2016).

However, the stochastic, intermittent and complex nature of the sport is further characterised by its variability and unpredictability (Wragg, Maxwell & Doust, 2000). These frequent alterations of activities, combined with unorthodox movement patterns and execution of various technical skills (Bloomfield, Polman, & O'Donoghue, 2007), mean that dynamic interactions between the members of two teams change continuously throughout the game (Casal et al., 2016). The attacking opposition can be considered in control, and are thus responsible for unexpected movements in a match (Tenga et al., 2010). It is therefore important to prepare for counteraction against these strategic technical-tactical actions in an attempt to improve performance (Casal et al., 2016). Preparation for enhanced sporting performance requires training of not only motor and physical abilities but also cognitive and perceptual skills (Schwab & Memmert, 2012). In particular, a close integration of these perceptual, cognitive and motor skills is required within team invasion sports (Afonso et al., 2012). In order for an individual to select and execute appropriate actions, environmental information must be located, identified and processed so as to integrate it with existing knowledge and current motor capabilities (Broadbent et al., 2014).

This extraction of relevant information from the environment requires an efficient and effective use of vision (Broadbent et al., 2014). Visual exploration of the environment during a game of soccer allows for key features to be identified, thus facilitating the planning, and use of appropriate motor responses (Timmis, Turner & Van Paridon, 2014). However, 1v1 confrontations often put players under extreme time pressure, whilst having to process environmental information in motion; this, added to the complexity of the task constraints, creates a very challenging situation (Schwab & Memmert, 2012). Players must therefore be able to direct their attention appropriately (Piras, Lobietti & Squatrito, 2014) by fixating on the most informative areas of display and perceive these events quickly and accurately (Williams & Elliot, 1999).

The majority of previous research investigating perceptual skills within performance have generally focused on comparisons between expert and novice performers (Memmert, Simons & Grimmes, 2009). It has been reported that, compared to novice performers, experts are more efficient in identifying and recognising meaningful patterns of play (Williams et al., 2010), thus generating appropriate actions more consistently. This is due to the expert performer being better attuned to the task constraints and more effective when anticipating the outcome of the action, compared to their less experienced counterparts (Afonso et al., 2012). Knowing where and when to look is therefore a crucial component of successful performance in sport (Piras, Lobietti & Squatrito, 2014).

AIM

While research has identified that expert and novice performers differ in their perceptual skills and basic attention abilities (Allen et al., 2006), it would seem more apparent to investigate differences in successful and unsuccessful patterns of play. These observational strategies can be examined through an individual's gaze behaviour within a simulated environment, with the number of fixations quantifying gaze control and attention (Lex et al., 2015). In certain situations, cognitive responses will either be based on perceived event probabilities or the exclusive ability to process information from an opponent's postural orientation (Piras, Lobietti & Squatrito, 2014). Therefore, the aim of this investigation was to identify differences in visual search strategies between successful and unsuccessful one-on-one defensive situations. It was hypothesised that successful defensive tackles would involve a greater number of fixations on the opponent's postural orientation, rather than focusing on the movement of the ball.

METHODOLOGY

Participants

Following institutional ethics approval, and in accordance with the latest rendition of the Helsinki Declaration (World Medical Association, 2013), three (n=3) elite female youth football players (mean SD: age = 14 years; stature = 1.66 ± 0.06 m; mass = 51.6 ± 5.9 kg) with no history of serious injury or illness volunteered to participate in the current study. All participants were involved in regular training and elite competition (at the International Level) as part of a regional talent identification programme within an English Premier League club structure. Due to the age of the players, permission was sought prior to participation from the club, coaches and parents. None of the participants reported any uncompensated visual deficit or difficulty with the stimuli used in the current study.

Instrumentation

The study was conducted outdoors on 3G artificial turf, due to the participants' familiarity with this playing surface. A size 4 football (Nike premier team) was used based on The Football Association's (FA) Standard Code of Rules for youth competitions (FA, 2017). Eye movements of the defensive player were recorded using a head-mounted gaze tracking device (Tobii Pro Glasses Eye Tracker 2, Tobii Technology: Figure 1), which recorded at 50Hz. The eye tracker contains four cameras built into the glasses (two on each lens – circled in blue), a gyroscope and an accelerometer to allow for the analysis of eye movement, and a forward-facing high definition camera (circled in red), which recorded the visual scene (1920 x 1080 pixel, 50Hz). Data from the eye tracker was recorded on a tablet with Tobii Pro Glasses Controller Software installed (Figure 2). The eye tracker was calibrated prior to each trial using a one-point calibration procedure, in accordance with the manufacturer's guidelines (Tobii Pro, 2018).

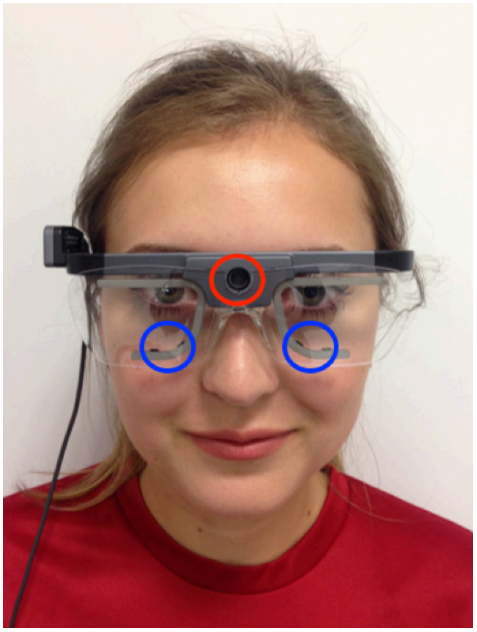

Figure 1 - Tobii Pro Glasses Eye Tracker 2 showing camera positioning (circled

Figure 2 - Tobii Pro Glasses Eye Tracker 2, unit and tablet with Controller Software

Procedure

Prior to testing, the participants followed a 10-minute warm-up protocol, consisting of a series of dynamics, activation and mobilisation exercises. The defensive player performed the warm-up whilst wearing the eye tracker to allow for familiarisation with the glasses and recording unit. The defending player confirmed that the eye tracker and recording unit did not hinder their range of movement. The defender wore the eye tracker for the duration of the testing.

A 1v1 zone was set up in a rectangular area with the dimensions of 10 yards x 5 yards. This was considered an appropriate area for the players to prepare for the attack, whilst limiting distance to place pressure on the defender (Yoshikawa, Fumoto, & Nakagawa, 2015). Two of the participants alternated as the attacking player after each trial, whilst the defensive player remained constant for the entire study. A total of twelve trials were completed, consisting of seven successful tackles and five unsuccessful tackles. The recalibration of the eye tracker device was used as a rest period between each trial. The defender and attackers were instructed to approach the task as they would in any regular game situation. No verbal cues were given to any participant in any of the trials and no restrictions on the participants' movement were enforced; the only instructions being to stay within the marked area. A successful tackle was defined as the defender removing the ball from the defined area or gaining control of the ball to the attacking line. An unsuccessful tackle was defined as the attacking player reaching the defensive line whilst maintaining control of the ball.

Data Analysis

The video footage of each trial was analysed using Tobii Pro Lab (Tobii Pro, no date). Analysis of the eye gaze data was performed manually, using custom areas of interest. The five defined locations were: attacker's postural orientation (subdivided into hips, legs and upper body positioning), ball focus and surrounding space. Three measures of search rate were examined: mean number of fixation locations per trial, mean number of fixations per trial, and the mean duration of fixation per trial (Roca et al., 2011). A fixation was defined as the period of time ≥100ms, when the gaze remained within 3° of the visual angle of a location (Panchuk & Vickers, 2006). Results from the testing were analysed using the Statistical Package for Social Sciences 23.0 software (SPSS, Inc), with an alpha level of 0.05 set as the level of statistical significance. Following the Kolmogorov-Smirnov test, significance values were identified using an independent t-test for normally distributed data and a Mann-Whitney U test for non-normally distributed data.

Table 1: Comparison of Search Rate Values

	Successful Tackle	Unsuccessful Tackle	P values
No. of Fixations	17.75 ± 3.96	7.75 ± 1.50	0.001
No. of Fixation Locations	3.63 ± 0.92	3.25 ± 0.5	0.469
Fixation Duration (ms)	152 ± 26	470 ± 68	< 0.001

All results presented as mean ± SD.

Table 2: Comparison of Fixation Duration Values

	Successful Tackle (ms)	Unsuccessful Tackle (ms)	P values
Hips	130 ± 20	320 ± 5	0.114
Legs	139 ± 18	478 ± 136	0.006
Body Position	152 ± 28	300 ± 11	0.134
Ball	143 ± 23	506 ± 135	0.008
Space	205 ± 77	493 ± 133	0.034

All results presented as mean ± SD.

DISCUSSION

The aim of the current study was to investigate the differences in search rate between successful and unsuccessful tackles in a skilled performer. A representative task simulating a real-life 1v1 defensive situation was implemented for increased ecological validity. Eye movements of the defender were recorded to measure the processes underpinning superior motor responses. It was hypothesised that successful tackles would be characterised by a greater number of fixations on the opponent's postural orientation, compared to focusing on the movement of the ball.

As predicted, search rate strategies were quantifiably different between successful and unsuccessful tackles. Successful tackles employed a visual search strategy that involved a significantly greater number of fixations ($P = 0.001$) of shorter duration ($P < 0.001$), compared to unsuccessful tackles. With regards to the specified locations, there was a significant difference in fixation duration at the following locations: legs ($P = 0.006$), ball ($P = 0.008$) and surrounding space ($P = 0.034$).

A number of similar investigations have analysed observational strategies in soccer performers. Though under varying scenarios, the general findings from these studies indicate that experts have superior perceptual-cognitive skills when compared with their less expert counterparts (Roca et al., 2011). These advanced skills enable the performer to select appropriate decisions under time pressure, resulting in more successful motor responses. For instance, the ability to successfully interpret information displayed from an opponent's postural orientation (Abernethy & Zawi, 2007) results in a superior ability to accurately predict the outcome of the action (Raab & Johnson, 2007); ultimately meaning that the generation of appropriate actions occurs more consistently.

One previous study used dynamic film sequences based on real-life matches to compare anticipation in skilled participants and their less skilled counterparts (Williams et al., 1994). It was concluded that skilled participants employed a search strategy involving more fixations of shorter duration than the less skilled defenders. This was the case when viewing 1v1, 3v3 and 11v11 defensive simulations. However, when presented with the 11v11 scenario, the number of fixations for both the skilled and less skilled defenders was much greater.

This is likely due to a greater number of external variables, such as players out of possession and the position of team-mates impacting the course of play (Ward, 2002).
Though not directly comparable, the general findings from Williams et al. (1994) are still in support of this study. For instance, both the successful tackles and skilled defender groups were characterised by a greater number of fixations of shorter duration. A more recent study that provides further support to this notion was conducted by Roca et al. (2011). This involved skilled and less skilled players moving and interacting with life-size, action sequences involving 11v11 scenarios filmed from the perspective of a central defender. Again, the general findings from this study were that skilled players employed a search strategy involving more fixations of shorter duration when compared with their less skilled counterparts.

In the current study, a much greater number of fixations (17.75 ± 3.96) during the successful trials were reported, compared to the skilled defender values (10.3 ± 1.00 and 12.93 ± 1.20) reported by Williams et al. (1994) and Roca et al. (2011), respectively. This is surprising considering that these previous studies were based on 11v11 scenarios, during which a much greater array of external influences are present. The reason for this difference may be related to the fact that a much more realistic environment was used in this study.

For instance, recordings of the participant were gained from real-life 1v1 confrontations, albeit in a simulated setting, whereas previous investigations implemented film-based action sequences recorded from either a birds-eye viewpoint (Williams et al., 1994) or a first-person viewpoint (Roca et al., 2011). The participant in the current study was presented with the ability to freely scan the environment from a three-dimensional perspective, which would have not been possible when analysing film-based action sequences.

Despite a greater number of fixations reported in this current study, there was not a significant difference found in the number of fixation locations between successful and unsuccessful tackles. This is likely due to the fact that, when in an 11v11 situation, defenders have to scan the entire field of play, making it seemingly logical that a fairly exhaustive search pattern would occur (Williams, Janelle & Davids, 2004).

Conversely, in a 1v1 situation, there are fewer external distractions; only the player in possession of the ball affects the visual search strategies (Ward, 2002). In contrast, significant differences were found in the mean number of fixations and the mean duration of fixations between successful and unsuccessful tackles. More specifically, the unsuccessful tackles were characterised by a significantly longer duration fixating on the

legs, ball and surrounding space, and thus a higher percentage of viewing time was spent at these locations. In comparison, the successful tackles were characterised by a greater percentage of total viewing time being spent fixating at the hips and body position of the athlete. The notion that successful tackles are characterised by a higher percentage of viewing time fixating on the postural orientation of the opponent is further supported by a follow-up study conducted by Williams and Davids (1998). This study investigated search patterns in 1v1 and 3v3 sub-phases in football.

Similar to previous reported findings, the skilled defenders employed more fixations of shorter duration when confronted by an attacker in possession of the ball. Specifically, this involved more frequent alterations in gaze behaviour at the hips and ball foot regions, respectively. Conversely, the unskilled defenders spent more time fixating on the ball. Findings from this study allow it to be concluded that the hip region acts as a focal point of important information by signalling the opponents next intended motor response (Williams, Janelle & Davids, 2004).

During 1v1 situations, consisting of an attacker-defender dyad, it is likely that a combination of eye movements is used. The fovea, responsible for sharp central vision, is used initially when extracting relevant task information, as this is when visual detail is of primary importance (Williams, Janelle & Davids, 2004). This scene gist recognition is important because it activates scene schemas, which later affects critical cognitive processes (Larson & Loschky, 2009). For instance, foveating on objects within a scene allows for object recognition, direction of attention and long-term memory for objects in a scene (Gordon, 2004; Eckstein, Drescher, & Shimozaki, 2005).

This gives partial reasoning as to why successful tackles are categorised by a significantly greater number of fixations. If the number of fixations on an object is high within a scene, more object properties are perceived; allowing superior detection of object functionality (Land & Tatler, 2009). Peripheral vision is likely to play a key role once the defender approaches, as more information relative to movement patterns is acquired. Williams & Davids (1998) suggest that the hip region allows for anchoring of the fovea, whilst allowing for effective use of the peripheral vision to extract external cues relating to the opponent's positioning and motor patterns.

Though information relating to eye movements in skilled performers is logical, a surprising discovery in the current study is the significant variation between successful and unsuccessful trials in one participant. This leads to question whether there is any conscious decision-making being made in relation to gaze control behaviours. Previous investigators have acknowledged the lack of clarity in whether superior decision-making is a result of early detection of relevant cues or the ability to process the perceived information more quickly (Lex et al., 2015).
The experiments conducted by Lex et al. (2015) offer evidence that a superiorly organised memory structure is in existence in the more skilled players, resulting in a perceptual advantage in tactical decision-making. However, based on findings from the current study, this seems to only be true when the player has directed their attention appropriately in order to focus on the most informative areas of display. This leads directly back to the concept that a superior ability to accurately predict the outcome of the opponent's action stems from the ability to successfully interpret information displayed from an opponent's postural orientation (Raab & Johnson, 2007; Abernethy & Zawi, 2007).

Within this study, a significant difference was not found between successful and unsuccessful trials in the time spent fixating at the hips. This would suggest that alternative factors take precedence over a player's perceptual and cognitive skills. However, results from the study suggest a trend towards a difference in hip focus between trials. In addition, the significantly longer duration of time spent fixating on the ball, legs and surrounding space of the opponent, which resulted in an unsuccessful tackle, lends support to the concept that anticipatory skills are superior when an increased percentage of viewing time is spent fixating on the postural orientation of the opponent (Piras, Lobietti & Squatrito, 2014). This is particularly evident in 1v1 confrontations when the external cues are reduced (Ward, 2002).

CONCLUSION

Results from the current study revealed that successful tackles were characterised by a significantly greater number of fixations of shorter duration than unsuccessful tackles. In addition, unsuccessful tackles were characterised by a significantly longer duration spent fixating on the ball, legs and surrounding space. It could be assumed that an increase in focus on an opponent's postural orientation leads to a subconscious ability to activate scene schemas, thus enhancing detection and recollection of object functionality.

This in turn leads to superior decision-making, and consequently an increase in successful motor responses. Based on this, future research should investigate whether verbal cues to place greater focus on an opponent's postural orientation within training is an effective method in increasing tackle success rate, in both skilled and unskilled defenders, in a 1v1 situation.

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POREĐENJE STRATEGIJA VIZUALNE PRETRAGE U USPJEŠNIM I NEUSPJEŠNIM ODBRAMBENIM SITUACIJAMA IGRE JEDAN NA JEDAN U NOGOMETU: STUDIJA SLUČAJA ELITNIH JUNIORKI

Ispitivanje perceptivnih vještina tokom sportske izvedbe se prvenstveno fokusiralo na poređenje između stručnjaka i početnika, uz ograničena istraživanja u kojima se vršila procjena razlika uspješnih i neuspješnih obrazaca igre. Takve opservacijske strategije se mogu procijeniti prateći ponašanje pogleda pojedinca. Prema tome, svrha ove studije je bila uporediti razlike strategija vizualne pretrage između neuspješnih i uspješnih odbrambenih situacija igre jedan na jedan u nogometu. Nakon što je istraživanje etički odobreno, odabrane su tri (n = 3) nogometašice juniorke (srednja vrijednost: dob = 14; težina = 51,6 5,9 kg; visina = 1,66 0,06 m) iz tima Engleske Premier lige. Zona jedan na jedan koja se sastojala od para napadač - odbrambeni igrač je korištena za analizu strategija vizualne pretrage u uspješnim i neuspješnim pokušajima oduzimanja lopte. Strategije pretrage odbrambenog igrača su snimljene koristeći uređaj za praćenje pogleda koji se stavlja na glavu. Ispitani su srednji broj fokusiranja po pokušaju, srednje trajanje fokusiranja po pokušaju i srednji broj lokacija fokusiranja po pokušaju. Rezultati su pokazali značajne razlike između pokušaja po pitanju srednjeg broja fokusiranja ($P = 0,001$) i srednjeg trajanja fokusiranja ($P < 0,001$). Stopa pretrage uspješnih pokušaja oduzimanja lopte je obilježena sa više fokusiranja tokom kraćeg perioda u poređenju sa neuspješnim pokušajima oduzimanja lopte. Rezultati ukazuju da veće fokusiranje na posturalnu orijentaciju protivnika vodi ka podsvjesnoj sposobnosti aktiviranja shema, povećavajući time otkrivanje i prisjećanje vezano za funkcionalnost objekta. Prema tome, potrebno je ohrabriti odbrambene igrače da svoj pogled prestanu fokusirati na loptu te da obrate više pažnje na kukove svojih protivnika.

Ključne riječi: nogomet, fudbal, vid, strategije pretrage, odbrana

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THE IMPACT OF SPIRAL STABILISATION EXERCISE ON INDIVIDUALS' POSTURAL SYSTEM

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ABSTRACT

Introduction: In recent decades, problems with proper body posture have been getting more frequent, often resulting in spinal pain. Therefore, it is essential to examine the impact of the Spiral Stabilisation of the Spine (SPS) exercise on body posture. Aim of the study: The main aim of this work is to show that SPS traction exercise prevents wrong body posture and eliminates muscle imbalances. Material and methods: The experimental group consisted of 26 university students (17 women, 9 men) in their first year of study. They were trained once a week for 12 weeks, under the guidance of a qualified trainer. The impact of exercises on postural stability was measured by a non-invasive method with the use of a full-body 3D scanner TC2 NX 16. In order to investigate the possible improvement of the monitored postural parameters after exercise, several methods of statistical hypotheses testing were used. Results: The results show that SPS traction exercise had a positive effect on the postural parameters of the subjects. A significant change occurred in their basic axial posture where imbalance got less frequent. Conclusions: The findings confirm a positive impact of SPS traction exercise on postural parameters of an individual. Moreover, they show the need for increasing anatomy knowledge and precise coordination of movement in young people.

Keywords: postural stability, spiral stabilisation, SPS exercise, statistical analysis, full-body 3D scanner

INTRODUCTION

Due to the common sedentary lifestyle, problems with proper body posture are getting more frequent and often result in spinal pain. Its occurrence may be due to different factors [5]. The pain itself features biological, psychological and social elements [20]. Body posture plays an important role, while its impairment is associated with physical inactivity.

Furthermore, bad posture is associated with poor movement patterns [3, 18, 31]. The current high incidence of impaired body posture in people around us, not only in the elder generation but also in young people, even in children [9, 12], led us to examine and verify SPS traction exercises. Gronek [8] specifies several types of exercises including endurance, resistance, and combined types of exercise. In Slovakia, several rehabilitation exercises are applied to prevent injury and treat back pain in the field of sports [14, 16, 17, 18]. SPS traction exercise can be considered as one of the

possible rehabilitation methods. The exercise primarily prevents the body from having an impaired body posture; moreover, it can eliminate muscle imbalances. According to several professional authorities, SPS traction exercise had a positive effect on cervical [7], thoracic, lumbar and sacral pain. SPS traction exercise can be used as muscle training for pain syndromes [17]. It is necessary to keep the exercise schedule and regularity so that the exercise has a positive effect on the body which can result in further change of movement patterns.

Posture can be perceived as an active bearing of body motion segments both at rest and against external forces, i.e., gravity. With proper posture, individual joints are correctly centred, ensuring balanced muscular activity and a healthy central nervous system [3, 4, 12]. Upright body posture is specific to a human and, along with locomotion, it is the basis for human mobility. Postural functions create a basis for any position and are the main condition for movement, not vice versa [20, 24]. The ability to maintain optimal posture during movement depends on the body's ability to dynamically stabilise segments. Therefore, proper muscular and nervous functioning plays an important role. It involves the majority of skeletal muscles, mainly of postural [32] and static function. In particular, a deep stabilisation system in co-activation with surface phasic muscles is involved in maintaining intrinsic stability.

Proper movement coordination is associated with adequate postural control. [3, 31, 14].

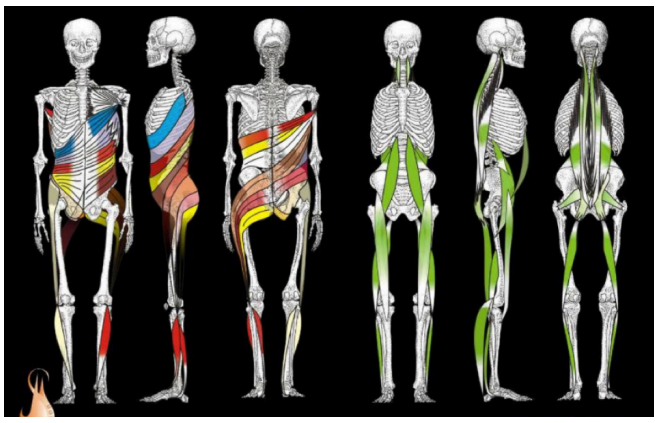


Figure 1 - Muscle chains
(source: www.spiralstabilization.com)

Functional stabilisation and mobilisation of the spine, which involves spiral stabilisation through muscle chains arranged in the spirals (Figure 1), is the core of SPS exercise. The exercise triggers an active compensation to achieve proper strengthening and stretching of spinal, torso, limbs and girdle muscles. Reciprocal inhibition (active relaxation) in stretched muscles and activation of agonists leads to the relaxation of antagonists.

Spiral muscles' enchainment tightens the abdominal area and creates a lift-traction force that pulls the spine upwards and lets the intervertebral plates regenerate. Moreover, when abdominal muscles' activity increases and stabilises the spine, the postural reaction is the proprioceptive stimulation of the foot [27, 28].

Therefore this study was carried out in order to evaluate the efficiency of SPS exercise.

METHODS

In order to evaluate the efficiency of SPS exercise, the initial and final measurements of certain body parameters were made in a group of 19-21-year-old university students (students of the 1st year of full-time university study). The measurements were carried out at the Department of Biomedical Engineering and Measurement of the Faculty of Mechanical Engineering at the Technical University of Košice.

The subjects in the experimental group had been training during a 12-week-semester, once a week, and they were supervised by a qualified trainer. Fifty students were enrolled in the initial measurements. However, only 26 students (17 women, 9 men) participated in the final measurements. Two women were excluded as their body proportions significantly changed within the semester - one student had gained too much weight, while the other lost too much.

The measurements of body parameters were made using a full-body 3D scanner (TC2 NX-16 full-scan). A full-body 3D scanner diagnosis is one of the non-invasive methods for assessing postural parameters [6, 10, 11]. The advantage of this method lies in obtaining a huge amount of information on the shape and dimensions of the person being scanned in a short period of time [13]. 3D scanning is one of the diagnostic methods in sports [26].

Exercise programme

Based on previous experience, in order to achieve a change in the monitored parameters, we chose a specifically developed exercise programme of spiral stabilisation of the spine (SPS). The exercise was performed during the semester (12 weeks), once a week in the form of an 80-minute group exercise and twice a week in the individual form during a shorter time interval (15 minutes). The group form of exercise was conducted under the supervision of a physiotherapist. Students began to perform exercises after the diagnosis, where the first lesson was a learning phase.

In the first phase of learning, which lasted 90 minutes, students completed a theoretical basis, which explained the principle of exercise, anatomy and basic methods of correcting practicing students. In the learning phase, the exercises were added gradually. The stabilisation phase lasted 4 teaching hours. At the beginning of implementing the specifically developed locomotor stabilisation programme (SPS), we took special care for the development of students' basic postural stabilisation. In order to achieve effective exercise during the stabilisation phase, it was necessary to apply an extremely consistent individual approach to the trainee students.

After mastering the basic exercises, balance pads were added. Following the acquisition of basic exercises, repetition of individual exercises was increased to improve technique and stability, after obtaining a subjective assessment of stability. The traction and rotation phase lasted 4 lessons, during which students practiced the entire exercise programme. At this stage of the exercise, we focused on dynamic stability and coping with balancing exercises. SPS exercise requires dynamic warm-up in the form of controlled joint rotation.

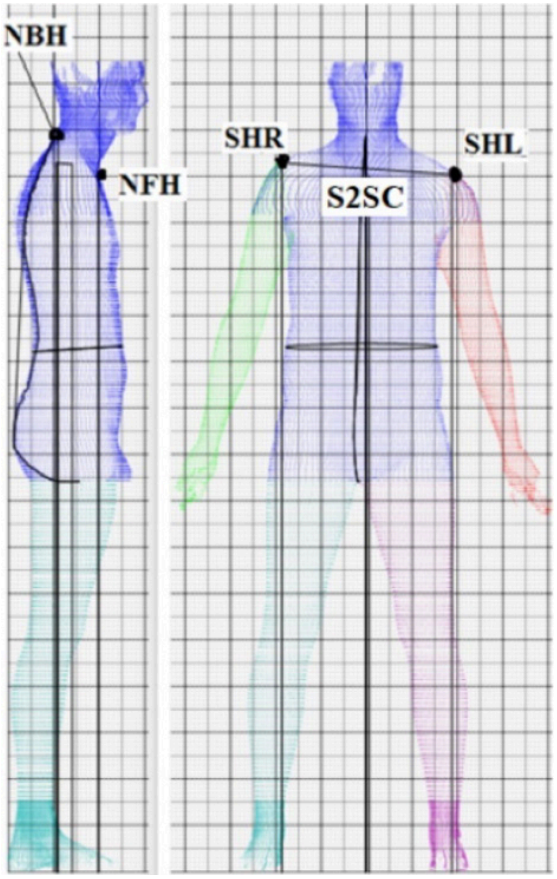


Figure 2 - The measured parameters of body posture Source: 3D scanner (own measurement) output

The length (in mm) of the following postural parameters was determined in the basic axial position of each individual (Figure 2):

- SHL (Shoulder Height - Left) - the distance of the left shoulder from the ground,
- SHR (Shoulder Height - Right) - the distance of the right shoulder from the ground,
- S2SC (Shoulder to Shoulder Calliper - straight line) - the distance between the left shoulder and the right shoulder,
- NBH (Neck Back Height) - the distance of C7 vertebrae jut from the ground,
- NFH (Neck Front Height) – the distance of the collarbones' joint connection from the ground.
- The SHL, SHR, NBH, and NFH points were marked manually by a trainer.

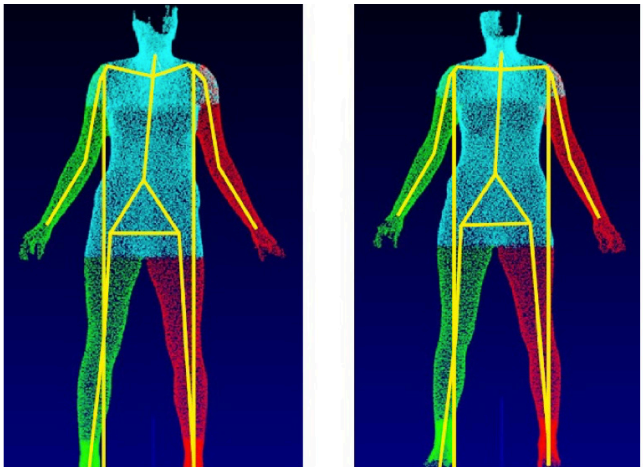


Figure 3 - Basic axial position (3D scanner measurements) of an exemplary student from the experimental group (left – initial measurement, right – final measurement)

Figure 3 shows the initial and final basic position of an exemplary student. It illustrates the progress in the basic axial position of an exemplary student's posture.
Paired observations were obtained at the end of the study. The differences in the values of parameters obtained before (initial values) and after (final values) the exercise programme were calculated to investigate the change (Table 1).Basic descriptive characteristics were used to describe the students' postural parameters. The Spearman's rank correlation coefficient was applied to measure the range of dependence among particular postural parameters. Subsequently, a paired t-test (in case of normal distribution of the postural parameter) or a Wilcoxon signed-rank test (in case of non-normal distribution of the postural parameter) were used to measure the difference between the initial and final values of the monitored parameters. All statistical calculations were performed with the use of the statistical software SAS® On Demand for Academics: Enterprise Guide (USA).

RESULTS

The changes between the initial and final measurements of the postural parameters pertaining to particular students are listed in Table 2 (positive changes indicate an improvement in a given parameter).
Positive changes are greater than the negative ones.

The majority of positive changes (16 out of 24) occurred in S2SC and NFH parameters. Improvements in both parameters were found in 13 students. The most significant absolute changes occurred in the S2SC parameter. Overall, positive changes in the experimental group outweigh the negative ones, both in their volume and absolute values.

Table 1: Comparison of Search Rate Values

Variable	Calculation	Description
dSHL[a]	SHL_initial – SHL_final	a positive result indicates progress in traction stabilisation
dSHR[b]	SHR_initial – SHR_final	a positive result indicates progress in traction stabilisation
dS2SC[c]	S2SC_final – S2SC_initial	a positive result indicates positive change in individual axial posture
dNBH[d]	NBH_initial – NBH_final	a positive change indicates progress in traction stabilisation
dNFH[e]	NFH_final – NFH_initial	a positive change indicates progress in traction stabilisation

a - difference in Shoulder Height - Left
b - difference in Shoulder Height - Right
c - difference in Shoulder to Shoulder Calliper
d - difference in Neck Back Height
e - difference in Neck Front Height

Table 2: Difference between the initial and final values of postural parameters (in mm)

Student label	dS2SC	dNFH	dSHR	dNBH	dSHL
06M	41	6	17	7	24
05F	32	2	18	3	25
23F	45	13	15	1	1
36F	43	11	11	-9	8
26M	20	14	21	-6	14
30F	13	8	9	4	14
04M	1	15	10	0	20
22F	2	-1	13	16	14
29F	2	13	-2	10	8
33F	6	25	-10	0	-3
27M	12	10	4	3	0
14M	-6	21	4	2	-11
34F	10	2	2	5	3
01M	10	5	-3	2	-1

37F	-7	17	-2	-2	-5
24F	3	1	0	6	4
07M	-6	-1	1	2	9
25F	1	0	-10	7	-1
28F	-1	4	4	-1	-1
39F	-2	-7	1	-2	5
31F	5	-4	-9	-3	-1
15M	-8	0	-5	0	-5
03M	-5	-1	-1	-7	-7
32F	-5	-15	-2	-3	-5
	dS2SC	dNFH	dSHR	dNBH	dSHL
The number of "+" differences	16	16	14	13	13
The number of "-" differences	8	6	9	8	10
No change	0	2	0	3	1

Figure 4 presents a stacked bar chart showing the change between the initial and final values of students' postural parameters. The greatest positive changes were observed in the following students: 06M, 05F, 23F, 30F and 04M.

Students 36F and 26M improved considerably in 4 parameters, but there was a slight worsening in the NBH parameter. However, there were some students who got slightly worse (as shown at the bottom part of Table 2). The changes between the initial and final values of postural parameters in the whole experimental group are summarised and displayed with the use of box plots (Figure 5). The most positive changes occurred in the S2SC parameter (dS2SC). The basic characteristics of differences in variables are shown in Table 3.

The arithmetic mean and median for all variables were positive, while the absolute values of maximum differences were higher than the absolute values of minimum differences in the experimental group. This confirms the hypothesis that SPS exercise has a positive influence on postural stability of an individual.

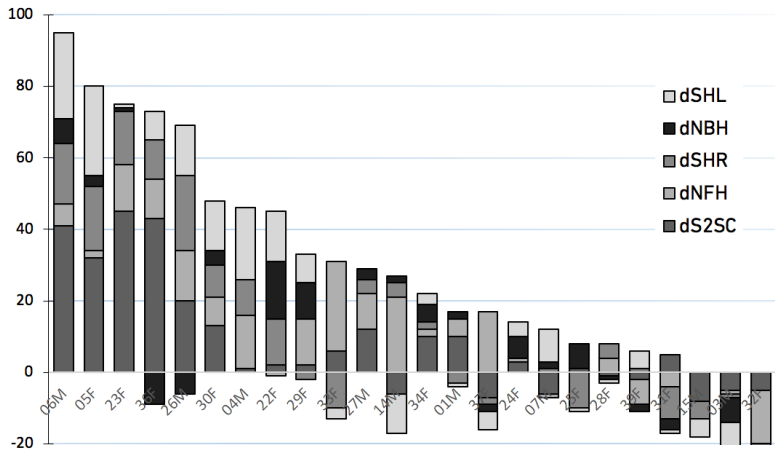


Figure 4 - Changes in students' postural parameters (in mm) – data from Table 2.
Note: Explanatory notes for legend entries (series) are presented in Table 1

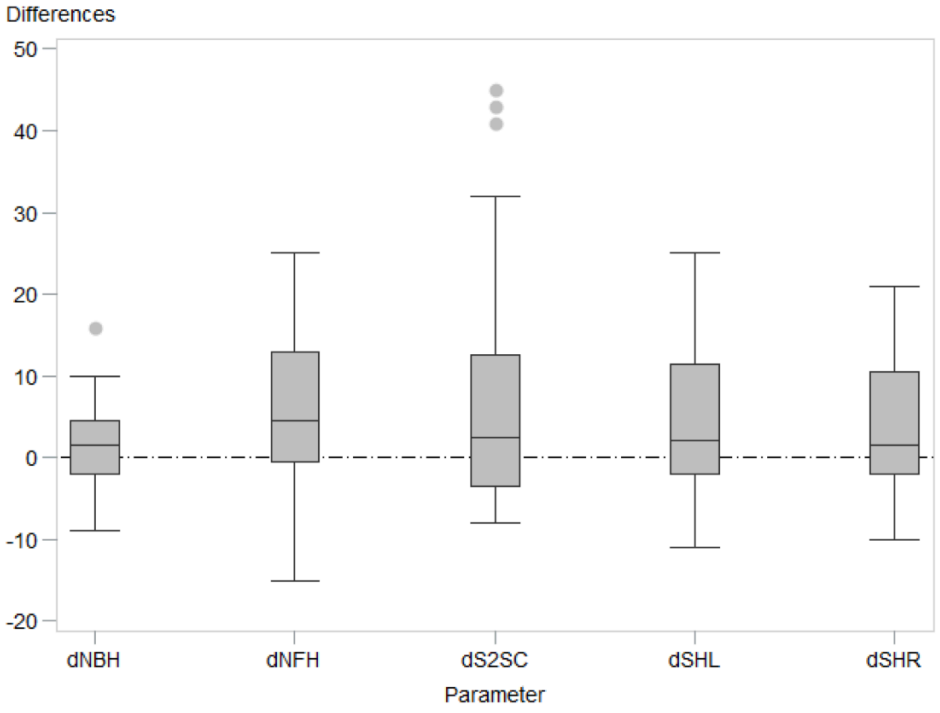


Figure 5 - Box plots of differences between the initial and final values in the measured postural parameters

Table 3: Basic descriptive characteristics of differences in postural parameters (in mm)

Variable	Mean	Median	Maximum	Minimum	Std Dev
dS2SC	8.6	2.5	45	-8	16.2
dNFH	5.8	4.5	25	-15	9.3
dSHR	3.6	1.5	21	-10	8.9
dNBH	1.5	1.5	16	-9	5.5
dSHL	4.5	2	25	-11	9.8

Table 4: Tests for normality - variables dS2SC, dNFH, dSHR, dNBH, dSHL (the numbers in the table represent the associated p-values)

Normality tests	p-value	dS2SC	dNFH	dSHR	dNBH	dSHL
Shapiro-Wilk	Pr < W	0.0008	0.926	0.324	0.806	0.152
Kolmogorov-Smirnov	Pr > D	0.0257	> 0.150	> 0.150	> 0.150	> 0.150

The obtained values of NFH, NBH, SHL and SHR were processed using the paired t-tests to verify the hypothesis of statistically significant changes between the initial and final values of postural parameters.

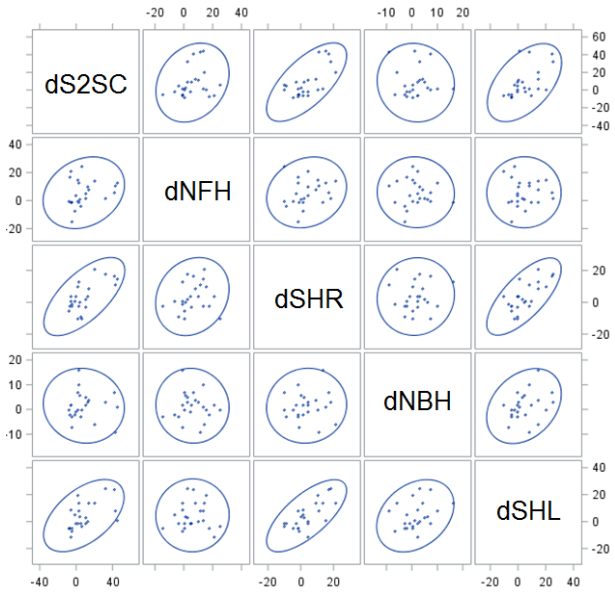
The results of all paired t-tests are shown in Table 5. The p-values of one-sided tests are less than 5% (a significance level) in the SHL, SHR and NFH postural parameters. They show statistically significant positive changes in these parameters after the application of SPS traction exercise.

According to the non-normal distribution of the dS2SC variable, a Wilcoxon signed-rank test was used to verify the hypothesis of statistically significant differences between the initial and final values of S2SC. The result of the test (test statistics: Z = -2.059; p-value = 0.02 for the one-sided test) showed statistically significant positive changes in the S2SC postural parameter.

A correlation analysis was used to determine the existence of statistically significant dependence between the changes in postural parameters. Since the dS2SC variable does not have a normal distribution (see Table 4), a non-parametric Spearman's rank correlation coefficient was preferred, rather than the Pearson coefficient. The values of correlation coefficients with p-values (results of the test: H0: ρ = 0) are shown on the right side of Figure 6. The calculation comes with a graphical representation of dependencies between the pairs of variables with the use of a scatter plot matrix (Figure 6, left side).

Table 5: The results of postural parameters' paired t-tests

Postural parameter	t-statistic	p-value (two-sided test)	p-value (one-sided test)
SHL	2.27	0.0330	0.0165
SHR	1.97	0.0608	0.0304
NBH	1.29	0.2094	0.1047
NFH	3.46	0.0022	0.0011



Spearman Correlation Coefficients

Prob > |r| under H0: Rho = 0, N = 24

	dS2SC	dNFH	dSHR	dNBH
dNFH	0.285	1		
	0.177			
dSHR	0.539	0.247	1	
	0.007	0.245		
dNBH	0.177	0.020	0.086	1
	0.408	0.927	0.689	
dSHL	0.564	0.046	0.683	0.375
	0.004	0.830	0.000	0.071

Figure 6 - The results of the Spearman test. Left side – scatter plot matrix with 95% confidence ellipse. Right side – correlation coefficients with associated p-values.

Three out of ten correlation coefficients showed statistically significant dependence between the associated variables. The most significant positive dependence occurred between the dSHR and dSHL variables (rs = 0.683, p-value ≈ 0). Furthermore, a significant positive dependence was observed between the dS2SC and dSHL variables (rs = 0.564, p-value = 0.004), and between the dS2SC and dSHR variables (rs = 0.539, p-value = 0.007). Other dependencies were not statistically significant.

METHODS

In Slovakia, spiral stabilisation exercises are often used in rehabilitation of patients to improve postural stability. Despite the extensive indication of exercise, evidence of its effectiveness is inadequate. The aim of our study was to test the efficiency of spiral stabilisation exercise. We investigated the effect of spiral stabilisation exercises on posture improvement. In our study, we found improved postures in an experimental group that consisted of university students. This is one of the first studies to confirm the effectiveness of spiral stabilisation exercise. Of course, there are several ways to improve posture. According to current evidence, it is not possible to determine the most optimal type of exercise to improve posture. Based on our results, it is possible that the application of spiral stabilisation exercises aims to improve posture in individuals.

Scientific and technological progress has caused changes in body posture and reciprocal inhibition of muscle chains in individuals. Back pain is mostly caused by hypoactivity. The accompanying symptoms may be weakness, worsened mobility, stiffness, and limited movement range. Furthermore, back pain may represent one of the main economic problems; it requires healthcare services and absence at work. A high prevalence of back pain and its associated comorbidities may be caused by a wide spectrum of factors. Back pain is nowadays one of the most common reasons for seeking a doctor and represents a major socio-economic problem. Almost 60 to 80% of the population experience back pain at some point in their life.

Static vertical muscle chains of the human body are constantly overloaded which can result in inhibition of dynamic muscle chains. This greatly affects body posture and causes pain and movement discomfort to an individual. However, the pain phenomenon is very complex [23, 24] and the impaired posture cannot be perceived as the only factor. Nevertheless, impaired posture can be associated with a high prevalence of degenerative changes in the spine. Degenerative changes such as intervertebral disc (IVD) degeneration, facet hypertrophy or IVD protrusion often accompany back pain and are interpreted as the cause of the back pain. Brinjikji et al. [1] have done a literature review to study the prevalence of impaired IVD in the asymptomatic population. The results from an MRI and a CT were considered. Parameters such as disc degeneration, loss of disc signal, disc height, disc protrusion, annular fissure, facet degeneration, spondylolysis, and spondylolisthesis were studied. These criteria were observed in 310 asymptomatic subjects. The prevalence of IVD impairments in 20- and 80-year-old asymptomatic subjects was 37% and 96%, respectively. The so-called "black disc" was observed in more than 50% of 40-year-old subjects, and 86% of 60-year-olds. The loss of disc height was lower in young individuals, but its prevalence grew by 1% each year.

The cases of disc protrusion and annular fissure were observed to be similar in each age category and did not rise with age. The authors indicated the prevalence of facet degeneration in young individuals (20-30 years old) at 4 to 9%. Spondylolisthesis was not a common observation for individuals up to 60 years of age, while in people over 60 years of age, the prevalence was 23% in asymptomatic subjects. The authors concluded that there was a considerable prevalence of degenerative changes in the back when it comes to the asymptomatic population. Finally, the authors stated that degenerative changes are natural in aging and every finding has to be interpreted according to the patient's clinical status.

Another review of 280 studies conducted by Brinjikji et al. [2] compared the prevalence of degenerative back changes in asymptomatic and symptomatic subjects of up to 50 years of age (n = 3097; 38.6% asymptomatic and 61.4% symptomatic). Symptomatic subjects had axial back pain and, in some cases, a radicular syndrome. The authors looked at the following aspects: IVD bulge/degeneration/extrusion/protrusion, annular fissure, central canal stenosis, spondylolisthesis, and spondylolysis. The disc bulge was present in 5.9% of the asymptomatic and 49.2% of the symptomatic subjects.

The degenerative disc was observed in 34.4% of the asymptomatic and 57.4% of the symptomatic subjects. The prevalence of disc extrusion in asymptomatic and symptomatic subjects was 1.8% and 7.1%, respectively. For disc protrusion, it was 19.1% and 42.2% in asymptomatic and symptomatic subjects, respectively. The prevalence of annular fissure in asymptomatic and symptomatic subjects was 11.3% and 20.1%, respectively. Central canal stenosis was found in 14% of the asymptomatic and 59.5% of the symptomatic subjects. Spondylolisthesis was observed in 3.2% and 6.2% of asymptomatic and symptomatic subjects, respectively. Finally, the prevalence of spondylolysis in asymptomatic and symptomatic subjects was 1.8% and 9.4%, respectively. The authors concluded the disc bulge, degeneration, extrusion, protrusion

and spondylolysis to be more prevalent in subjects of 50 years of age and younger with back pain, compared to asymptomatic ones.

The spiral stabilisation exercise method is based on the connection of the posture and degenerative changes of the spine. The spiral stabilisation exercise method assumes that the improvement of postural parameters will also improve patients' pain. This is based on the principle of the biomechanical model of pain, where the result of poor posture aggravates the issue. The aim of spiral stabilisation exercise is to improve postural parameters and spinal pain. Our study saw an improvement in students' postural parameters, but our study did not focus on improving back pain in patients. We hypothesise that posture improvement may also occur in patients with back pain, but further study is warranted in patients with back pain.

The particular phases of the spiral muscle stabilisation process are highly time-consuming; moreover, it is necessary to properly adapt them for various individual cases. Based on the results of this study, the experimental group of trainees was shifted into the stabilisation phase through the SPS training process. The adaptation phase of movement patterns varies among individuals in terms of time or intensity of exercise within individual training units. It must be emphasised that without an individual approach, new movement patterns cannot be established. It is difficult to determine what is the optimal time needed to improve postural parameters. We recommend that studies be conducted with better methodological quality to investigate the short- and long-term benefits of exercise with a control group that would undergo another type of rehabilitation exercise to improve posture. The experimental group of students saw a general improvement in the monitored parameters.

The most significant changes - by 8.6 mm on average - occurred in S2SC (Shoulder to Shoulder Calliper - straight line), where the position of shoulders improved in the inferior dorsal direction of the sagittal plane. The changes in the NFH (Neck Front Height) postural parameter reached the highest median value (4.6 mm). The measurements showed a change of posture from flexion to extension with balanced shoulders after the application of SPS exercise. Further findings showed that changes in postural parameters SHR (Shoulder Height - Right) and/or SHL (Shoulder Height - Left) were strongly associated with changes in the postural parameter S2SC.

Another limitation of our study was the insufficient control of probands during exercise. We spent a lot of time educating probands on the right exercise technique, but we could not control the optimal exercise technique during their home exercise. We hypothesise that exercise with a physiotherapist could achieve better results in improving postural stability.

Real life confirms students' awareness of the need to be physically active. According our experience, physical activity in our university is generally low. Nowadays, more conscious individuals seek physical education lessons although Physical Education is only compulsory for two semesters (1 academic year) of their study at the Technical University of Košice. Our findings highlight the need to develop and improve the locomotion of university students.

CONCLUSION

The results of statistical analyses show that traction exercise, SPS training in our case, had a positive impact on the postural parameters S2SC, SHL, SHR and NFH of the experimental group of students. However, studies with a wider range of participants and better design are needed to confirm our results.

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UTICAJ VJEŽBE SPIRALNE STABILIZACIJE NA POSTURALNI SISTEM POJEDINACA

Uvod: posljednjih decenija problemi sa pravilnim držanjem tijela postaju sve češći te nerijetko za posljedicu imaju bolove u kičmi. Prema tome, ključno je ispitati uticaj vježbe spiralne stabilizacije kičme (engl. SPS - Spiral Stabilisation of the Spine) na držanje tijela. Cilj studije: glavni cilj ovog rada je pokazati da SPS vježba trakcije sprječava loše držanje tijela i otklanja mišićnu neravnotežu. Materijal i metode: eksperimentalna grupa se sastojala od 26 studenata (17 žena, 9 muškaraca) prve godine akademskih studija. Oni su vježbali jednom sedmično u trajanju od 12 sedmica, a pod vodstvom kvalificiranog trenera. Uticaj vježbi na posturalnu stabilnost je mjeren putem neinvazivne metode uz korištenje 3D skenera za cijelo tijelo TC2 NX 16. Kako bi ispitali da li su se praćeni posturalni parametri poboljšali nakon vježbe, koristili smo nekoliko metoda statističkih hipoteza. Rezultati: rezultati pokazuju da je SPS vježba trakcije pozitivno uticala na posturalne parametre ispitanika. Došlo je do značajne promjene u njihovom osnovnom držanju tijela u centralnom položaju uz manju učestalost neravnoteže. Zaključci: pronalasci potvrđuju pozitivan uticaj SPS vježbe trakcije na posturalne parametre pojedinca. Nadalje, oni ukazuju na potrebu za većim poznavanjem anatomije i precizne koordinacije pokreta kod omladine.

Ključne riječi: posturalna stabilnost, spiralna stabilizacija, SPS vježba, statistička analiza, 3D skener za cijelo tijelo

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SCHOOL SPORTS: CURRENT OBJECTIVES AND PERCEPTION OF FUTURE PHYSICAL EDUCATION TEACHERS

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ABSTRACT

Despite the undeniable educational potential of school sports, the individual and social values attributed to it are not inherent to the practice. This responsibility falls mainly on the educators, whose attitudes, disposition and personal vision of school sports determine its implementation. For this reason, this study analysed the opinion and perceptions of future Physical Education specialists on the objectives of school sports, with the aim of identifying the main shortcomings and divergences between theory and practice. 328 students of Physical Education who have different levels of education, 104 women and 221 men, in the age between 17 and 38 years old were consulted based on a questionnaire elaborated ad hoc. Although the majority of students considered socialising, educated in values, inclusion, developing motor skills and promoting healthy habits to be the fundamental objectives of school sports, a high percentage of students gave importance to the values related to competitiveness. It was also found that students' academic training influenced their view of school sports. There was also a divergence between the ideal goals of school sports and the current state as perceived by students. In conclusion, it is essential to improve the training of the agents who interact directly with children in order to transform school sports and guarantee children's complete development and an extensive education in values.

Keywords: physical education, school sports, aims, values, educational potential

INTRODUCTION

Sport is considered an essential element for the harmonious development of individuals (Zulaika, 2006) and given its influence on the physical, mental and social well-being, its promotion is defined and regulated by international organisations (European Sports Charter, 1992). The White Paper on Sport of the European Union (2007) highlights its potential for social inclusion, integration, and equal opportunities, as well as the role of sport in education.

Taking into account all the virtues attributed to sport, it seems obvious to recognise the importance of school sports, the first introduction of sports to children, and one of the pillars of the sport system. The Decree 125/2008, dated 1st July, on School Sports of the Basque Country defines school sports as "an organised sporting activity that is practiced by schoolchildren during non-teaching hours throughout the period of compulsory schooling", and specifically highlights its essential functions such as the comprehensive education of schoolchildren, the balanced development of their personality and the acquisition of healthy habits. Similarly, school sports are understood as an indispensable tool in the global process of education in values (Monjas et al., 2015).

These include dignity, tolerance, communication, cooperation, companionship, discipline, fair play, respect for rules and others, and enjoyment, among others (Balci & Erdeveciler, 2017; Beregüi & Garcés, 2007).However, despite the unquestionable educational potential of school sports (Prat et al., 2004) and its contribution to social construction,

these personal and social values are not inherent to the practice of sport (Venero, 2008), they are not generated automatically or spontaneously, and depending on their orientation, they could even be negative (Monjas et al., 2015). The inappropriate attitudes of coaches and families and specialised school sports where children are relegated could cause more risks than benefits (Lumpkin, 2008). Several studies show that the influence of coaches is not always appropriate, as there are deficiencies in the transmission of positive values (Balci & Erdeveciler, 2017), shortcomings in methodological and didactic resources and an orientation overly focused towards competition (González & Campos, 2010), often using management techniques concentrated on results rather than participation (Espada et al., 2013).

Therefore, it is clear that instructors play a vital role in this educational task which should go hand in hand with the objectives of the educational system in general, and the area of physical education in particular (Ortuzar, 2006). As proposed by Venero (2007), we should refer to those directly responsible for intervention in school sports as "educators", since instruction in physical and technical learning, the provision of a critical attitude to negative behaviours and actions (Monjas et al., 2015) and the dissemination of positive social and personal values is in the hands of these agents (Beregüi & Garcés, 2007).

Unfortunately, a high percentage of those individuals responsible for school sports have no training (Espada et al., 2013; Manrique et al., 2013; Pérez et al., 2016) or their training is not appropriate (Bernabé et al., 2018), risking the achievement of the objectives and the formative nature of school sports, as well as the future relationship of boys and girls with sports.

For all these reasons, it is considered essential to provide proper training for those individuals involved in school sports in order to develop a sport practice that does not reproduce the dominant counter-values of society, such as competition, violence, and discrimination (Venero, 2007), which are often covered by the media and sports institutions (Prat et al., 2004). For this purpose, particular actions must be taken where specific proposals make the educational and training potential of sport visible (Monjas et al, 2015) and where coaches and families join forces and work to achieve these objectives (Lumpkin, 2008).

Therefore, these sports practices must be based on educational criteria in order to transform sport into a didactic element (Monjas et al., 2015). To this end, it is important to first define the purposes of school-age sports activities in order to avoid negative trends that traditional models could cause in children (Lleixà et al., 2015). In this initial analysis, it is essential to know the attitudes and motivations of future physical education professionals regarding school sports (Beregüi & Garcés, 2007), since their vision will determine the implementation in their daily lives (Monjas et al., 2015).

For this reason, the present study will focus on analysing the opinion and perception regarding the objectives and goals of school sports according to its future leaders, and investigating whether these objectives are in line with the educational orientation that is set out by law. From this analysis, the purpose will be to identify the main shortcomings and divergences between theory and practice and to take these data as a starting point for the design of a possible future training plan, which will ultimately aim to improve the quality of the context of school sports practice in the province of Alava.

MATERIALS AND METHODS

Participants

The sample was composed of 328 Physical Education students who have different levels of education (Table 1) and attend educational institutions in Vitoria. 104 were women, 221 were men and 3 were non-binary, aged between 17 and 38, with an average age of 20.8 (±2.17).

Measures

For evaluating the opinion and perception of future teachers regarding the objectives of school sports, the tools designed for this purpose (Beregüi & Garcés, 2007) were taken as a reference and an ad hoc adaptation was made accounting for the particularities of school sports in the Basque Autonomous Community as set out in Decree 125/2008.

In order to establish the dimensions under study and the items in the questionnaire, advice was sought from experts in the field of school sports. The participants assessed the statements "School sports should serve to..." scoring the following items using a 5-point response scale (1 = very much in disagreement and 5 = very much in agreement):

- make friends and help to socialise
- grow as a person and educate in values
- contribute to the acceptance of all their peers
- develop basic motor skills
- promote healthy habits
- support gender equality
- normalise the use of the Basque language
- occupy children's leisure time
- supply the pool of top teams
- prepare children for high performance

A section was added at the end of the questionnaire so students could add other objectives that they considered important. The participants first assessed the situation of school sports by expressing their opinion in relation to their ideal school sports and then they expressed their opinion based on the perception of reality that they observed.

Procedure

After contacting the educational institutions and obtaining the corresponding permits, the questionnaires were administered following the same protocol and were always accompanied by the presence of expert research staff in order to be able to resolve any questions.

Participation in the research was voluntary and the questionnaires were completed by the participants under their informed consent and anonymously to guarantee the confidentiality of the data. No student refused to participate in the research. The study was approved by the Ethics Committee of the University of the Basque Country.

Data analysis

A descriptive analysis of the variables, a comparison between groups using t-test and ANOVA, and a correlation analysis using Pearson's r were performed. Data analysis was executed with the statistical package SPSS v. 20.0 for Windows. The significance level was set at $p < .05$.

Table 1: Participants´ educational background and sex

Educational background	Total students	Women	Men	Non-binary
Technical specialist in Physical Activity and Sport Animation	80	23	57	0
Primary Education degree (mention of physical activity)	77	33	41	3
Physical Activity and Sports Science degree	171	48	123	0

RESULTS

Figure 1 shows what are the main objectives of school sports according to the students' opinion, ordered from the highest to the lowest scores, 5 being the highest score.

As can be seen in Figure 1, there were differences between the desired objectives and those that students perceived in reality. For instance, the objectives that should have had less importance according to the students' opinion and that dominated the last positions (leisure time occupation, supplying the pool of top teams and preparation for high performance) took more importance in reality, even reaching the first position in the case of leisure time occupation. In terms of supplying the pool of top teams and preparation for high performance, they also gained importance in reality, moving up to sixth and seventh place, respectively. In contrast, the fundamental objectives according to the students' opinions lost up to 1.6 points in reality (Fig. 1).

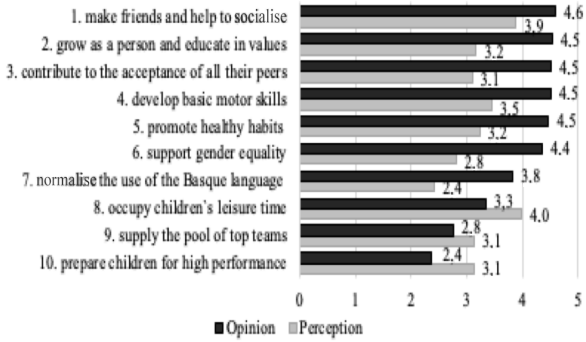

Figure 1 - School sports' main objectives according to students' opinion and perceived reality

Looking more closely at the students' opinions, the importance awarded to each objective can be seen in Table 2. The majority (89-93%) of the students strongly or somewhat agreed with the objectives of making friends and helping to socialise, growing as a person and educating in values, contributing to accepting their peers, developing basic motor skills and promoting healthy habits.

In relation to the support of gender equality through school sports, although a large majority (85%) agreed with this objective, a small percentage (5%) disagreed or strongly disagreed. As for the normalisation of the Basque Language, a high percentage of students agreed (66%) with this objective. However, 23% neither agreed nor disagreed and 11% of the students did not agree that this aim should be a part of school sports. As can be seen in Table 2, there was a great variability of responses regarding leisure time occupation as an objective of school sports.

Although almost half (48%) of the students agreed that school sports should be a leisure activity, 29% neither agreed nor disagreed and 22% did not agree that school sport should be a mere leisure activity. Similarly, while 34% agreed with the objective of supplying the pool of top teams, 26% neither agreed nor disagreed.

However, 41% did not agree that school sports serve this purpose. Regarding the objective preparing for high performance, only 18% of the students agreed, while 27% neither agreed nor disagreed and 59% expressed their disagreement.

Table 2: Schools sports' main objectives according to students

Objectives	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
1. make friends and help to socialise	67%	26%	6%	1%	0%
2. grow as a person and educate in values	64%	28%	7%	1%	0%
3. contribute to the acceptance of all their peers	66%	24%	8%	3%	0%
4. develop basic motor skills	60%	31%	8%	1%	0%
5. promote healthy habits	59%	32%	6%	2%	0%
6. support gender equality	58%	27%	9%	3%	2%
7. normalise the use of the Basque language	35%	31%	23%	5%	6%
8. occupy children's leisure time	17%	31%	29%	12%	10%
9. supply the pool of top teams	9%	25%	26%	15%	26%
10. prepare children for high performance	5%	13%	27%	27%	29%

When analysing the opinions and perceptions among different groups of students, significant differences were observed according to their initial academic training. Students possessing the Physical Activity and Sport Sciences degree provided significantly more importance to the objective of promoting healthy habits than the other groups of students ($p = .014$). Instructors in Physical Activity and Sport Animation gave more importance ($p = .011$) to preparing for high performance and future, Physical Education primary school teachers highlighted the role of school sports in contributing to the acceptance of all their peers ($p = .023$) and in promoting the Basque language ($p = 0.000$). In addition, this last group was also more critical in perceiving reality in a more negative way than the other groups ($p \geq .036$). In detail, they perceived that the objectives of making friends and helping to socialise, contributing to the acceptance of their peers, growing as a person and educating in values, supporting gender equality, and

developing basic motor skills were carried out less than they would like. In the same way, these students also perceived that the mere occupation of leisure time took too much importance in reality (p = .000). The analyses performed by sex and age did not show statistically significant differences among the groups. Analysing the relationships between the objectives, significant correlations were found between different purposes of school sports. For example, the scores of r = .59 and r = .52 regarding the opinion and perception, respectively, were obtained between supplying the pool of top teams and preparing for high performance. Similarly, high correlation scores were observed between the other goals, according to the students' opinions and their perception of reality (Table 3)

Table 3: Correlations between different objectives according to students' opinion and perceived reality

	1.		2.		3.		4.		5.		6.		7.	
	O	P	O	P	O	P	O	P	O	P	O	P	O	P
1. develop basic motor skills			0.53*	0.46*	0.46*	0.43*	0.38*	0.32*	0.39*	0.41*	0.25*	0.31*	0.41*	0.31*
2. promote healthy habits					0.46*	0.41*	0.36*	0.32*	0.46*	0.34*	0.33*	0.29*	0.42*	0.23*
3. grow as a person and educate in values							0.45*	0.30*	0.56*	0.49*	0.31*	0.38*	0.53*	0.41*
4. make friends and help to socialise									0.56*	0.41*	0.37*	0.14*	0.51*	0.19*
5. contribute to the acceptance of their peers											0.42*	0.33*	0.57*	0.48*
6. normalise the use of the Basque language													0.46*	0.46*
7. support gender equality														

DISCUSSION

In this article, the objectives of school sports were presented in the eyes of different groups of students who are related to physical activity and who are the future agents responsible for school sports. Personal opinions on what students believe school sports should ideally be and the perception of reality pertaining to each participant's closest environment were taken into account. In addition, these data were also examined according to the students' academic training.

The aim of this study was to establish a starting point in order to design and develop specific training interventions that will improve the current condition of school sports.Taking into account the opinion of the students, most of them agreed that socialising, educating in values, inclusion, developing basic motor skills and promoting healthy habits are fundamental objectives of school sports, leaving those focused on high performance and competition in the background. Similar values have been reported in different studies where fun and personal improvement (Lee et al., 2000), creating future and healthy habits (Manrique et al., 2013), cooperation and companionship (Beregüi & Garcés, 2007; Manrique et al., 2013) were chosen ahead of competition and winning.

However, as some authors reported (Manrique et al., 2013) there is still a small percentage (8%) that considers important the objectives of a competitive nature. In our study, this percentage was higher, with 17% of students considering school sports as preparation for high performance and 33% of those who thought that school sports should supply the pool of top teams.

In addition, it was also observed that thes objectives were highly valued by future instructors in Physical Activity and Sports Animation in comparison with university students. In the same way, other studies also highlighted these differences in priorities according to the studies of school sports instructors (González & Campos, 2010), emphasising the impact of initial training on the individual vision of school sports.

As Ortuzar (2006) indicated, the two areas of action pertaining to school sports, such as schools, federations and clubs, are based on different visions and objectives. Sport in the school context should follow educational foundations, and therefore, it should be developed in a very different way as opposed to traditional sports training (Robles et al., 2006), where the search for results and the exaltation of triumph often lead irremediably to discrimination against children with less abilities (Águila, 2017). For this reason, some of the students who advocate for competition and high performance may have participated and/or been part of sports institutions where the promotion of performance-based sport is pursued, a vision far removed from that of school sports, where sport should be the means and not the end.

On the other hand, when it comes to the students' opinion, the divergence observed between the ideal objectives of school sports and the perceived current state of these objectives is worrying. The increase in competition and performance goals and the decrease in goals such as accepting peers, educating in values, promoting healthy habits and supporting gender equality, highlight the gap between theory and practice. In the same way, Gonzalo (2013) also detected early specialisation, competitiveness, having victory as the only objective and gender inequality as characteristics of school sports in the city of Segovia.

It is clear that, in order to transform school sports, it is essential to change the profile of the instructors and offer the economic and social recognition in accordance with the responsibility they are given (Manrique et al., 2013). Furthermore, as Hernández (2014) indicated, it is necessary to reconsider the true educational value of school sports practice beyond the dominant sports idealisation which is present today.

In addition, the significant correlations between certain objectives observed in this study confirm that values are closely related to each other so that when one develops, the others benefit as well (Monjas et al., 2015).

In spite of the significance that instructor training has in the development of these values, we must not forget the motivations that move children, since these should be taken into account aligning them up with the objectives of physical education teachers (Martins et al., 2014).

This lack of agreement and coherence could damage the adherence to sport of the youngest children, as shown by Martins et al. (2014), where girls in the last cycle of primary and the first cycle of secondary school reported dislike for sport, incompetence and disinterest in physical effort among other reasons for not practicing school sports. These results clearly show that their interests were not taken into account in their previous sport experience.

Similarly, Picos et al. (2015) observed an association between the perception of the quality pertaining to physical-sports activity programmes in primary school and early dropout and concluded that the relationships with instructors, in addition to the attitudes towards non-competitive sport and the impact of the programme on external sports practice, were excellent predictors of children satisfaction, a strong reason to consider instructors as a key element in the adherence to sports programmes.

It is important to underline that the transmission of positive sports values previously defended will only be achieved by ensuring that the most important aspects of school sports programmes are offered to children (Mandic et al., 2012), in order to ensure adherence and reduce dropout rates (Picos et al., 2015). Likewise, we cannot forget the specific needs of children with a low socioeconomic status and/or obesity, since they are the population with the lowest levels of sports participation (Mandic et al., 2012).

However, it should be considered that these values are promoted from different settings in addition to the school, such as the family, institutions and the media (Monjas et al., 2015).

Therefore, in addition to the importance of defining these values through the synchronisation between school sports instructors and Physical Education teachers, it is important to emphasise the importance of educating families. This education will help families understand the school sports context and teach them to participate and behave in this setting with their children (Hernández, 2014), allowing the promotion of these values and objectives to be developed in a joint and coherent way.

CONCLUSION

In conclusion, an alternative school sports model that moves away from the competitive federated sport model should be developed. This model should be in line with the general objectives of the educational system and emphasise the training of the agents that interact directly with the children, which would guarantee the achievement of many educational benefits which are attributed to the sport practice. This would mean a qualitative and quantitative improvement in the integral development, character and personality construction, education in values, health, and quality of life of our little ones, and consequently, in the very near future, of the citizenship as a whole.

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ŠKOLSKI SPORT: TRENUTNI CILJEVI I PERCEPCIJA BUDUĆIH NASTAVNIKA FIZIČKOG OBRAZOVANJA

Uprkos neosporivom obrazovnom potencijalu školskog sporta, individualne i društvene vrijednosti koje mu se pripisuju nisu svojstvene praksi. Odgovornost uglavnom leži na nastavnicima čiji stavovi, dispozicija i lična vizija školskog sporta određuju njegovu primjenu. Zbog toga je ova studija analizirala mišljenje i percepciju budućih specijalista za fizičko obrazovanje po pitanju ciljeva školskog sporta u svrhu identifikovanja glavnih nedostataka i odstupanja između teorije i prakse. Ad hoc upitnikom je zatraženo mišljenje 328 studenata fizičkog obrazovanja koji posjeduju različite stepene obrazovanja, od kojih je 104 žene i 221 muškarac u dobi između 17 i 38 godina starosti. Iako većina je studenata smatrala da su socijalizacija, učenje vrijednosti, inkluzija, razvijanje motoričkih vještina i promocija zdravih navika osnovni ciljevi školskog sporta, veliki udio studenata je davao važnost vrijednostima vezanim za takmičenje. Također je otkriveno da je akademsko obrazovanje studenata uticalo na njihov stav o školskom sportu. Nadalje, bilo je odstupanja između idealnih ciljeva školskog sporta i trenutnog stanja po pitanju percepcije studenata. Zaključno, bitno je poboljšati obuku onih koji su u direktnoj interakciji sa djecom kako bi se transformisao školski sport te garantovao potpuni razvoj djece i iscrpno učenje vrijednosti.

Ključne riječi: fizičko obrazovanje, školski sport, ciljevi, vrijednosti, obrazovni potencijal

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BOOK REVIEW: "SPORTS VALUES IN EVERY CLASSROOM: TEACHING RESPECT, EQUITY AND INCLUSION TO 8-12 YEAR-OLD STUDENTS"

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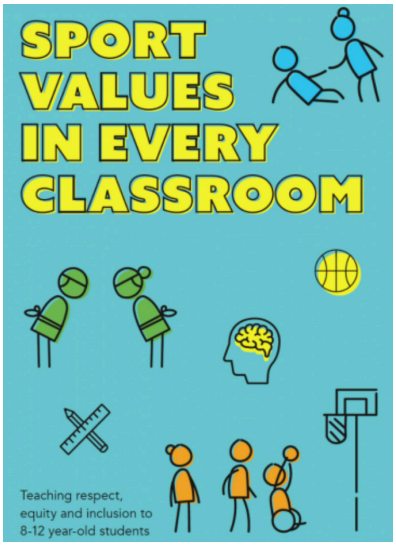
ABSTRACT

This paper is a book review of the work titled "Sport values in every classroom: Teaching respect, equity and inclusion to 8-12 year-old students" which was made by corporate authors: UNESCO, Agitos Foundation, World Anti-Doping Agency, International Council of Sport Science and Physical Education, Olympic Foundation for Culture and Heritage, International Fair Play Committee (2019), and is 186 pages long and written in the English language.

Keywords: book review, sport, students, sport values

INTRODUCTION

The book "Sports values in every classroom: teaching respect, equity and inclusion to 8-12 year-old students" is written with the intent to point out and show the possibilities that sports can offer when it comes to the socialisation process and development of moral values among the younger population, in this case, among 8- to 12-year-olds. Six partner organisations, UNESCO, Agitos Foundation, World Anti-Doping Agency, International Council of Sport Science and Physical Education, Olympic Foundation for Culture and Heritage and International Fair Play Committee, have jointly created this book which deals with theoretical and practical definitions as well as methodological approaches to the development of social skills such as respect, equity and inclusion. The authors of this book were guided by a student-centred curriculum developed by Don Hellison in 2011, and titled "Teaching for Personal and Social Responsibility Model" (TPSR). With this book, the authors want to help teachers of sports and sports education in the process of instilling moral values based on respect, equity and inclusion through practical activities that can be carried out independently or incorporated into the existing educational curricula.



BOOK CONTENT

The book is organised into three parts: theoretical, practical and the concluding part.

In part one, the concepts of respect, equity and inclusion are explained in a simple and understandable way, as the fundamental social values related to the development of fairness, fair play, and "sportspersonship" in sports.
In this theoretical part, each of the above mentioned three social values is elaborated in detail, emphasising the essence of each of them. Additionally, to present the general definitions of the targeted social values, the authors have presented the information that links respect, equity and inclusion with sports, as well as the policies and definitions of the targeted social skills pertaining to different world sport organisations.

Furthermore, the authors have presented theoretical frameworks for the personal knowledge and attitude assessment of teachers who will be the facilitators of the educational process, as well as for the knowledge and attitude assessment of the students who will be at the centre of the educational process. In this theoretical part, the authors have created analytical cards for the three listed social values. With these cards, the teachers should be able to determine the level of understanding when it comes to the concepts of respect, equity, and inclusion, both by teachers and students and before the educational activities begin.

In the second part of the book, which is of a practical nature, the authors have developed educational mini teaching units - activity cards, 10 for each of the listed social values in which there are practical exercises for students. In each activity card, teaching activities are explained in detail and timed, alongside the illustration of the possible cross-curriculum links with other subjects. The cards contain colourful illustrations, graphs, and schematic examples of planned activities with the specified props as well as the possibilities of performing indoor or outdoor activities.

In the last chapter of the book, the authors have summarised several relevant aspects that determined the partners in this project, defined the concepts and method of project development, which ultimately resulted in this book being published.
In the concluding part, the authors have presented the planning, development, and project implementation process, and have redefined the social skills covered in this book through multidimensional approaches to the mentioned social skills of the renowned world organisations dealing with children's development and education in the world. The authors also point out the fact that the learning model - Teaching for Personal and Social Responsibility Model (TPSR) guided the authors in the process of creating this book.

The last part also talks about learning strategies as well as how to assess the acquired knowledge of students at the end of the learning process. In addition to the theoretical review of how to assess the students' knowledge and achievements, the evaluation cards with instructions are also attached.

The book is imbued with illustrations, drawings, and graphs which further contribute to the clarity of the presented curricula and the manner of their implementation.

CRITICAL EVALUATION

After gaining insight into the book's content and its concept, it can be concluded that the book is not solely intended for practitioners and teachers of sports, but also for teachers from other educational fields who work with children. The book is written in a simple but precise language.

With this book, by using well-known definitions, while respecting basic didactic principles, such as the principle of appropriateness and practical applicability, gradualism, and a methodical approach, fun, and entertainment as well as the principle of effective action, the authors are offering useful tools to teachers for developing targeted social skills among students.

In addition, in the theoretical part of the book, the authors recognise the importance of understanding general, specific and practical characteristics of each three targeted social skills before conducting practical classes, and as a preliminary step, they state the need for teachers' self-assessment in relation to their own knowledge and attitudes about respect, equity, and inclusion.

This type of approach will certainly increase the competence of readers - teachers, and thus contribute to their (readers') better understanding, conceptualisation, and implementation of teaching activities in practice.

Given that a big percentage of target groups of children aged 8-12 are already actively participating in certain formal educational processes, which is a legal requirement in most countries, the reasonable assumption is that the presented mini-curricula will functionally fit into the existing teaching activities. The design of activity cards, due to their simplicity and flexibility, will not present any thematic or organisational obstacle when implemented in schools

or sports clubs. The movement-based principle presented in the book achieves the effect of the biopsychosocial development of students, which certainly aligns with the modern sports educational trends in the world. The possibility of conducting teaching activities outdoors and in closed spaces allows teachers to keep up the continuity in teaching processes and the ability to create different environments, thus achieving environmental multidimensional influence on students when teaching.

The planned use of low-cost and easily accessible props, including some which are improvised from materials all around us, allows for educational dispersion to wide geographical and educational areas. The implementation of new and innovative forms of education for younger ages is often not possible due to limitations caused by infrastructural or economic problems. The design of the teaching process, articulated through activity cards, enables the differentiation of the teacher's approach to each student depending on the student's abilities. By using various methods of transferring educational content, as presented in the activity cards, as well as using different media when conducting education, it is possible to tailor educational activities for students and thus improve the effects of learning and acquiring new knowledge.

Modelling knowledge assessment through pre-evaluation sessions and post-evaluation sessions incorporated in the main educational curricula enables the students to be gradually introduced to the problems that the educational process strives to resolve. Furthermore, it helps the students themselves to understand the concept to be discussed and gives them the freedom to give their feedback during the assessment process, after the exercise has been completed.

The convertibility of educational activities, reflected in the possibility to perform activities independently or as part of other similar sports activities, helps make the approach to the designed educational content a holistic one. Incorporating educational content presented in this book into other sports activities or into formal physical education in schools is possible due to the simplicity and complementarity of the planned activities presented on the activity cards.

Moreover, the cross-curriculum modifications of sports activities that are applicable in mathematics/geometry, geography, social sciences, fine arts, history, and other educational fields, make a unique reason which adds to the "likeability", the originality of this educational model.

In the final part, using an objective and realistic way, the authors offer a brief overview of the project's creation, the choice of partners, and an explanation of the determined learning strategy that relies on existing and reputable learning models. With this, the authors have successfully homogenised their work in its entirety and enabled the reader to get a formal justification of the actions taken when writing this book. As an additional tool, the authors have also presented a system for evaluating the final results of the outlined educational process. Using the two types of assessment procedures, in the form of formative and summative assessments, teachers and practitioners will have a much easier time summarising their activities and determining the achieved levels of knowledge among students.

CONCLUSION

The book “Sports values in every classroom: teaching respect, equity and inclusion to 8-12 year-old students” uses an acceptable, simple, and, at the same time, professional, relevant and original way to present an educational model for developing social skills among the group of students aged 8-12.

Given the specifics of the target group, the authors have combined several teaching approaches that were incorporated into one educational unit. The book “Sports values in every classroom: teaching respect, equity and inclusion to 8-12 year-old students”, due to its original design and content, possessing theoretical and practical educational elements, and defining and emphasising global moral values, certainly presents valuable and useful literature for both professional educators as well as for ordinary readers.

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PRIKAZ KNJIGE: "SPORTS VALUES IN EVERY CLASSROOM: TEACHING RESPECT, EQUITY AND INCLUSION TO 8-12 YEAR-OLD STUDENTS"

Ovaj rad je napisan u formi prikaza knjige čiji je naslov "Sport values in every classroom / Teaching respect, equity and inclusion to 8-12 year-old students", a koja je napisana od strane korporativnih autora: UNESCO, Agitos fondacija, Svjetska antidoping agencija, Međunarodno vijeće sportskih znanosti i tjelesne edukacije, Olimpijska fondacija za kulturu i nasljeđe, Međunarodni fair play odbor (2019), te ima 186 stranica na engleskom jeziku.

Ključne riječi: prikaz knjige, sport, učenici, sportske vrijednosti

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PHYSICAL INACTIVITY AND SEDENTARY BEHAVIOUR IN ADOLESCENTS – BRAZIL, 2015

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ABSTRACT

Objective: analyse the prevalence of physical inactivity and sedentary behaviour as well as its association with sociodemographic aspects and school administrative dependence in Brazilian adolescents. Methods: transversal and analytical study using data from the 2015 National School Health Survey (PeNSE), sample n = 102,072 of 9th grade adolescents from public and private schools. The variables considered in this study were sociodemographic, school administrative dependence, physical activity and sedentary behaviour. The bivariate analysis was performed by using Pearson's chi-square test, the binary logistic regression was used to estimate the adjusted odds ratio (ORaj), with the SPSS® software utilising the module for complex samples. Results: the prevalence of physical inactivity was higher in the Northeast Region (69.6%) and the sedentary behaviour was more frequent in the South Region (63.3%).
The aspects associated with physical inactivity were found in the South Region (ORaj = 1.25; CI = 1.09-1.33), 15-year-olds (ORaj = 1.16; CI = 1.04-1.29), the participants' skin colour/race (ORaj = 1.24; CI = 1.12-1.38) and the children whose mother has no education or an incomplete elementary school (ORaj = 1.40; CI = 1.28-1.53), and those associated with sedentary behaviour were the ones who lived in the South Region (ORaj = 1.96; CI = 1.78-2.15), were male participants (ORaj = 1.16; CI = 1.10-1.23), the children whose mothers have completed high school or have an incomplete undergraduate education (ORaj = 1.54; CI = 1.42-1.67) and public school students (ORaj = 1.23; CI = 1.13-1.33).
Conclusion: high prevalence of physical inactivity and sedentary behaviour was found in adolescents from the Northeast and South regions. It is necessary to direct greater attention to this school-age population, with planning and the execution of action strategies aimed at the promotion of a healthy lifestyle being essential.

Keywords: motor activity, sedentary behaviour, adolescent, adolescent behaviour, cross-sectional studies

INTRODUCTION

Physical inactivity (PI) is the fourth main risk factor for mortality in the world. At the global level, it is estimated that three to fourth adolescents aged 11 to 17 years do not comply with global recommendations for physical activities leading to a healthy lifestyle, thus, they do not practice physical activity ranging from moderate to vigorous intensity, for at least 60 minutes per day, with a total of 300 minutes per week (WHO, 2018). In Brazil, a nationwide school-based study carried out in 2016 showed a prevalence of leisure-time physical inactivity of 54.3%, being higher in female students (70.7%)

(Cureau et al., 2016). A study carried out with school-age youth from Grande Florianópolis identified that 48.6% of them were inactive, and presented a higher prevalence in young females (53.9%) (Lisboa et al., 2018). Sedentary behaviour (SB) is another important risk factor for health, especially amid adolescents (Carvalho et al., 2015; Grillo et al., 2018; Lourenço et al., 2018). Sedentary behaviour refers to the time devoted to activities performed in a sitting position and in front of "screens" (television, computer, video games, smartphones), with an energy expenditure close to rest values (Tremblay et al., 2017). In a nationwide inquiry conducted in Brazil, in 2016, over half of the interviewed adolescents (51.8%) reported spending two hours or more in front of screens, with this habit being more prevalent in boys, students of private schools in the Southern Region of the country (J. S. Oliveira et al., 2016).
High prevalence of PI and SB are a great challenge to public health all over the world, considering regular practice of physical activity as an important prevention factor to health damage, mainly preventing non-transmissible chronic diseases (NTCD), like cardiovascular disease, obesity, some types of cancer and diabetes. Moreover, it contributes to enhanced mental health, wellness and life quality (CDC, 2014; WHO, 2018). Therefore, adolescents must be motivated to perform various leisure sports, and if they are performed throughout adolescence, they might be kept during the adult life (CDC, 2014; Mäkelä et al., 2017; WHO, 2010).
Systematic review studies have shown that most research on PI and SB is concentrated in Brazil's South and Southeast Region and, usually, in the state capital cities and, although the studies mostly approach sociodemographic factors associated with PI and SB, there is a lack of studies associating PI and SB with the adolescent's type of school (private or public). In this sense, this research becomes relevant, because it profiles adolescent physical activity levels and SB in all Brazilian capital cities in either private or public school environment (Ceschini et al., 2016; Guerra et al., 2016).

PROBLEM AND AIM

The World Health Organisation (WHO) advises to implement and maintain risk factor systems aimed towards adolescent's health. Therefore, this research contributes in aiming to fill the knowledge gap concerning adolescents' health related to PI, SB and associated factors (such as school, public or private), nationwide, because the information will serve as parameters to promote public policy interventions, mainly in the school context, for preventing risks and promoting health. In this context, this research aims to analyse the prevalence and factors associated with physical inactivity and sedentary behaviour in Brazilian school adolescents.

METHOD

This is a transversal and analytical study based on the School Health National Research (Portuguese acronym PeNSE) data from 2015. SHNR (PeNSE) is an inquiry made by the Brazilian Institute of Geography and Statistics (IBGE) every three years along with the Ministry of Health and supported by the Ministry of Education which supplies the information about risk factors distribution and protection against non-transmissible chronic diseases in Brazilian school-age adolescents as the target audience (M. M. de Oliveira et al., 2017).

SHNR (PeNSE) target audience has been constituted since its first edition in 2009 (Sample 1) by 8th grade students from middle school (9º Ano do Ensino Fundamental), aged from 13 to 17 years. However, students from the 6th grade (middle school) to the 12th grade (high school) were included in 2015 (Sample 2).

Sample 1 (n = 102,072) was used in this study, and it comprised 8th grade (middle school) students from public and private schools in the cities and the countryside during the 2015 school year, represented by the Brazilian adolescent population in the 26 capital cities and Federal District, 26 Federal Unities (FU), five large regions and Brazil (Brasil, 2016).

The data was collected from April to September 2015 through a self-administrated questionnaire delivered to the students' smartphones by IBGE technicians during the collection day in each school drawn to compose the sample (Brasil, 2016).

The dependent variable were:

a) Physical inactivity (yes, no): students who accumulated physical inactivity <300 min/week were considered physically inactive. This information was obtained through eight questions (question code: B03001 to B03007), which considered three domains: walking or cycling to school (round trip), physical education classes at school and other additional school physical activities (Brasil, 2016).

b) Sedentary behaviour (yes, no): it has been acquired from the following question: "On an average day, how long do you spend siting, watching TV, accessing your computer, playing videogames, talking to your friends or doing other activities while sitting?". Those who indicated that they keep sitting for more than three hours on an average weekday were considered as exhibiting sedentary behaviour (Brasil, 2016).

Independent variables: sex (male, female); age (≤ 13, 14, 15 and ≥ 16 years); colour/race (white, black, brown, yellow and indigenous); mother's education (no education or unfinished middle school, finished middle

school or unfinished high school, finished high school or unfinished higher education and finished higher education) and school administrative dependence (public or private).Initially, in the statistical analysis, the sample was described according to sociodemographic characteristics and school administrative dependence, in terms of absolute frequencies (n), relative frequencies (%) and confidence intervals (CI 95%). In addition, PI and SB prevalence have been estimated according to a large region.

A bivariate analysis has been made using the Pearson's chi-square test to verify independent and dependent variables in association. Binary logistic regression was used to estimate the adjusted odds ratio (AOR) and its respective confidence interval of 95% (CI95%).

The data were analysed by the IBM® programme Statistical Package for the Social Sciences (SPSS®), version 20.0, using the module for complex samples. The adopted significance level was α = 0.05.SHNR (PeNSE in Portuguese-Br) 2015 was approved by the National Health Research Ethics (Conep) from the Health National Council, under technical advice #1.006.467 (03/30/2015). Every student involved in the research filled out the Terms of Free and Clarified Consent (TCLE) and were informed they might not answer some determined questions or quit the research at any moment. The data has no individual's identification and was obtained directly from the Brazilian Institute of Geography and Statistics (IBGE) website.

RESULTS

Sample 1 was composed of 102,072 students. Most of them were females (51.7%), aged 14 (50.6%), of brown colour/race (46.0%), with the mother's education being unknown or not informed (30.8%), enrolled in public schools (79.5%) and residents of the Northeast Region (35.6%), (Table 1). The prevalence of PI and SB by Brazilian regions is presented in Figure 1. PI has a higher prevalence in the Northeast Region (69.6%; IC95% = 69.1-70.1), as SB has a higher prevalence in the South Region (63.3%; IC = 62.3-64.3).

A higher incidence of PI was observed among South Region adolescents (AOR = 1.25; IC95% = 1.09-1.33), aged 15 (ORaj = 1.16; IC = 1.04-1.29), of black colour/race (AOR = 1.24; IC = 1.12-1.38) and the sons of mothers who have no education or an incomplete middle school education (AOR = 1.40; IC = 1.28-1.53). Being a public school student presented a physical inactivity protection factor (AOR = 0.91; IC= 0.84–0.99) (Table 2).

SB incidence was higher in those living in the South Region (AOR = 1.96; IC = 1.78-2.15), who were male (AOR = 1.16; IC = 1.10-1.23), with their mothers having completed high school or having an incomplete higher education (AOR = 1.54; IC = 1.42-1.67) and public school students (AOR = 1.23; IC = 1.13-1.33) (Table 3).

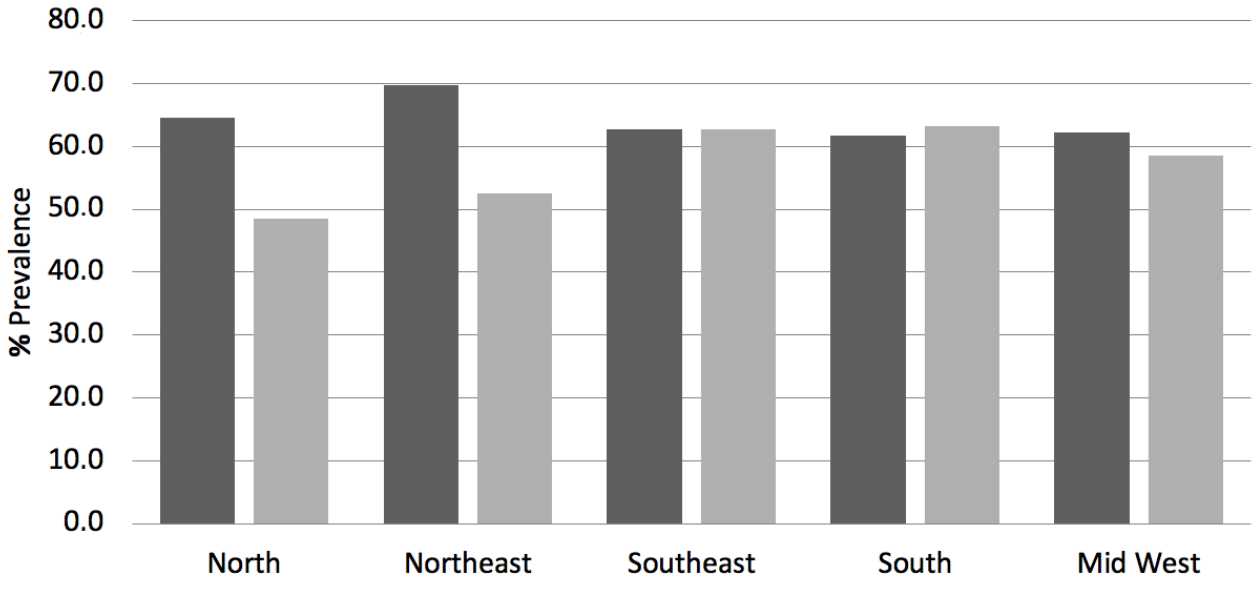

Figure 1 - Sedentary behaviour and physical inactivity prevalence in school-aged adolescents according to regions, Brazil, 2015.

Table 1: Characterisation of school-aged adolescents (Sample 1) participating in the School Health National Research (PeNSE), Brazil, 2015.

Variables	n	%	CI95%
Region			
North	23,937	23.5	23.2 – 23.7
Northeast	36,334	35.6	35.3 – 35.9
Southeast	17,772	17.4	17.2 – 17.6
South	9,850	9.7	9.5 – 9.8
Midwest	14,179	13.8	13.7 – 14.1
Sex			
Male	49,290	48.3	48.0 – 48.6
Female	52,782	51.7	51.4 – 52.0
Age			
≤ 13	17,260	16.9	16.7 – 17.1
14	51,611	50.6	50.3 – 50.9
15	20,864	20.4	20.2 – 20.7
≥ 16	12,337	12.1	11.9 – 12.3
Colour/race			
White	33,775	33.1	32.8 – 33.4
Black	12,849	12.6	12.4 – 12.8
Yellow/Indigenous	8,405	8.2	8.1 – 8.4
Brown	46,935	46.0	45.7 – 46.3
Not informed	108	0.1	0.1 – 0.1
Mother's education			
No education or incomplete middle school education	23,748	23.3	23.0 – 23.5
Middle school or incomplete high school education	12,299	12.0	11.9 – 12.2
Complete high school or incomplete higher education	23,359	22.9	22.6 – 23.1
Complete higher education	17,232	16.9	16.7 – 17.1
Unknown/not informed	25,434	24.9	24.7 – 25.2
School administrative dependence			
Public	81,154	79.5	79.3 – 79.8
Private	20,918	20.5	20.2 – 20.7

Source: School Health National Research – PeNSE, 2015.

Table 2: Factors associated with physical inactivity in school-aged adolescents, Brazil, 2015.

Variables	Physical Activity (%)			
	Inactive	Active	AOR	CI95%
Region				
North	65.7	34.3	1.16	(1.08 - 1.27)
Northeast	70.4	29.6	0.83	(0.78 - 0.89)
Southeast	64.0	36.0	1.10	(1.01 - 1.19)
South	62.5	37.5	1.25	(1.09 - 1.33)
Midwest	62.1	37.9	1.00	
Sex				
Male	56.1	43.9	0.44	(0.41 - 0.47)
Female	74.6	25.4	1.00	
Age				
≤ 13	67.7	32.3	1.11	(0.99 - 1.25)
14	65.6	34.4	1.10	(1.01 - 1.20)
15	63.8	36.2	1.16	(1.04 - 1.29)
≥ 16	65.8	34.2	1.00	
Colour/race				
White	66.2	33.8	1.14	(1.07 - 1.22)
Black	62.0	38.0	1.24	(1.12 - 1.38)
Yellow/Indigenous	65.0	35.0	1.17	(1.05 - 1.31)
Brown	66.4	33.6	1.00	
Mother's education				
No education or incomplete middle school education	68.3	31.7	1.40	(1.28 - 1.53)
Complete middle school or incomplete high school education	65.8	34.2	1.07	(0.98 - 1.16)
Complete high school or incomplete higher education	62.9	37.1	1.24	(1.15 - 1.34)
Complete higher education	60.8	39.2	1.00	
School administrative dependence				
Public	65.6	34.4	0.91	(0.84 - 0.99)
Private	65.6	34.4	1.00	

DISCUSSION

According to this research data, a higher prevalence of PI was demonstrated in the Northeast Region, with higher SB in South Region adolescents. Health risk behaviour such as sedentariness and a lack of physical activity, already established in adolescence and childhood which may be extended until adult life, contribute to morbidity and mortality. These behaviours may be avoided (Eaton et al., 2012).

A systematic revision in Brazil identified that Brazilian adolescent's PI prevalence varied from 22.3% to 96.7%. This prevalence variability is due to lacunas still present in studies dealing with physical inactivity prevalence in this population, as variability of instruments that determine physical activity levels and irregular distribution of these instruments in Brazil, interfering in a comparison among studies (Ceschini et al., 2016).

The Study of Cardiovascular Risk in Adolescents (Portuguese acronym "ERICA"), a school-based country-wide cross-sectional study, pointed to a high prevalence of physical inactivity in leisure-time mainly in the South/Southeast Region, which confirms the results of this research.

Such a finding may be justified by easier access to technological devices (smartphones, computers, and videogames) in that region. Accessing these technological devices may contribute to higher physical inactivity because this access provides them with the possibility of long-term sitting, which is also characterised by a high SB. Furthermore, other factors are important to analyse this context, such as violence which the adolescents avoid by moving to leisure spaces, mainly in the Southeast Region where crime and violence rates are higher, and keeping adolescents from these spaces, thereby contributing to PI increase (Cureau et al., 2016).

In the present study, being the son of a mother with no education or an incomplete middle school education was a physical inactivity risk factor. Similar results were found in a study conducted by Silva et al. (2016) indicating that, for adolescent sons whose mothers have a higher education, there is a higher chance to access information about physical activity and health, which consequently may affect the sons' education and inclination to adopt a healthy lifestyle, in other words, a mother figure is a protection factor related to healthy habits.

Most of the studies on sedentary behaviour are concentrated in South and Southeast regions (Guerra et al., 2016). A study conducted with adolescents in Pelotas – RS identified a general prevalence of sedentary behaviour (69.2%) during weekdays, with the values close to those found in the present research. However, the social and cultural differences of each region must be taken into account when making the comparison, as there are different customs employed in the research and SB routines of each population (Vieira et al., 2019).

A study conducted with school-age adolescents from Sombrio – SC and Sergipe estate identified that being female increased sedentary behaviour chances, which is different from the data obtained in this research indicating a significant association of sedentary behaviour in males. However, in a research conducted in Pelotas's public schools, the results were similar to this research because male adolescents were more likely to play electronic games (sedentary behaviour). Higher economic class male adolescents present higher SB which can be explained due to easy access to screens; however, there is no literature consensus related to these results due to variability in cut-off points for sedentary behaviour (Dias et al., 2014; Ribeiro et al., 2019).

Research conducted with students from Pelotas – RS, aged ≥ 15 years, found that they were more involved in sedentary activities (television and electronic games) during the week (Ferreira et al., 2016). Several results were found in our study, where the chance of being sedentary was higher in the 14-year-old age range; however, this association was not significant in the present research. This may cause contradiction with the study conducted in Cuiabá which indicates that older adolescents don't feel motivated to perform other activities like physical exercise; this practice is not a part of their expectations and replaces physical exercise with sedentary behaviours (Dias et al., 2014).

Regarding sedentary behaviour and the type of school (administrative dependence), our findings diverge from the results found in a study conducted with 1.716 adolescents in Cuiabá – MT, which presented a greater chance of sedentary behaviour in private-school adolescents (Dias et al., 2014). Different types of culture, environment and social behaviour from each region may influence sedentary behaviour, which can possibly explain the differences amongst the studies. Therefore, comparisons must be cautious (Vieira et al., 2019).

As a limitation of this study, it is worth highlighting the type of delimitation (cross-sectional), which cannot determine a cause-and-effect relationship between the outcome and co-variables, as well as the presence of memory bias in students, often underestimating or overestimating the responses to the questionnaires, thus skewing the results.

CONCLUSION

The present study found high physical inactivity prevalence and sedentary behaviour in Brazilian adolescents, mainly among the residents of the Northeast and South regions.

Physical inactivity and sedentary behaviour were associated with the South Region, in participants aged 14 and 15, of the black and yellow/indigenous colour/race, who are the sons of mothers with no education/incomplete middle school education or completed high school/incomplete higher education and those who are public school students (only for sedentary behaviour).

It is relevant to direct public policies towards this school-age population, especially from the South Region, as positive habits related to health adopted still in adolescence may continue in adult life and school can constitute a propitious space for these practices.

It is recommended that health and education authorities develop inter-sectoral strategies aimed towards a continuous intervention to promote health both in public and private schools.

Parents and school importance are highlighted in the sense of guiding and encouraging healthy lifestyle practice in this stage of intense changes.

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FIZIČKA NEAKTIVNOST I DUGOTRAJNO SJEDENJE KOD ADOLESCENTATA - BRAZIL, 2015

Cilj: analizirati učestalost fizičke neaktivnosti i dugotrajnog sjedenja kao i njihovu povezanost sa sociodemografskim aspektima te školskom administrativnom ovisnošću kod brazilskih adolescenata. Metode: transverzalna i analitička studija koja koristi podatke iz Nacionalne školske ankete o zdravlju iz 2015. godine (PeNSE), uzorak n = 102.072 adolescenta koji pohađaju 9. razred javnih i privatnih škola. Varijable koje su uzete u obzir u ovoj studiji su bile sociodemografske, školska administrativna ovisnost, fizička aktivnost i dugotrajno sjedenje. Bivarijantna analiza je provedena koristeći Pearsonov hi-kvadrat test, a binarna logistička regresija je korištena za procjenu prilagođenog omjera izgleda (ORaj), uz korištenje SPSS® softvera - modula za kompleksne uzorke. Rezultati: učestalost fizičke neaktivnosti je bila viša u Sjeveroistočnoj regiji (69,6%) a dugotrajno sjedenje je bilo češće u Južnoj regiji (63,3%). Aspekti povezani sa fizičkom neaktivnošću su pronađeni u Južnoj regiji (ORaj = 1,25; CI = 1,09-1,33), kod petnaestogodišnjaka (ORaj = 1,16; CI = 1,04-1,29), učesnika određene boje kože/rase (ORaj = 1,24; CI = 1,12-1,38) te djece čija majka nije obrazovana ili ima nezavršenu osnovnu školu (ORaj = 1,40; CI = 1,28-1,53), dok su oni povezani sa dugotrajnim sjedenjem bili prisutni kod osoba koje su živjele u Južnoj regiji (ORaj = 1,96; CI = 1,78-2,15), učesnika muškog roda (ORaj = 1,16; CI = 1,10-1,23), djece čije su majke završile srednju školu ili imaju nepotpuno dodiplomsko obrazovanje (ORaj = 1,54; CI = 1,42-1,67) te učenika državnih škola (ORaj = 1,23; CI = 1,13-1,33). Zaključak: Visoka učestalost fizičke neaktivnosti i dugotrajnog sjedenja je pronađena kod adolescenata iz Sjeveroistočne i Južne regije. Potrebno je posvetiti više pažnje ovoj školskoj populaciji uz ključno planiranje i izvođenje strategija aktivnosti koje imaju za cilj promociju zdravog načina života.

Ključne riječi: motorička aktivnost, dugotrajno sjedenje, ponašanje adolescenata, studija presjeka

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THE SIGNIFICANT ROLE OF SCORING FROM SET PLAYS IN THE 2018 FIFA WORLD CUP

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ABSTRACT

The aim of this study was to analyse the set-play goals achieved in the 2018 World Cup as well as to examine their impact on game outcome. A chi-square analysis was used in the study, and the level of significance was set at $p < 0.05$. Overall, 42% of all goals came from set plays in 64 matches of this tournament, which is on average 1.1 per match. The team that scored one or more goals via set plays won 71.1%, lost 13.2% and had a tie in 15.8% of the occasions ($X^2 = 24.368$, $p < 0.001$). The results showed that 25 goals were achieved from corner kicks, and the most effective delivery area was the goal centre area, while after indirect free-kicks, the most frequent delivery area was the second-post area. Most of the goals (75.0%) from indirect free-kicks came from the sides, which had significant difference with the central area ($X^2 = 4.000$, $p < 0.05$). All direct free-kick goals (6) were scored from the central area out of the 18-yard box and the distance was < 25m from the goal in all of them. In total, 17 referee decisions changed after VAR reviews, 9 resulted in goals and 89% of them impact the current game outcome.

Keywords: goal, set play, game outcome, video assistant referee

INTRODUCTION

One-third of goals in elite soccer is scored during set plays (Casal, Maneiro, Ardá, Losada, & Rial, 2015; Michaildis, Michaildis, Primpa, 2013; Yiannakos & Armatas, 2006). Goals coming from set plays can determine the outcome in matches (Castelo, 1999; Mombaerts, 2000; Silva, 2011).

The importance of set-play goals has been highlighted by numerous studies. Carling, Williams and Reilly (2005) mentioned that successful teams have more set plays during a match, convert more set plays into attempts on goal, score more goals from set plays and defend set plays more effectively, which is highlighted by the 1:7 set play to goal ratio, typically produced by successful teams compared to 1:15 ratio produced by unsuccessful teams.

Recently, Vergonis et al. (2019) stated that 42% of total goals in the 2018 World Cup was scored after a set play and this proportion was the largest in modern history of the FIFA World Cup, which begun in 1998 with 32 teams participating in the finals. Also, in 2018, a video assistant referee (VAR) was used for the first time in a World Cup tournament and had a decisive impact on goal scoring, mainly via penalties (Vergonis et al., 2019).

So, the aim of this study is to analyse the set-play goals achieved in the 2018 World Cup as well as to examine their impact on game outcome.

MATERIAL AND METHODS

SAMPLE

We analysed all soccer matches (64) from the final phase of the World Cup 2018. A total of 71 goals have been scored from a set play. We did not include the goals achieved during the penalty process.

Experimental Approach to the Problem

All the games were analysed through a systematic observation according to Lames (1991, 1994) and Singer and Willimczik (2002). Each game has been analysed by two experienced observers. The analysis variables were:

- The type of set play (corner, direct free-kick, indirect free-kick, penalty, throw-in)
- Corner kick delivery area (first-post, second-post, goal centre)
- Indirect free-kick delivery area (first-post, second-post, goal centre)
- Indirect free-kick area
- Direct free-kick area
- Distance from the goal during the direct free-kick
- Penalties and goals awarded after the use of VAR
- Goals after the decisions have changed with VAR review and influence on game outcome

Statistical Analysis

All the data were analysed using the statistical package for Windows SPSS 25.0. A descriptive analysis and a chi-square analysis were used. The level of significance was set at $p < 0.05$.

RESULTS

42% of all goals came from set plays in 64 matches of this tournament which is on average 1.1 per match. Regarding the type of set play (Figure 1), most of the goals were scored following a corner kick (25), penalty (22) and indirect free-kick (16), which were significantly different from direct free-kick (6) and throw-in (2) ($X^2 = 27.944$, $p < 0.001$). The team that scored one or more goals than the opponent during a game after set plays won 71.1%, lost 13.2% and tied in 15.8% of the occasions ($X^2 = 24.368$, $p < 0.001$) (Figure 2).

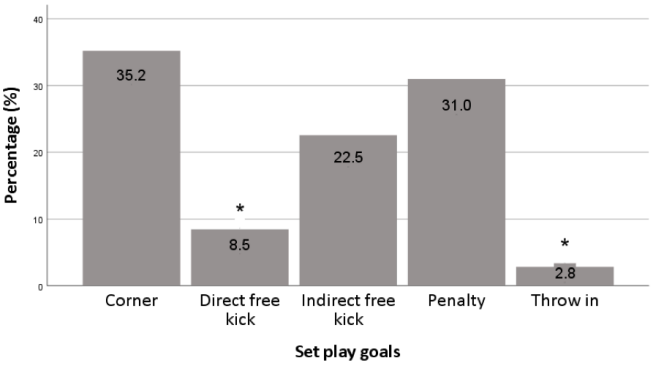

Figure 1 - Percentage of action prior to goal scoring in set play. *denotes a significant difference ($p < 0.001$) with corner, penalty and indirect free-kick.

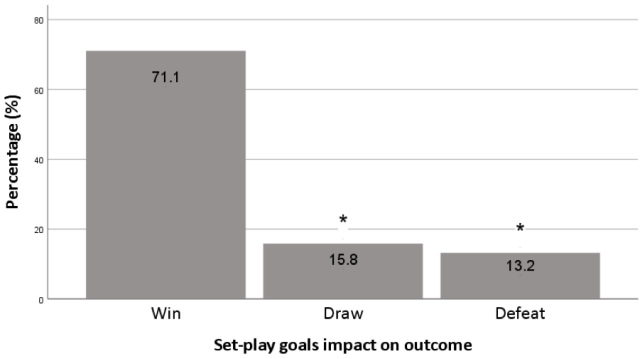

Figure 2 - Percentage of set-play goals' impact on game outcome. *denotes a significant difference ($p < 0.001$) with win.

In total, 600 corners were executed, and 25 of them (4.1% success rate) ended in goals. Overall, this accounted for 14.7% of all goals scored in the tournament.

Specifically, 12 goals came from corner kick delivery towards the goal centre (4 to 11 meters from the goal line and positioned centrally in front of the goal), while 7 and 6 goals were scored after delivery to the first and second goalpost, respectively (Figure 3). No significant differences were observed between the groups.

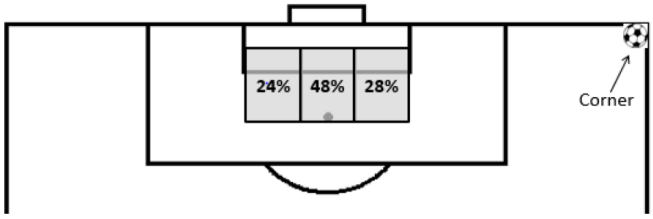

Figure 3 - Percentage of corner kick delivery area

16 goals were scored from indirect free-kicks (long or short). Regarding the indirect free-kick delivery area, statistical analysis showed that 9 goals were scored from free-kick delivery towards the second goalpost, 5 goals were scored towards the goal centre and 2 goals towards the first goalpost (Figure 4). No significant differences were observed between the groups.

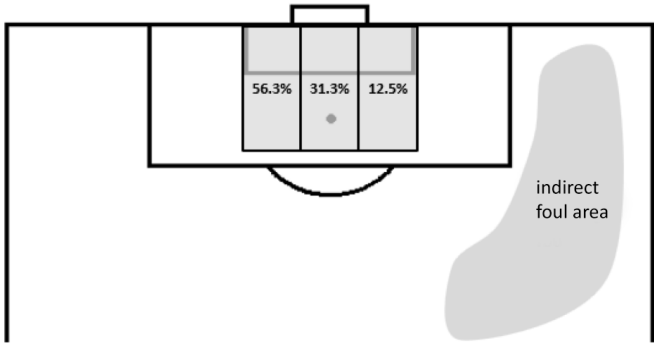

Figure 4 - Percentage of indirect free-kick delivery area

Most of the goals (12) scored from indirect free-kicks came from the sides (right or left), while the rest (4) came from the central area out of the penalty area (Figure 5). Significant differences were observed between the groups ($X^2 = 4.000$, $p < 0.05$)

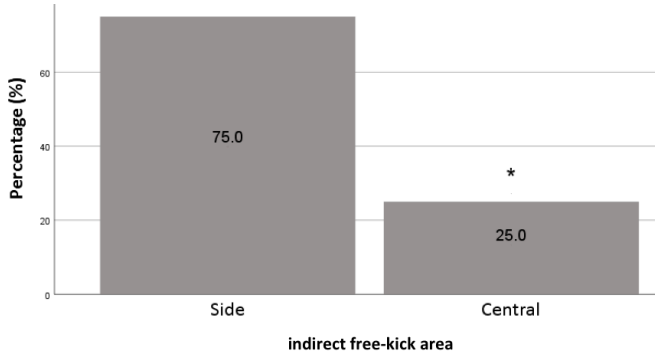

Figure 5 - Percentage of indirect free-kick area *denotes a significant difference ($p < 0.05$) with the side area.

All the goals (6) from direct free-kicks were scored from the central area out of the 18-yard box and the distance was < 25m from the goal in all of them (Figure 6).

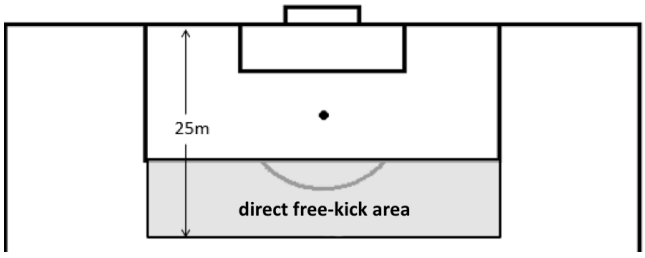

Figure 6 - Direct free-kick area

VAR reviews changed 17 first decisions of the referee. Eight of them resulted in goals, 7 from penalties and 2 from offside decisions. Overall, this accounted for 5% of all goals scored in the tournament and 89% of these goals influence the game outcome, the time during which they were scored (Table 1).

Table 1: Goals after the decisions were changed with the use of VAR review.

Goals after the decisions were changed with VAR review	Frequency (n)	Percentage (%) of total goals	Influence on outcome (%)
Goals from penalties awarded	7	4%	86%
Goals awarded (offside decisions)	2	1%	100%
Total	9	5%	89%

DISCUSSION

Overall, it was found that 42% of the goals scored during the 2018 World Cup came from set plays and this proportion is the largest in modern history. The scoring rate after a set play in the tournament averaged 1.1 goals per game, while the overall scoring rate in the tournament averaged 2.64 goals per game. Njororai (2013) reported that the set play scoring rate in the 2010 World Cup was 0.54 goals per game. The improvement in the success rate of set plays could be attributed to the increased number of fouls being made, the vigilance of the referees to notice infringements by defenders, the introduction of a video assistant referee, improved delivery of dead-ball situations and better preparation on the part of the offensive teams for the set plays (Vergonis et al., 2019).

In reference to the type of set plays, the results revealed a greater rate of occurrence of goals after corner kicks (35.2%), penalties (31%) and indirect free-kicks (22.5%).

Similar results were mentioned in previous studies (Tousios Michailidis, Mandroukas, Mikikis, & Metaxas, 2018). In the 2018 World Cup, 22 penalties resulted in goals, while in 2010 and 2014 World Cups, 9 and 12 goals, respectively, were scored from penalties. The increased number of goals scored from penalties in the tournament could be somewhat attributed to the use of VAR.

The results of the present study showed a significant role of scoring from set plays for the game outcome, as the team which scored one or more goals than the opponent after set plays won 71.1% of the games. The above results support previous findings suggesting that goals arising from set plays have a decisive influence on the outcome of the game (Dios, López, Sanjurjo, & Suárez, 2017). Within this study, 35.2% of set-play goals came from corner kicks. Previous studies mentioned that the success rate of corner kicks was between 1.6% and 3.2% (Ardá, Maneiro, Rial, Losada, & Casal, 2014; Carling et al., 2005; Sánchez-Flores et al., 2012), while in the current study, the rate was 4.1%. The increment could be attributed to the improved delivery of corner kicks and better preparation on the part of the offensive teams.

As for the delivery area of the corner kicks, the results showed that 48% of goals were scored after delivery to the goal centre. According to Pulling (2015), the delivery area is more important than the delivery type in regard to creating attempts at goal. Our findings are supported by Schmicker (2013) and provide further evidence for the significance of the central area in front of the goal, both in terms of attacking and defending a corner kick.

Regarding the indirect free-kick delivery area, the analysed data revealed that the goals came from delivery towards the second goalpost area (56.3%), which is in line with the results of previous studies (Lopez et al., 2018). This area provides more time for the players to attack the ball, reduces the chance of offside position and increases the range of passing for the offensive team. Within this study, we examined the direct free-kick area and found that all the goals which came from direct free-kick were scored from the central area out of the 18-yard box and the distance was < 25m in all of them.

In 2018, the first use of VAR in a World Cup tournament impacted not only the accuracy of referee decisions, but also the goal scoring (Vergonis et al., 2019). In our study, we explored the goals scored after the decisions were changed with the use of VAR review as well as their impact on game outcome. The results showed that 5% of all goals were scored after the decisions changed, while 89% of these goals influence the game outcome, the time during which they were scored. Vergonis et al. (2019) mentioned that VAR had a decisive impact on game outcome and 60% of goals via VAR came from penalties.

CONCLUSION

The findings highlighted the importance of scoring from set plays for the game outcome. The most effective delivery area for corners was the goal centre area, and for indirect free-kicks, it was the second-post area. All the direct free-kicks came from the central area outside the penalty box. Also, VAR review could affect the game outcome. Coaches should be aware of the above findings in to order to make their teams more effective, both in terms of attacking and defending a set play situation.

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ZNAČAJNA ULOGA POSTIZANJA GOLOVA NAKON PREKIDA IGRE TOKOM SVJETSKOG NOGOMETNOG PRVENSTVA 2018. GODINE

Cilj ove studije je analizirati golove koji su postignuti nakon prekida igre na Svjetskom prvenstvu 2018. godine, kao i ispitati njihov uticaj na ishod utakmice. U studiji je korištena hi-kvadrat analiza, a nivo značajnosti je postavljen na $p < 0,05$. Ukupno je 42% svih golova postignuto nakon prekida igre u 64 utakmice ovog prvenstva, što je prosječno 1,1 gol po utakmici. Tim koji je postigao jedan ili više golova nakon prekida igre je pobijedio u 71,1%, izgubio u 13,2%, te imao neriješen rezultat u 15,8% utakmica ($X^2 = 24,368$, $p < 0,001$). Rezultati su pokazali da je 25 golova postignuto udarcem iz ugla, a najučinkovitiji prostor za dodavanje lopte je bio centralni dio peterca, dok je, nakon indirektnih slobodnih udaraca, najčešći prostor za dodavanje lopte bio zona druge stative. Većina golova (75,0%) postignutih indirektnim slobodnim udarcima je realizovana sa strane, što se značajno razlikovalo od onih postignutih iz prostora peterca ($X^2 = 4,000$, $p < 0,05$). Svi direktni slobodni udarci (6) su postignuti iz prostora peterca, dodavanjem iz šesnaesterca uz udaljenost < 25m od gola u svim slučajevima. Ukupno je 17 sudijskih odluka promijenjeno nakon preispitivanja putem VAR-a; 9 je rezultiralo golovima a 89% je uticalo na trenutni ishod utakmice.

Ključne riječi: gol, prekid igre, ishod utakmice, pomoćni video sudac

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ORGANISATIONAL PERFORMANCE AND LEADERSHIP IN SPORTS MANAGEMENT

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ABSTRACT

In the modern world, the sports system experiences continuous and deep quantitative, structural and qualitative transformations arising from the recent social, economic, political and technological requirements for the development of society. At a modern level of implementing sports and business technology in sport, there is a highly expressed tendency to replace the existing means and procedures with more reliable and objective methods, which imposes the need for a valid and purposeful action in the area of sports management. Certainly, the new scientific and technological discoveries, their application and implementation into the functioning of a modern sports organisation, services, lifestyle and management styles require the prospective changes and creation of a quality leadership approach to become the only possible mode of existence and development of modern sport. We live in a time of increasingly faster, more dramatic, more complex and unpredictable changes which have a growingly significant impact on the behaviour, business activity and management in organisations. The answers to the accelerating changes, in the environment where sports organisations conduct their business and broader social mission, require managers to become transformational leaders. This implies having the ability to create a vision, mission, policy and strategy as well as their implementation, thereby attaining a significantly greater universal value for consumers and major transformation shifts in a short period of time.
The ultimate goal of organisation is achieving sports and business efficiency. This goal can be more easily achieved by establishing a proper sports organisation which is appropriate for its goal. This means that the sports organisation is simultaneously the result of the organisational process. Perceived as the result of the organisational process, a sports organisation then represents an optimal combination of a logical and purposeful relationship between organisational units which help in coordinating the activities and people included in procuring, allocating, using and replacing organisational resources. The method of establishing a sports organisation certainly extends over the definition of the organisational process as well as the principles according to which the process is conducted. The organisational process also provides the rules, procedures and methods which define the organisational structure of a sports organisation since it is one of the requirements for its successful management.

Keywords: management, leadership, business, modern sport

INTRODUCTION

The postulate in treating and considering the notion of a sports organisation is that it is a complex system which can be defined as an ideal structure of interconnected and logically prescribed parts with an optimal coordination and clearly defined goals. This also signifies that a sports organisation is considered in the context of a systematic approach to its activities since it is a part of a more general, higher system, but at the same time, it is structured into subsystems (Životić, Veselinović, 2010).

The systems theory treats the issue of system affiliation and the problem of systematic structuring as an emphasised relationship between the organisation and the external environment, which simultaneously enables the observation of a sports organisation in the context of a situational environment. A systematic and situational approach towards organisation is the fundamental aspect in which a sports organisation operates.

A modern sports organisation is a complex organism which can function in the form or institutional framework of sports federations, a sports club and other sports collectives. Within it, different interests of individuals and groups of people, stimuli and restrictions, organisational discipline and the freedom of creation, formal requests and informal initiatives are entwined, summarised and coexistent (Habić, 2013). At the same time, it is also a complex economic, political, social and sports phenomenon because it is oriented towards satisfying the general human needs, in addition to being a complex management function since the system, such as an organisation, must be governed. Managing a sports organisation is primarily a complex process since it continuously creates the functional framework and a complex system due to the organisation being defined by systematic categories.

Within the management process, everything associated with the notion of organisation can provoke a certain level of confusion when it is defined since, as it was already stated, organisation can simultaneously be observed as a process and an institutional form. Leadership has a special role in the establishment, maintenance and development of certain groups (Životić, 2007) in an organisation. A leader has the task to, during the phase of establishing a group, determine its goals and needs which are of an economic, social or sports nature; during the phase of group maintenance, he has to work on strengthening group cohesion, the moral values and roles of individuals, as well as to solve arising conflicts and remove their causes when it comes to the organisational work system.

AN EFFICIENT ORGANISATIONAL PROCESS IN A SPORTS ORGANISATION

The main and fundamental goal of an efficient and purposeful organisational process is achieving sports and business efficiency. This goal can be more easily achieved by establishing a proper sports organisation which is appropriate for its goal. This means that the sports organisation is simultaneously the result of the organisational process. Perceived as the result of the organisational process, a sports organisation then represents an optimal combination of a logical and purposeful relationship between organisational units which help in coordinating the activities and people included in procuring, allocating, using and replacing organisational resources (Tomić, 2006). The method of establishing a sports organisation certainly extends over the definition of the organisational process as well as the principles according to which the process is conducted. The organisational process also provides the rules, procedures and methods which define the organisational structure of a sports organisation since it is one of the requirements for its successful management (Veselinović, 2012).

The principles of the organisational process in sports organisations can be: work specialisation, job grouping, coordinating the relations between parts of a whole (implies communication, coordination, cooperation and integration of parts with the whole) and managing a sports organisation, implying the transfer of authority and jurisdiction, responsibility, centralisation and decentralisation, including other management categories, such as the functions which are implied - prediction, planning, organisation, staff policy, management and control.

In order to fully achieve the effects of the organisational process, managers must create an organisation based on appropriate parameters and criteria. They also must define all the jobs and tasks which are or will be performed in a sports organisation (Veselinović, 2012). Subsequently, they should determine the hierarchical jurisdictions and locate the authority and responsibility of the managerial and non-managerial staff. And finally, they should establish vertical and horizontal information channels necessary for successful coordination between the parts as well as the coordination of the parts with the sports organisation as a whole, etc.

The basic stages of the organisational process, arising from the corresponding activities within the process, are: establishing the fundamental principles of the organisational structure; systematising jobs and work tasks at the level of the structured organisational units; establishing a relationship between the defined positions, posts and human resources as well as coordinating the defined hierarchical relationships within the organisational structure (Životić, Veselinović, 2018).

All the stages in the organisational process are interconnected and entwined, and the four stages of the organisational process are mutually interactive and dependent. For example, establishing an organisational structure cannot even be conceived or conducted until the end without the participation of the other three stages.

This means that the structure of a sports organisation is observed and understood differently, according to the fact that it cannot be simply and objectively defined (Životić, Veselinović, 2018). In sports practice, organisational structure has most frequently been illustrated as an organisational chart, a diagram of the bodies, management, division of tasks and jurisdictions, from the aspect of the vertical and horizontal organisational level. Such an approach would significantly reduce the exhaustive image of the organisational structure.

ORGANISATIONAL PERFORMANCE AND LEADERSHIP IN A SPORTS ORGANISATION

Team organisation promotes collectiveness. It enables individuals to cooperate, participate in joint work, learn and establish a creative attitude towards the method for solving certain problems in an organisation through dialogue. The managers face the decision to establish the organisational structure as a team network, starting with the goals of the organisation, the values, attitudes and character of the employees, tolerance and cooperation between the individuals and ad hoc groups, emotional attitudes, task pressure, the effect of time and individuals' readiness to accept the rules of the game or team standards and affiliation towards the collective, i.e., joint work (Životić, Veselinović, 2010).

Personal characteristics of individuals affect the creation and expression of individuals' specific perception in an organisation, identification of the problem and its causes as well as the relation towards the job and other individuals (Tomić, 2010). It is the ability to perceive a certain phenomenon, to understand and comprehend reality, to explain and demonstrate in an acceptable manner and to be objective without mystique and prejudice. With time, individuals acquire knowledge enabling them to see the world and other things in a certain manner. An individual's value system, inter alia, represents only the personal attitude on what is good and what has value, what constitutes a priority and what does not. For some, the measure of value is seen in money or profit, while others place morale, justice and truth above all other values. Belief represents a significant dimension of individuals' personal values since it expresses the relationship of the individual towards the truth, past and present events. Individuals' value and beliefs constitute the basis of behaviour in a sports organisation (Tomić, 2010).

Independence and individuality of employees constitute a strategy of "transferring" obligations from the management to the individuals - lower organisational units, that is, levels. The "transfer" process is conducted based on a plan, in portions and certain periods which are favourable from the organisation's point of view. It is meaningful because it should enable individuals' independence, initiative and innovation as well as positively affect productivity and rational usage of production factors, leading to a decrease of costs (Tomić, 2007).

Individuals' skills are twofold - acquired and inherited. Both have the function of persuading associates to follow their leader, respecting his idea and vision. A leader will, with the help of a skill, influence individuals and, with their help, turn his vision into reality, into action, in a rational and generally acceptable way. It is widely accepted that modern sport needs people with "leadership skills" since it is believed that they represent a specific asset in a sports organisation. In modern sport, leadership is a highly appreciated value. It is considered that the ability of a leader to create a social architecture needed to generate intellectual capital will be a key competitive advantage in the future. Intellectual capital refers to knowledge, ideas, innovation and "know-how" (Terzić, 2012).

Intellectual capital does not only imply the knowledge which the sports organisation has at disposal, but also the employees' competences as well as the organisational structure, business processes, intellectual property and corporate culture (Dmitrović, 2015). The resources, both within a sports organisation and the external resources (relations with the consumers and other stakeholders), are also extremely important. Intellectual capital contains such factors which have not been encompassed in official financial reports but are important for the creation of the organisation's value.

Proper usage of intellectual capital increases the value of a sports organisation. The qualitative dimension is more important for it, as opposed to the quantitative one which will create added value. Intellectual capital is a pathway to the future in a state of dynamic changes in sport (Dmitrović, 2015). Many sports organisations are not aware of the size of the potential hidden in the employees' heads since it is precisely the knowledge which represents a hidden value of a sports organisation. The market position of a sports organisation is determined by its success in identifying and implementing the knowledge at its disposal. A leadership position in sport is provided by those sports organisations enabling synergy of the existing knowledge and modern sports achievements. Today, the main job of a leader, at all the levels, is to supervise the processes in which the old, non-functional and antiquated ideas are abandoned, simultaneously preparing the people and organisations to cope with the change, love the change and develop an affection towards it, parallel to

innovations which are suggested, tested, modified and adapted to the tendencies of modern sport. Leadership is nowadays observed as a process which is completely different from management. It is seen as a process where people other than the managers can be leaders and where the focus is placed on interaction between the leaders and associates. It is a relationship aiming at a mutual accomplishment of a common purpose, and not only the leader's purpose (Terzić, 2012). Leadership is a process striving towards making urgent changes, and not only the process for accomplishing a basic and current sports goal. Persuading associates to accept change is a sign of leadership in modern sports organisation. True leadership means finding solutions for adapting to changes in modern sport. Managers decide by themselves, while leaders use the employees to find a common solution. This introduces certain disruptions in sports organisations because the employees should adopt new roles (Northouse, 2008). The way in which business is conducted in sports organisations is changing. A leader must constantly keep in mind the context, which is why it is not good to engage him solely in the application of a solution. A leader must know the extent to which the employees are able to learn new ways of conducting their work. It is highly important to build confidence for performing the job in a new way.

One cannot even imagine a modern sports organisation which could exist without leadership for a long time. No organisational structure is complete, and leadership is precisely that which fills the existing voids since each activity and decision cannot be planned and predicted in advance (Veselinović, 2012). Additionally, organisations function in varying conditions, regardless of the sports market, technology, legislation and other forces to which a sports organisation must adapt. Leadership it precisely that which should sense these changes and convince people to adapt. Leadership can provide this enthusiasm, the spirit of collectiveness according to which an "inspired" group differs from another "inert" one. Leadership is the ability to influence others so that they cooperate and contribute to accomplishing goals of the sports organisation.

THE INFLUENCE OF LEADERSHIP ON TRANSFORMATIONAL PROCESSES IN A SPORTS ORGANISATION

Leadership combines talent with the ability to influence others - individuals, groups and organisations. Just as management, leadership is the ability to persuade others to conduct work, whereas the difference lies in the fact that people share the same values and opinions on the application of the strategy and the manner in which it should be conducted. Leaders create new ideas, approaches and methods and they have a talent to obtain above-average results from an average sports collective. In order for a leader not to be lonely at the top of the pyramid, it is necessary for his associates to have the same culture in a sports organisation (Terzić, 2012). This is the basis for understanding and trust, necessary to successfully overcome all issues encountered in the process of implementing a strategy.

When it comes to the expertise which a manager and a leader have to possess, the following three types come to the forefront: technical (professional knowledge), interpersonal (ability to work with people) and conceptual (business thinking ability). Motivating associates and employees is one of the most important tasks of a modern leader. In order to accomplish the goals of a sports organisation, great efforts and energy must be invested. (Tomić, 2007). Since leadership, that is, governance as the function of management includes influencing the employees, motivation represents an integral part of their job. It refers to the exploration of strengths which drive behaviour.

Leadership is a vital concept for the transformation of a sports organisation. It is a process striving towards making real changes, and not only the process for accomplishing some business goal. Leadership includes leaders and associates who desire real changes in a sports collective. The direction in which the changes occur must be the result of a planned process with participation of both leaders and associates.

Transformational leaders evoke interest in transforming sports organisations, inspire and motivate employees to focus on changes. All employees have to understand that the incremental improvements will not lead to the desired state and that transformation as a basic qualitative change is of great importance for increasing the competitiveness of a sports collective (Životić, Veselinović, 2018).

The transformation process takes place in several stages, beginning with considering the need for a change, followed by creating a new vision, and ending in institutionalising the change. The first task of a transformational leader is to consider the need for a change. It is important to determine the right concept in order to begin the transformation process. Either way, it is better to begin before a crisis emerges.

That is why it is necessary to re-examine the basic assumptions on the place and role of the sports organisation in society (Živković, 2009). This is required in order to detect the impact and change in the environment on the position of the sports collective.

Awareness of the need for a change is the starting point in initiating transformational changes. The process encompasses a good problem diagnosis so as to establish which type of change is needed. The most complex issue is to help employees in abandoning their old beliefs and values which represent an obstacle for initiating changes (Živković, 2009).

Changes alter the power distribution and status in a sports organisation, having the possibility to jeopardise one's status and career. Almost everyone has to learn new patterns of behaviour. A transformational leader helps people accept the need for a change and positively influences their confidence and optimism.

A transformational leader has a clear vision of the future state of his or her sports organisation. He is somewhat of a social architect for his sports collective, he builds trust among associates, making his position clear, and reflecting it during the entire transformation process. He is a strong role model for his associates. He does not only create the vision, but is also an agent of change.

An excellent example of transformational leadership is the FC Barcelona. The sudden progress of this club began in 2003 when Joan Laporta became the president of the club, bringing about good leadership, management and media strategy. He introduced clear cost control in such a way that the club must not contribute more than 65% of its revenue for the players' salaries.

The transfer of the Brazilian footballer Ronaldinho was the most significant step in initiating change, and in the last 10 years, the club has quadrupled its revenue. The revenues reached 900 million euros (the entire sports organisation, with the football club constituting 90% of it), which is a record annual revenue in sport. The average weekly salary in FC Barcelona is 110,000 euros per player (the highest of all teams in the world), and it is planned to renovate the Camp Nou stadium and expand the capacity to 105,000 seats, with the investment value estimated to be 650 million euros.

CONCLUSION

The complexity of modern sport requires a scientific approach, not only from the aspect of medicine, psychology and sociology, but primarily from the aspect of management. The changes in sport are characteristic for societies in transition; they arise from the pressure and character of the challenges as well as from finding the true causes of the previous unsuccessful business in many sports organisations which they have to face.

The modern and future sports organisation will increasingly encounter turmoil, turbulent situations and chaos in business. The world of changes now faced by mankind continues with an exponential trend and great fear for the survival of companies. The world increasingly faces the horrible uncertainty of the future and changes which become certain values. In such circumstances, the survival of sports organisations, that is, businesses is connected with greater efforts which we call the ability to create new, heretofore untold ways and ideas for success and accomplishing adequate sports results.

Management equally represents activities and people needed in all organised efforts, facilitating and contributing to a more efficient functioning of an organisation directed towards satisfying human needs. Management makes sure that the whole group does not stray from the path leading towards accomplishing the set goals, resolves disputes and coordinates the difference of opinion, makes decisions on the strategy and period for executing activities as well as maintains the structure of activities and relationships intended for accomplishing the set goals.

Management facilitates human efforts in organised groups and appears only when people want to cooperate in order to accomplish some goals.

The imminence and acceleration of changes, the increase in the degree of change diffusion and the presence of the social responsibility phenomenon require managers to possess leadership abilities and entrepreneurial spirit - to be the bearers of new tendencies in sport.

From the aspect of managerial roles and tasks, the key organising activities can refer to: determining the organisational structure of a sports organisation, projecting communication links and coordination channels, distributing jobs and responsibilities as well as determining their assessment criteria.

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ORGANIZACIONE PERFORMANSE I LIDERSTVO U SPORTSKOM MENADŽMENTU

Sistem sporta u savremenom svijetu doživljava neprekidne duboke kvantitativne, strukturalne i kvalitativne transformacije, koje proističu iz novijih društvenih, ekonomskih, političkih i tehnoloških uslova razvoja društva. Na savremenom nivou sprovođenja sportske i poslovne tehnologije u sportu, postoji veoma izražena težnja da se postojeći način i postupci zamijene pouzdanijim i objektivnijim metodama, što nameće i potrebu za pravovaljanijim i svrsishodnijim delovanjem u oblasti sportskog menadžmenta. Izvesno je da nova naučna i tehnološka otkrića, njihova primjena i implementacija u funkcionisanje moderne sportske organizacije, usluge, način života i stilovi rukovođenja uslovljavaju da potecijalne promjene i kreiranje kvalitetnog liderskog pristupa postaju jedino mogući načini egzistencije i razvoja savremenog sporta. Živimo u vremenu sve bržih, dramatičnijih, kompleksnijih i nepredvidljivih promjena, koje sve značajnije utiču na ponašanje, poslovanje i upravljanje u organizacijama. Odgovori na ubrzanje promjena, u sredini u kojoj sportske organizacije obavljaju svoju poslovnu i širu društvenu misiju, traže od menadžera da budu transformacioni lideri. To podrazumijeva da imaju sposobnost kreiranja vizije, misije, politike i strategije i njihove implementacije, postižući pri tom znatno veću opštu vrijednost za konzumente i krupne transformacione zaokrete u kratkom roku. Krajnji cilj organizovanja je ostvarenje sportsko-poslovne efikasnosti. Ovaj cilj se može najlakše postići uspostavljanjem odgovarajuće sportske organizacije, primerene njenim ciljevima. To znači da je sportska organizacija ujedno rezultat procesa organizovanja. Shvaćena kao rezultat procesa organizovanja, sportska organizacija u tom slučaju predstavlja optimalnu kombinaciju logične i svrsishodne povezanosti organizacionih jedinica pomoću koje se obavlja koordinacija aktivnosti i ljudi, uključenih u pribavljanje, alociranje, korištenje i zamjenu organizacijskih resursa. Put kojim se dolazi do sportske organizacije ide svakako preko definisanja procesa organizivanja a ujedno i principa prema kojima se taj proces odvija. Proces organizovanja, takođe, daje i pravila, procedure i postupke kojima se definiše organizaciona struktura sportske organizacije, jer je to jedan od uslova uspješnog upravljanja u njoj.

Ključne riječi: menadžment, liderstvo, poslovanje, savremeni sport

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COMPARATIVE EFFECTS OF HIGH INTENSITY VERSUS MODERATE INTENSITY TRAINING PROGRAMME ON OBESE YOUNG WOMEN

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ABSTRACT

Background: Moderate intensity is recommended for previously sedentary individuals for preventing and managing obesity as well as providing health benefits. However, high intensity exercise protocol has shown similar results with less than 40% of time spent on moderate intensity. The aim of the study was to determine the effectiveness of high versus moderate intensity training programme on anthropometrical, physiological and blood parameters in previously obese young women.
Methods: Ninety young women aged 22 ± 2 (18-26) years were match-paired into three groups: High Intensity group (n = 30), Moderate Intensity group (n = 30), and Control group (n = 30). The training frequency for this study was 3-5 days per week, and the duration of the intervention was 8 weeks. The subjects were trained using two training modes which were aerobic and resistance training for both training groups. Maximum heart rate percentage of 60-75 and 76-95 was the intensity used for MICT and HIIT, respectively.
Results: The study population had a mean BMI of 30.44 ± 3.39 Kg/m^2; mean BF (%) of 38.51 ± 4.74%, and the mean age of 22 ± 2.22 years. No significant difference was observed in BMI (p = 0.581). One-way analysis of variance showed significant decreases of body weight (p = 0.018) and waist-hip ratio (p = 0.012). Both exercise intensities were associated with a significantly greater reduction of body fat percentage and VO2max (p = 0.000). There was a significant improvement observed in the HIIT group in total cholesterol (p = 0.047) and glucose (p = 0.044).
Conclusions: The study findings suggest that HIIT overall is the strategy for eliciting comparable anthropometrical, physiological and health parameters which benefit MICT. Both HIIT and MICT are equally effective in improving VO2max and reducing body fat percentage, despite half the time spent on HIIT. This suggest that HIIT is capable to produce a feasible outcome and it can be used to replace moderate intensity modalities as the primary mode of exercise in promoting weight loss in sedentary obese individuals.

Keywords: obesity, high-intensity interval training, moderate intensity continuous training, aerobic and resistance training

INTRODUCTION

A dramatic increase of obesity and its related diseases has been recognised in the African region amongst the middle-aged population in recent years (Sartorius et al., 2015; Steyn, & Mchiza. 2014; Averett, Stacey, & Wang. 2014). Even though the occurrence of increased weight is present at any age, it is more rapid between the ages of 20 and 40 years old (Kong et al., 2016). Obesity (body fat percentage ≥ 32%) is associated with an increased risk of morbidity and mortality at all ages (Abdelaal, le Roux, & Docherty.

2017). In addition, obesity is recognised as a major health problem, causing non-communicable diseases such as cardiovascular diseases (CVD), type 2 diabetes, hypertension, stroke, osteoarthritis and various types of cancer (Swift et al., 2014; Adeboye, Bermano, & Rolland, 2012).

Research from the South African Department of Health (SADH, 2016) reveals that the rate of obesity includes 30 percent of the adult population, considering 70 percent women and 40 percent men as obese. Obesity is fundamentally caused by the imbalance of calorie intake and energy expenditure (World Health Organisation, 2016). Another contributing factor is due to our modern environment with its high levels of technology, resulting in less physical activity, together with high calorie and high sugar containing fast foods. (Ali & Crowther, 2010). The growing obesity challenge is further spread by the rapid expansion of fast food stores and restaurants (Igumbor et al., 2012).

Lack of physical activity can lead to severe health and functional problems later in life (Hamer et al., 2014). The WHO recommends that older adults should either participate in 150 minutes of moderate intensity aerobic fitness per week, 75 minutes of vigorous intensity aerobic physical activity per week or an equivalent combination of both (Kilpatrick et al., 2014). However, studies have shown that less than 50 percent of American adults adhere to the guidelines of the World Health Organisation regarding physical activity. Physical activity is an essential determinant in energy expansion and plays a very important role in the treatment and management of obesity; it leads to greater health benefits across all populations (Kannan et al., 2014; Garcia-Hermoso et al., 2016). Regular physical activity has a positive effect on strength, aerobic capacity, flexibility, mental wellbeing and cognition (Hamer et al., 2014).

Exercise results in a strong reduction of potential chronic disease risks caused by a lack of, or inadequate physical activity and obesity (Cassidy et al., 2017; Roxburgh et al., 2014). Furthermore, regular exercise training demonstrates a significant impact in reducing chronic inflammatory diseases, which in turn play a major role in increasing HDL concentration, thereby decreasing the risk of cardiometabolic diseases (Su et al., 2019; Wang & Xu, 2017; Elmer et al., 2015). Despite these positive benefits, many adults around the world demonstrate low levels of physical activity due to many reasons including time and lack of motivation (Turk et al.,2017).

Lack of physical activity combined with poor diet remain the primary risk factors and have increased the occurrence of obesity and other related complications (Bhurosy & Jeewon, 2014; Chan & Woo, 2010). A large number of South Africans fail to meet the recommended daily levels of physical activity and therefore, further contribute to the obesity prevalence issue (Keating et al., 2013).

The WHO (2004) recommends that for health benefits, all adults complete a minimum of 30 minutes of moderate intensity aerobic physical activity 5 days per week or vigorous exercise for 20 minutes 3 days per week. For the prevention of weight gain, an individual requires 60 minutes of daily physical activity. This can be achieved through a single session or by accumulated bouts of training, each lasting 10 minutes (Trost et al., 2002). With these health problems, obesity needs to be recognised as a disease that warrants an intervention, even if comorbidities are not yet present (Swift et al., 2014; Van der Merwe & Pepper, 2005).

Prevention and reduction of obesity depends entirely on the individual's daily lifestyle. Physical activity has long been used as a primary and secondary prevention measure of obesity as it contributes to weight loss and to maintaining weight (Coquart et al., 2008). Micklesfield et al. (2013) highlighted a strong relationship between physical inactivity and obesity. This correlation is influenced by factors such as sociocultural, environmental and behavioural, as well as socio-economic status amongst black women in South Africa (Micklesfield et al., 2013). Swift et al. (2014) recommend that clinicians always advise all their patients to do regular exercise training in order to maintain a healthy weight, both if they are of an average weight and if they are at risk of obesity. A combination of aerobic and resistance training is helpful in reducing body weight and improving body fat percentage. Aerobic training (AT) is essential for managing glycaemic control and reducing cardiovascular risk factors (Yavari et al., 2012). It also plays an important role in increasing skeletal muscle capitalisation, blood flow and glycogen synthesis activities (Sawczyn et al., 2015). Resistance training (RT) is responsible for improving muscle strength and endurance, enhancing flexibility and body composition (by increasing lean mass) and decreasing cardiovascular risks (Yavari et al., 2012).

The effects of exercise on obesity and associated problems are dependent upon its frequency, intensity and duration (Wilson, Ellison, & Cable, 2016). Literature demonstrates a close relationship between exercise intensity and weight reduction (Xiao & Fu, 2015; Fisher et al., 2015). Trapp et al. (2008) defined high intensity intermittent exercise protocol as a brief high intensity resistance exercise followed by brief low intensity aerobic bouts of exercise that are slightly longer or with an active recovery period. Short duration (20-45 minutes) high intensity programmes have had a substantial effect on body composition compared to moderate and low intensity programmes (Wewege et al., 2017; Heydari, Freund, & Boutcher, 2012; Smart, Dieberg, & Giallauria, 2011).

Fisher et al. (2015) noted improvements in cardiovascular fitness, body composition and vascular function after high intensity interventions compared to other modes of training. In contrast, the study conducted by Lira et al. (2010) found that low and moderate intensity resistance exercises result in an improved lipid profile more than high intensity resistance training.

Krause et al. (2013) noted a reduced capacity of fat oxidation and a shift in the use of fat to carbohydrates at lower intensities, resulting in a maximum rate of fat oxidation. However, it remains unclear which type, frequency, or intensity of exercise is more beneficial to obese individuals. (Kraus et al., 2002). Furthermore, the exact intensity which provides the most health benefits in obese individuals remains inconclusive. Therefore, the primary objective of this study is to investigate the effects of high intensity versus low intensity intermittent resistance exercise and aerobic training on obese female university students.

METHODS

Subjects

Ninety (90) obese women with body fat % (BF %) of ≥ 32%, aged between 18 and 24 years old were recruited from the student populace of the University of Zululand. The participants were required to be sedentary which was validated using the Physical Activity Questionnaire (PAR-Q) completed prior to the commencement of intervention. Sedentary is defined as individual participating in not more than 1 training session, and less than 30 minutes of moderate intensity physical activity for the last 3 months (Swift et al., 2017). They have to have no absolute contraindications to exercise or musculoskeletal injuries (acute and chronic) which would have limited them from training. The study subjects did not take medication or supplements that enhance their metabolism or alter their fat metabolism. Interested individuals were screened using PAR-Q. All subjects gave a written informed consent and all procedures of the study were approved by the University's Ethics Department.

STUDY DESIGN

This 8 weeks' study followed a descriptive, quasi-experimental design investigating the effects of two training intensities, in the form of high intensity and moderate intensity, on reducing anthropometrical parameters, improving healthy and physiological parameters in obese female university students. The subjects were match-paired to 3 different groups according to their age, BF% and BMI. Group 1 (Control) was a non-exercising group which was requested to keep the physical activity at the same level as before the study. Group 1 (High Intensity) performed 15 minutes' aerobic and 15 minutes' resistance training 3 days/week at the maximum heart rate percentage of 85 from week 1 to week 4, and then progressed to maximum heart rate percentage of 95 from week 5 to week 8, with the aerobic training consisting of spinning exercise. Group 2 (Moderate Intensity) performed 30 minutes' aerobic and 30 minutes' resistance training 3 days/week at the maximum heart rate percentage of 60 to 68 from week 1 to week 4, and then progressed to maximum heart rate percentage of 68 to 74 from week 5 to week 8. A week before the commencement of the intervention programme, the subjects had to do baseline testing.

EXERCISE INTERVENTIONS

Training programmes were a minimum of 8 weeks' duration and were divided into two according to the investigated intensities which were moderate intensity and high intensity. Moderate intensity was a 30 minutes' aerobic training on a cycle ergometer at the maximum heart rate of 60 to 75%. HRmax was estimated using (220-age- resting heart rate* 68 and 74%) 30 minutes of resistance training. High intensity was a 15 minutes' aerobic training on a cycle ergometer at the maximum heart rate of 76 to 95 %. HRmax was estimated using (220-age- resting heart rate* 84 and 95%) 15 minutes of resistance training (three sets of 8-12 repetitions at 10RM for each and every resistance exercise); 10RM was determined prior to the beginning of the intervention during the testing week. The subjects' 10RM was tested for each and every exercise in the intervention programme; if the subjects achieved more than 10 repetitions, the weight was increased, and if the participants achieved less than 8 repetitions, the weight was decreased and, after a short rest, the subjects were asked to try again until exactly 10 repetitions were achieved. During the intervention, the participants were instructed to increase/decrease weight by 2.5kg if more or less than 12 repetitions were achieved. Lastly, the participants' heart rate was monitored by the researcher throughout the training sessions to ensure that they train at the correct exercise intensity; to make this possible, the participants were divided into manageable groups of 10. The duration of the exercise programmes excluded the 10 minutes' warm-up and 10-minutes cool-down.

Measurements

All research variables were measured before and after the intervention programme in a control environment by the same researcher and at the same standardised time of day.

The measured variables included anthropometrical, physiological and health parameters.Anthropometrical parameters: body mass was measured using a Detecto Eye Level Physician Beam Scale (model 2391). Height was measured using a Marsden HM-250P Leicester portable height measure, body mass index was calculated using values from mass (Kg)/Height^2 (m^2). The mass and height were recorded to the nearest 0.1 kg and 0.1 cm, respectively. Waist circumference was measured at the mid-point between the iliac crest and the bottom of the ribcage, and hip circumference measurement was taken at the widest gluteal circumference; these two values were used to calculate the waist-hip ratio. Body fat percentage was determined by the use of the Jackson/Pollock 7-Site Caliper Method, the skin folds' sites used were the triceps, subscapular, chest, mid-axillary, suprailiac, abdominal, and thigh. BF% was calculated using a linear software body fat calculator.

Baseline blood tests (blood glucose and cholesterol): subjects were instructed not to do any strenuous activity or take caffeine for 48 hours. The tests were performed in the morning after overnight fasting (8-12 hours). Blood was drawn by pricking the finger using a disposable lancet device. The drawn blood was then analysed using an Accutrend Plus cholesterol metre measuring device. Physiological Parameters: Cardiovascular fitness was evaluated using a multistage shuttle run test. The subjects were instructed to run back and forth (shuttles) between two cones placed 30 metres apart from each other. The subjects' pace was controlled by an audible beep that sounded each and every time the subject was expected to reach the cone for the completion of a shuttle. The test was automatically cancelled if a subject failed to complete two successive shuttles. VO2max was determined using the number of successfully completed shuttles.

Statistical analysis

The analyses were performed using an IBM SPSS statistics software (version 19, NY. USA). Descriptive data were presented as mean ± SD, unless it is stated otherwise. The percentage change between the pre-test and post-test was calculated for each evaluated parameter. A two-way ANOVA with repeated measures was used to measure the main effects of the exercise intervention in anthropometry, health as well as physiological parameters across all groups (HIIT, MICT, and CON). $P \leq 0.05$ were considered statistically significant

RESULTS

Subjects

The study population had a mean BMI of 30.44 ± 3.39 Kg/m^2; mean BF (%) of 38.51 ± 4.74%, and the mean age of 22 ± 2.22 years. Ninety female subjects were recruited and match-paired to their respective groups (n = 30 in each of the control, HIIT, MICT groups) for the study, with 9 individuals dropping out - 1 from HIIT group for personal reasons which were not exercise-related, 8 from MICT group due to study commitments before the completion of the intervention. The training frequency for this study was 3-5 days per week, and the duration of the intervention was 8 weeks. The subjects were trained using two training modes which were aerobic and resistance training for both training groups. The maximum heart rate percentage of 60-75 and 76-95 was the intensity used for MICT and HIIT, respectively. Table 1 shows the general pre-intervention characteristics of the study population.

Table 1: General pre-intervention characteristics of the sample divided into the Control group, High Intensity group = HIIT and Moderate Intensity group = MICT

Variables	Control (n = 30)	HIIT (n = 29)	MICT (n = 22)
Age (years)	22 ± 2.10	23 ± 2.7	22.4 ± 2.33
Weight (Kg)	75.34 ± 13.77	71.09 ± 10.09	73.24 ± 12.41
BMI (Kg/m^2)	30.6 ± 3.96	29.92 ± 2.73	30.8 ± 3.40
WHR (cm)	0.749 ± 0.06	0.748 ± 0.06	0.75 ± 0.05
BF (%)	38.79 ± 5.03	38.69 ± 4.87	38.04 ± 4.44
GLU (mmol/L^1)	4.03 ± 1.07	3.80 ± 1	3.85 ± 1.01
CHOL	4.86 ± 1.63	4.68 ± 1.66	5.09 ± 1.60
VO2max	37.14 ± 4.30	37.72 ± 3.68	37.43 ± 3.95

Table 2: Anthropometrical, physiological and health parameter data before and after the intervention

Variables	Control group (n = 30)		HIIT group (n = 29)		P-value	MICT group (n = 22)		P-value
	Pre	Post	Pre	Post		Pre	Post	
Weight (Kg)	75.34 ± 13.82	76.30 ± 13.77	71.09 ± 10.09	67.93 ± 10.59*	0.018	73.24 ± 12.41	70.36 ± 12.58	0.266
BMI (Kg/m^2)	30.60 ± 3.96	28.98 ± 7.12	29.92 ± 2.73	27.54 ± 3.62	0.581	30.80 ± 3.40	28.37 ± 4.18	1.000
WHR (cm)	0.75 ± 0.063	0.76 ± 0.065	0.75 ± 0.06	0.70 ± 0.051*	0.012	0.75 ± 0.052	0.71 ± 0.044	0.067
BF (%)	38.79 ± 5.03	37.86 ± 5.45	38.69 ± 4.87	25.20 ± 4.55	0.000	38.04 ± 4.44	23.67 ± 3.97	0.000
GLU (mmol/L^1)	4.03 ± 1.07	4.14 ± 0.96	3.8 ± 1	3.46 ± 0.51*	0.018	3.85 ± 1.01	3.49 ± 0.49*	0.044
CHOL	4.86 ± 1.63	5.25 ± 1.47	4.68 ± 1.66	4.20 ± 0.74*	0.047	5.09 ± 1.60	4.14 ± 0.54	0.286
VO2max	37.14 ± 4.30	36.94 ± 3.71	37.72 ± 3.68	47.06 ± 3.72*	0.000	37.43 ± 3.95	45.22 ± 4.04*	0.000

Compared to the baseline, body weight only decreased significantly in the HIIT group (p = 0.018). However, no statistical difference was found between the groups in BMI (p = 0.581; 1.000) for the HIIT and MICT, respectively, after the intervention. Significant WHR reduction was observed in the HIIT group (p = 0.012). After the exercise programme, body fat percentage showed a significant reduction in both the HIIT and MICT groups with (p = 0.000). Physiological and blood parameters Eight weeks of HIIT and MICT programmes resulted in significant improvement of VO2max with 47.06 ± 3.72 and 45.22 ± 4.04 (mean ± SD), respectively. At the end of the intervention, VO2max was significant in both training groups with p = 0.000. Fasting glucose showed a significant decrease with 3.46 ± 0.51 and 3.49 ± 0.49 (Mean ± SD) in both the HIIT and MICT groups, respectively. P-values were 0.018 and 0.044 for the HIIT and MICT, respectively. The total cholesterol significant difference was only found in the HIIT group with 4.20 ± 0.74 vs 4.14 ± 0.54 in the MICT; p-values were 0.047 for the HIIT and 0.286 for the MICT.

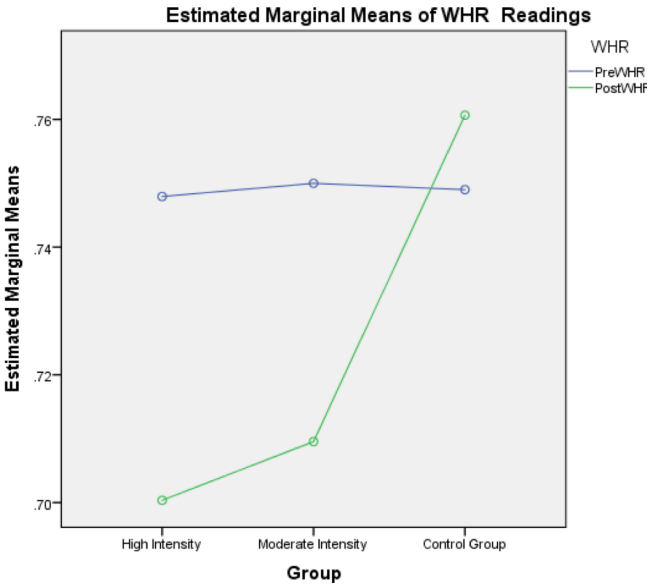

Figure 1 - Waist-Hip Ratio changes between the pre-intervention and post-intervention programme with HIIT (n = 29), MICT (n = 22) and Control (n = 30) groups. Data are presented in means. HIIT = High Intensity Intermittent Training, MICT = Moderate Intensity

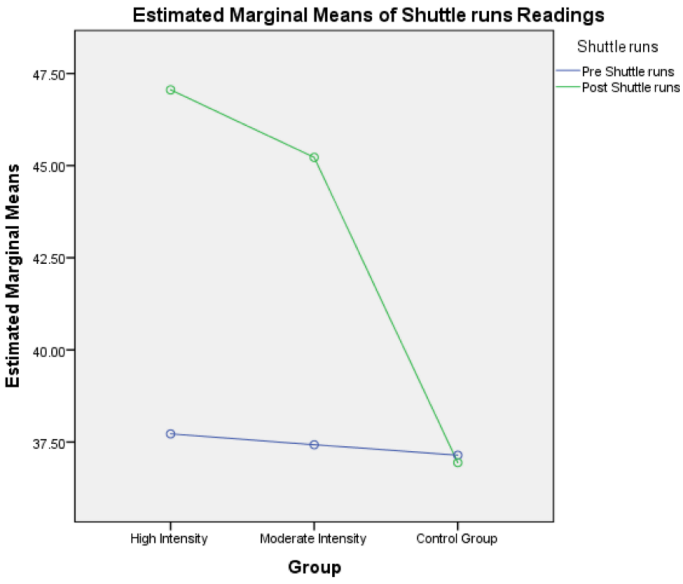

Figure 2 - Shuttle run (VO2max) changes between the baseline and after the intervention programme. Data is represented as means.

DISCUSSION

The purpose of the study was to determine the effectiveness of high versus moderate intensity aerobic and resistance training programme on anthropometrical, physiological and blood parameters in previously obese young women. The crucial outcomes of the study were that HIIT and MICT programmes significantly decrease body fat percentage in both exercise groups which supports the findings by (Trapp et al., 2008; Wewege et al., 2017; Racil et al., 2013). This also shows that HIIT is more time-efficient which was indicated by double time spent on the MICT protocol. These results were in contrast with the findings of Keating et al. (2014) who reported that continuous exercises and not HIIT reduce the total body fat and android fat in previously sedentary obese individuals. A significant fat loss showed by MICT primarily depends upon the training volume and the duration of the sessions.

In addition, cardiorespiratory fitness is an essential predator of health and mortality (Keating et al., 2014); participating in both exercise groups leads to a significant improvement of VO2max with no difference between the groups. These results suggest that HIIT is equally effective, compared to MICT programmes, in improvement of cardiorespiratory fitness and aerobic capacity of previously obese individuals, despite half the time spent on HIIT compared to MICT. Weston, Wisløff, and Coombes (2013) have also found that both intensities' programmes investigated in this study elicit a significant improvement of VO2max. Racil et al. (2016) explained the improvement of cardiorespiratory fitness as a result of a decrease of body fat percentage, as it helps the subjects' skeletal muscle in supporting hard efforts for longer duration, which in turn allows for significant improvement of VO2max. The study findings suggest that both exercise intensities are capable to confer improvement of the total body fat percentage and cardiorespiratory fitness which subsequently play a huge role in improving cardiometabolic health. These findings are in line with those of the study conducted by (Zhang et al., 2017).

Despite the great reduction of body fat percentage, no significant reduction of body weight and waist-hip ratio was observed in the MICT programme. In the present study, we found a significant reduction of body weight with the HIIT programme despite half the time spent practicing it compared to the MICT programme; a study conducted by Smith-Ryan et al. (2016), a meta-analysis conducted by Andreato et al. (2019), and a study conducted by Hornbuckle, McKenzie, and Whitt-Glover (2017) support this finding. Furthermore, HIIT also produced a greater reduction of the waist-hip ratio. On the contrary, the meta-analysis conducted by Wewege et al. (2017) demonstrated

that both HIIT and MICT protocols cause a similar degree of change in WHR. This may be due to the duration (which was between 12 and 15 weeks) of the studies which were included in this review. These findings provide a suggestion that using HIIT can not only improve muscle mass but also body weight and waist-hip ratio through a decrease of body fat percentage, thereby reducing cardiometabolic risk factors in previously sedentary obese young women. These findings are in accordance with the studies performed by Keating et al. (2017), Batacan et al. (2017), both demonstrating that HIIT remains a more advantageous exercise protocol compared to MICT in inducing significant improvements of body composition.

The improvement of body weight, body fat percentage and waist-hip ratio can have many benefits to previously obese young women such as reduced total cholesterol, glucose and blood pressure (Hornbuckle, McKenzie, & Whitt-Glover., 2017). One fascinating finding in the present study was the absence of BMI reduction, despite a significant body weight loss and BF% reduction observed; this is likely due to the bone density and lean body muscle gain. These findings support the suggestion of Racil et al. (2013) that HIIT is a potent exercise protocol for improving body composition of previously sedentary obese young women.

From our study findings, comparing HIIT with the MICT programme, the total cholesterol showed a statistically significant improvement in the HIIT programme. These results are consistent with that of Ghodsi, Zolfaghari, and Fattah. (2016), who demonstrated that HIIT induces significant improvement of the total cholesterol with the same exercise protocol of the present study. There was no significant improvement observed in MICT after the exercise intervention. However, these findings were inconsistent with the review study conducted by Wood et al. (2019) who found no significant change in either MICT or HIIT. This may be due to the fact that most studies included a training frequency of 3 days per week, and for the HIIT group, there had been an active break between training intervals in the duration of 30 seconds (a maximum of 25 minutes per session).

Both MICT and HIIT appear to be equally effective in improving fasting glucose. Moreover, HIIT improvement was accomplished in only 50% (excluding the warm-up and cool-down which were identical for both groups) of the time taken for the same improvement via MICT. Furthermore, there was a significant difference between the training groups, with HIIT being more effective in terms of improving fasting glucose in previously obese females. A great improvement of fasting glucose can improve the health status and prevent metabolic diseases such as diabetes (Ghodsi, Zolfaghari, & Fattah, 2016). Racil et al. (2016) demonstrated contrasting results to that of the present study where both training groups showed similar significance.

CONCLUSION

Our study findings suggest that 8 weeks of HIIT and MICT elicit similar improvements in VO2max and BF%, and that neither exercise intensity produced a significant reduction of BMI. However, the HIIT protocol is more effective considering that it takes approximately 50% of the time committed to the MICT sessions. In addition, HIIT demonstrated superiority in improving VO2max and reducing BF%, BW, WHR, fasting glucose as well as total cholesterol in previously sedentary obese young women when compared to MICT.

Therefore, HIIT is a time-efficient protocol for improving cardiorespiratory fitness, reducing BW, BF%, WHR, glucose, and cholesterol, thereby reducing cardiometabolic risk factors in previously sedentary obese young women.

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KOMPARATIVNI EFEKTI VISOKO INTENZIVNOG NASPRAM TRENING PROGRAMA UMJERENOG INTENZITETA NA PRETILE MLADE ŽENE

Kontekst: Umjereni intenzitet se preporučuje kod prethodno fizički neaktivnih pojedinaca za sprječavanje pretilosti i nošenje sa istom, kao i za pružanje zdravstvenih dobrobiti. Međutim, visoko intenzivni protokol vježbanja je pokazao slične rezultate uz manje od 40% vremena provedenog na izvođenje protokola umjerenog intenziteta. Cilj studije je bio utvrditi učinkovitost visoko intenzivnog naspram trening programa umjerenog intenziteta na antropometrijske, fiziološke i parametre krvi kod prethodno pretilih mladih žena.
Metode: Devedeset mladih žena u dobi od 22 ± 2 (18-26) godine je, metodom podudaranja, podijeljeno u tri grupe: grupa visokog intenziteta (n = 30), grupa umjerenog intenziteta (n = 30), i kontrolna grupa (n = 30). Učestalost treninga u ovoj studiji je bila 3-5 dana sedmično, uz trajanje intervencije od 8 sedmica. Ispitanici obje grupe su izvodili dvije vrste treninga koji su bili aerobni i trening snage. Procenat maksimalnog broja otkucaja srca u vrijednosti od 60-75 i 76-95 je intenzitet korišten za MICT i HIIT, respektivno.
Rezultati: Populacija u ovoj studiji je imala aritmetičku sredinu BMI-ja u vrijednosti od 30,44 ± 3,39 Kg/m^2; aritmetičku sredinu BF-a (%) u vrijednosti od 38,51 ± 4,74%, i aritmetičku sredinu dobi u vrijednosti od 22 ± 2,22 godine. Nije uočena značajna razlika u BMI-ju (p = 0,581). Jednostruka analiza varijanse je pokazala značajno smanjenje tjelesne težine (p = 0.018) i omjera struka i kukova (p = 0,012). Oba intenziteta vježbanja su povezana sa značajno većim smanjenjem procenta tjelesne masnoće i VO2max (p = 0,000). Uočeno je značajno poboljšanje u HIIT grupi po pitanju ukupnog holesterola (p = 0,047) i glukoze (p = 0.044).

Zaključci: Pronalasci studije ukazuju da je ukupni HIIT strategija za poticanje uporedivih antropometrijskih, fizioloških i zdravstvenih parametara koji imaju korist za MICT. HIIT i MICT su jednako efikasni u poboljšanju VO2max i smanjenju procenta tjelesne masnoće bez obzira na prepolovljeno vrijeme koje je potrebno za izvedbu HIIT-a. Ovo pokazuje da je HIIT sposoban za proizvodnju ostvarivog rezultata te se može koristiti kao zamjena za modalitete umjerenog intenziteta kao osnovni način vježbanja za promociju smanjenja težine kod fizički neaktivnih pretilih pojedinaca.

Ključne riječi: pretilost, visoko intenzivni intervalni trening, umjereno intenzivni neprekidni trening, aerobni i trening snage

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DIFFERENCES IN MOTOR SKILLS BETWEEN WOMEN ATTENDING PERSONAL AND GROUP FITNESS PROGRAMMES

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ABSTRACT

One of the biggest problems of modern humans is a passive lifestyle and a lack of physical activity. Physical inactivity is more prevalent among women than men, and participation in physical activity decreases as women age. Those women who are physically active usually take part in group or personal fitness exercise programmes. The purpose of the present study was to investigate the differences in motor skills between the two groups of women who attend group and personal fitness programmes. The results of the present study revealed that there were significant differences between the two groups of participants in five out of seven tested variables. Women from the personal fitness programme had better results in strength tests standing broad jump, sit-ups, and bent arm hang, while the women from the group fitness programme were more successful in the flamingo balance test and the shuttle run 10x5 m agility test. Finally, no significant differences were observed between the groups in plate tapping and sit-and-reach ($p = 0.43$) tests. The presented findings suggest that participation in both the personal and group fitness exercise programmes has its advantages for motor skill improvement and that all clients should choose in line with their personal goals.

Keywords: personal fitness, group fitness, physical activity, women

INTRODUCTION

One of the biggest problems of modern humans is a passive lifestyle and a lack of physical activity. Due to the rapid development of technology, an increasing number of people indulge in sedentary activities. With the help of the Internet, computers and telephones, we can perform most daily tasks, often without leaving home. From school, work-related obligations to socialising, everything becomes available to us at the click of a button. This way of life, combined with bad eating habits, quantity, and quality of food consumed, already brings serious consequences. Insufficient physical activity affects the development of obesity, diabetes, malignant diseases, postural status disorder and the development of deformities (Katzmarzyk, & Craig, 2002; Kodama et al., 2009; Lee et al., 2011; Sawada et al., 2014). Physical activity is defined as any bodily movement produced by skeletal muscles that result in energy expenditure (Caspersen, Powell, & Christenson, 1985). However, other authors suggest that physical activity is any movement of the body resulting from muscle contraction, which affects energy expenditure above the basal levels (Stoiljković et al., 2012). Walking, cycling, climbing stairs and daily household chores are the prerequisites for our body to stay healthy. However, it is known that only vigorous effort can lead to significant improvements in physical fitness (McArdle, Katch, & Katch, 2000). The majority of experts in the exercise field agree that there are two categories of fitness: 1) health-related physical fitness, and 2) motor-performance physical fitness (Gadžić, 2019).

Women and group fitness programmes

Physical inactivity is more prevalent among women than men, and participation in physical activity decreases as women age. Furthermore, women's exercise participation has been studied less extensively than men's (Segar et al., 2002). Although considerable research on fitness in women has been conducted in the last 20 years, not all findings are conclusive. Women usually take part in group or individual (personal) fitness activities. In women who attended group aerobic classes, favourable associations have been reported, linking this type of activity with its positive effects on health.

Study results showed that 70.4% of participants believed that exercising aerobics greatly contributes to improving health, 28.4% believe that it partially contributes, and only 1.2% said that they did not know the answer, while none of the participants have had a negative opinion (Jorgić, 2008). A group fitness programme conducted on female students resulted in significant improvements in functional abilities (Mikić, Đug, Tanović, & Mehinović, 2009) as well as in certain motor skills (Milenković & Veselinović, 2010; Mikalački, Čokorilo, Korovljev, & Montero, 2013). While many group exercise intervention studies have shown increases in physical activity over the course of the intervention, a meta-analysis reported that the few studies that examined adherence during the months following the intervention generally reported small effects. In addition, almost 50% of Americans discontinue exercise programmes within 6 months (Dishman & Buckworth, 1996).

Women and personal fitness programmes

Personal trainers play a critical role in fitness clubs, especially concerning women's health and fitness. They teach and correct exercise techniques, design resistance training programmes for their clients, and prescribe the training intensity, volume, frequency, and workout structure. It is plausible that an individual who trains on his own becomes accustomed to training at a certain level of perceived exertion, and it is possible that these individuals may select inadequate intensities to achieve what they wanted in the absence of a personal trainer. The positive influence of supervised resistance training is well-documented in other studies (Fleck & Kraemer, 2004; Kraemer & Ratamess, 2004; Mazzeti et al, 2000). The results of the previous study indicated that the majority of women who trained in fitness clubs with self-selected training intensities may be considered too low for progression in muscular fitness, and in addition to individual training goals, it appeared that the self-selected intensities may have been influenced by the subjects' perceptions or misconceptions about resistance training. Those women who consistently trained under the supervision of a personal trainer self-selected higher resistance training intensities, reported higher RPE values, had greater initial 1RM strength, and were less likely to believe the misconception of excessive "muscle bulk" via resistance training than the women who trained on their own. These results support previous studies demonstrating the superiority of supervised resistance training (Ratamess et al., 2008). The purpose of the present study was to investigate the differences in motor skills between the two groups of women who attend group and personal fitness programmes.

METHODS

Participants

The sample consisted of 50 healthy women (25 from group fitness programme and 25 from personal fitness programme), aged 28 ± 2.2, with an exercise experience of at least 9 months. Basic anthropometric measurements of participants from the personal fitness programme are: body height 167.25 ± 6.22, body mass 63.14 ± 5.84, while the group fitness participants' measurements are: body height 166.18 ± 5.25, body mass 61.5 ± 7.8, respectively.

Exercise protocols

A personal training programme was developed and applied four days a week with an average duration of 60 minutes per session. All exercises were combined and performed with and without equipment. The intensity of exercises was mixed aerobic/anaerobic, from 60% to 90% of the maximum effort. Each exercise session was commenced with a standardised 5-minute warm-up, with stretching exercises and calisthenics lasting 5 minutes. The main workout consisted of various movements covering strength, endurance, mobility, and agility exercises on fitness machines and bodyweight interval exercises in work–rest ratio 1:2. Finally, a 5-minute cooldown was carried out at the end of every session.

Group fitness workouts were performed for 60 minutes at 60% to 80% intensity, with activities that include circuit training, obstacle courses, and various equipment for resistance training (resistance bands, light dumbbells, TRX bands, kettlebells, medicine balls, and Swiss balls). Every training started with a warm-up in the form of step aerobics or classic aerobics. The focus of the first day was on overall muscle activation, the second training aimed at the lower body and abdominal muscles, the third session targeted the back, chest and arms, and the fourth training promoted total muscle development.

Motor skill tests

Motor skills were assessed by Eurofit tests: flamingo balance (balance), plate tapping (upper body speed), sit-and-reach (extent flexibility), standing broad jump (lower body muscular power), sit-ups (abdominal muscular endurance), bent arm hang (upper body muscular endurance), and 10×5m agility shuttle run (running speed-agility).

Statistical analysis

The following statistical procedures were conducted for the whole cohort. Basic descriptive parameters, arithmetic mean (AM), standard deviation (SD), minimum (MIN), maximum (MAX), skewness and kurtosis, were calculated for all variables. Since the data was found to be parametric, an independent samples t-test ($p \leq .05$) was used to determine any differences between the two groups of participants engaged in the study.

RESULTS

Table 1 shows the results of descriptive statistics related to the motor skills of the personal fitness group of participants. The mean values of motor skill variables suggest that participants from the personal fitness group had above average results in flamingo balance, plate tapping, sit-and-reach, and bent arm hang tests, while in other tests, they were below average (Tomkinson et al., 2018).
Standard deviation values indicate that the most heterogeneous results were in standing broad jump and bent arm hang tests.

The results of descriptive statistics pertaining to motor skills for the group fitness participants are presented in Table 2. Identically, the arithmetic means of their results are somewhat above average in flamingo balance, plate tapping, sit-and-reach, and bent arm hang tests, while the results of standing broad jump, sit-ups, and the shuttle run 10x5m are below average.

Table 1: Descriptive statistic of motor skills for personal fitness participants

Personal fitness	**M**	**SD**	**Min**	**Max**	**Skew**	**Kurt**
Flamingo balance	7.8	3.21	3	14	0.12	-0.25
Plate tapping	11.43	0.78	9.9	12.5	0.57	0.12
Sit-and-reach	30.06	5.67	18	38	-0.39	0.51
Standing broad jump	141.93	20.07	119	178	-0.05	-0.15
Sit-ups	15.12	2.36	12	21	-0.57	0.07
Bent arm hang	20.62	8.57	2	38	-0.38	-0.70
Shuttle run 10x5m	23.26	1.76	19.8	26.2	0.09	-0.30

Table 2: Descriptive statistic of motor skills for group fitness participants

Group fitness	**M**	**SD**	**Min**	**Max**	**Skew**	**Kurt**
Flamingo balance	5.4	2.16	2	9	0.12	-0.59
Plate tapping	11.42	0.95	9.9	13	0.07	0.22
Sit-and-reach	30.75	6.06	15	42	0.25	-0.31
Standing broad jump	136.06	22.65	107	183	-0.03	-0.13
Sit-ups	13.56	2.06	10	19	-0.17	0.71
Bent arm hang	15.56	7.43	1	29	1.08	1.21
Shuttle run 10x5m	22.95	1.84	19.4	25.8	0.19	-0.41

Table 3: Results of a t-test for independent samples

Variable	Personal fitness	Group fitness	Sig.
Flamingo balance	7.8	5.4	**0.04**
Plate tapping	11.43	11.42	0.69
Sit-and-reach	30.06	30.75	0.43
Standing broad jump	141.93	136.06	**0.01**
Sit-ups	15.12	13.56	**0.02**
Bent arm hang	20.62	15.56	**0.03**
Shuttle run 10x5m	23.26	22.95	**0.01**

Table 3 shows the results of the t-test for independent samples that was used to determine any differences between the two groups of participants. The findings revealed that there were significant differences between the two groups of participants in five out of seven tested variables. Women from the personal fitness programme had better results in standing broad jump ($p = 0.01$), sit-ups ($p = 0.02$), and bent arm hang ($p = 0.03$), while the women from the group fitness programme were more successful in flamingo balance ($p = 0.04$) and the shuttle run 10x5 m ($p = 0.01$) tests. Finally, no significant differences were observed between the groups in plate tapping ($p = 0.69$) and sit-and-reach ($p = 0.43$) tests.

DISCUSSION

Physical activity, physical exercise, and their effects have been studied and documented in a large number of studies. As previously mentioned, women usually take part in group or personal fitness activities. Since very few studies compared the two concepts of exercise, we decided to test the differences in motor skills of women who attend these two exercise programmes. The results of the conducted independent t-test revealed differences in motor skills between the two groups of participants, and it is difficult to give advantage to any of the aforementioned programmes. It seems that personal training had more influence on various forms of strength, such as lower body explosive strength, the repetitive strength of the abdominal muscles, and the static strength of the shoulder girdle. These findings are congruent with the results obtained by Ratamess et al. (2008) who found that women who consistently trained under the supervision of a personal trainer had greater improvement in strength compared with the no personal trainer group.

The authors believe that this is due to the positive influence of a personal trainer who continuously observes and prescribes the amount of weight lifted during each set of every workout, resulting in a better resistance training stimulus yielding greater strength improvements over time. Another reason might be present in the fact that women who trained with a personal trainer, who has listening and motivational skills, put more effort and get accustomed to a higher level of exertion during workouts (Focht, 2007; Melton, Dail, Katula, & Mustian, 2010).

Group fitness class participants had better results in tests that estimate balance, agility, and speed (flamingo balance and the shuttle run 10x5m). This difference may have been attributable to the group training specificity. Training specificity has a great influence on the development of motor abilities and adaptation (Zaciorski & Kremer, 2009).

Positive effects of group fitness programmes have been confirmed in several studies that include improvements in functional abilities (Mikić, Đug, Tanović, & Mehinović, 2009), motor skills (Milenković & Veselinović, 2010; Mikalački, Čokorilo, Korovljev, & Montero, 2013), or mental and emotional well-being (Yorks, Frothingham, & Schuenke, 2017). However, to the authors' knowledge, there are no studies that compare the effects of personal and group fitness programmes on women's motor skills, hence it is hard to relate to other research.

The programme for the group fitness class of the present study was designed to focus primarily on the amount of movement. Therefore, activities like circuit training, obstacle courses, step aerobics,

and classic aerobics, alongside various elements of resistance training (workout with resistance bands, light dumbbells, TRX bands, kettlebells, medicine balls, and Swiss balls), probably led to a greater improvement in agility and speed compared to the personal fitness group.

CONCLUSION

This study was designed to determine if there is any difference in motor skills of women who attend personal and group fitness programmes. Based on the results presented in this paper, it can be stated that the differences between the two groups of participants do exist in five out of seven motor skills. However, the findings do not provide clear arguments to favour either programme in terms of the higher level of motor skills. This conclusion is based on the fact that the personal fitness participants had better results in three motor skills and group fitness participants had more success in two motor tests. This research suggests that participation in both the personal and group fitness exercise programmes has its advantages for motor skill improvement and that all clients should choose in line with their personal goals.

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RAZLIKE U MOTORIČKIM SPOSOBNOSTIMA ŽENA KOJE VJEŽBAJU U INDIVIDUALNIM I GRUPNIM FITNES PROGRAMIMA

Jedan od najvećih problema modernih ljudi je pasivan životni stil i nedostatak fizičke aktivnosti. Fizička neaktivnost se češće javlja kod žena nego kod muškaraca i fizička aktivnost kod žena opada sa procesom starenja. One žene koje su fizički aktivne obično se uključuju u personalne ili grupne programe vježbanja. Cilj ovog istraživanja je da se ispitaju razlike u motoričkim sposobnostima između dvije grupe žena koje vježbaju po personalnom i grupnom fitnes programu. Rezultati istraživanja su pokazali da postoje značajne razlike između dvije grupe ispitanica u pet od sedam motoričkih testova. Žene koje su praktikovale personalni fitnes program su imale bolje rezultate na testovima snage skok u dalj iz mjesta, podizanja trupa do sjeda i izdržaj u zgibu dok su žene iz grupnog fitnes programa bile uspješnije na flamingo testu ravnoteže i testu agilnosti - trčanje 10x5m. Na kraju, nisu utvrđene razlike između grupa na testovima taping rukom i dohvat u sjedu. Prezentirani rezultati ukazuju da oba fitnes programa vježbanja imaju svoje prednosti kada se radi o poboljšavanju motoričkih sposobnosti i da klijenti samostalno, u skladu sa svojim osobnim ciljevima, treba da izaberu odgovarajući program.

Ključne riječi: personalni fitnes, grupni fitnes, fizička aktivnost, žene

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PREDICTION OF YOUNG VOLLEYBALL PLAYERS' QUANTITATIVE MOTOR SKILLS BASED ON BASIC ANTHROPOLOGICAL CHARACTERISTICS

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ABSTRACT

The purpose of this study was to determine the prediction of quantitative motor abilities based on some basic anthropological characteristics in young volleyball players. The research was conducted on a sample of 32 volleyball players aged 15 to 17 (± 6 months), participants in the volleyball camp "Trebinje" in 2016. The participants were tested in 5 morphological variables: body height (BH), body weight (BW), arm span (AS), maximum one-arm reach (M1AR), maximum two-arm reach (M2AR), 4 explosive power tests, namely: maximum spike reach (MSR), maximum standing block reach (MSBR), maximum running block reach (MRBR), medicine ball throw 2kg (MEDT2KG), and 1 flexibility test - bench forward bend (BFB). Significant relationships were found between the variable maximum spike reach (MSR), (R = 0.748) maximum standing block reach (MSBR) and (R = 0.866) maximum running block reach (MRBR) as well as the system of variables relating to quantitative motor skills (R = 0.871). There were no significant relationships between medicine ball throw 2kg (MEDT2KG) (R = 0.552) and bench forward bend (BFB) as well as the quantitative motor ability variable system (R = 0.27). Medicine ball throw 2kg does not represent any specific element in the special sports games, but, in such movements, in addition to explosive power, specific, repetitive strength of the torso, relative repetitive strength and arms and shoulder girdle strength are manifested, which are not dominant in the volleyball game as the jumping explosive power. When considering the relationship between force, speed and time as well as the ESD value, they can, very easily, be the parameters which make an essential difference in terms of the manifestation of explosive power. This research confirmed that, on the basis of jumping explosive power, a prediction of success in the quantitative motor abilities of young volleyball players can be made and, in that way, training can be directed towards the development of explosive power. Research can be used to guide, control and adequately select training activities for learning or improving some volleyball techniques.

Keywords: personal fitness, group fitness, physical activity, women

INTRODUCTION

Out of all the motor skills that are, without a doubt, important for success in the game of volleyball, primacy is given to strength in all the forms of manifestation. It belongs to the group of basic and specific quantitative abilities (strength, speed, endurance and flexibility) (Milanović, 2009). Exploring this motor ability (Skender, 2004), (Čanaki, Šoš, & Vučetić, 2006; Marelić, Đurković, & Rešetar, 2008; Skender, 2008; Đurković, Marelić, & Rešetar,

2012; Tahiraj, Bajqinca, Blagojević, Begu, Mehmeti, & Grajqevci, 2014), when choosing tests, explosive power and its modalities occupy a very high place, hierarchically. Jumping, in volleyball, is a prerequisite for a successful attack and defence online. According to the structure of movement, it is the most energetically demanding, and according to the frequency, it is the most common physical ability of volleyball players. According to Nešić (2005), the average number of rebounds performed by one volleyball player in a game (5 sets) is about 100 rebounds for a player in the middle blocker position, 90 rebounds for a blocker, and about 70 rebounds a receiver. In today's, as they call it, "atomic" volleyball, in addition to physical fitness, the determinants of success are the physical dimensions, above all those of a longitudinal character.

The main purpose of this research is to predict the quantitative motor abilities of young volleyball players based on some basic anthropological characteristics. In this regard, the subject of this research are body dimensions and quantitative motor abilities as well as their interrelationship. Based on this, the research assumptions are (1) that there is an influence of body dimensions on quantitative motor abilities, (2) that based on the obtained measurements, it is possible to predict the results of young cadets, and (3) that the body dimensions of volleyball players are correlated with motor skills. It will be verified whether and to what extent the chosen body dimensions affect the test result, then, the level of young volleyball players' achievement with an emphasis on quantitative motor skills will be assessed, and the connection between volleyball cadets' body dimensions and motor skills specific to volleyball will be sought.

WORK METHODS

The sample of respondents

The research was conducted on a sample of 32 volleyball players aged 15 to 17 (± 6 months), participants in the volleyball camp "Trebinje" in 2016. The camp was organised within the Summer School of Sports in Trebinje. The respondents are active players of volleyball clubs from Republika Srpska; they actively train volleyball for at least 2 to 4 years; for all volleyball players, the plan envisages a load of 5 training sessions per week with a total training duration of 90-120 minutes; all of them are healthy, which was determined on the basis of a medical examination.

Sample variables

From the space of body dimensions, the longitudinal dimensionality of the skeleton and body volume and mass were treated. Five (5) tests were applied: body height (BH), body weight (BW), arm span (AS), maximum one-arm reach (M1AR), and maximum two-arm reach (M2AR). The body height and weight testing procedure was measured according to IBP instructions (Weiner & Lourie, 1969). Body height was measured with an anthropometer according to Martin, to the nearest 0.1 cm. Body weight was measured with a Tanita scale (CORP, Arlington Heights, IL), with an accuracy of 0.1 kg.

Five (5) tests were applied to assess the level of (specific) motor ability related to jumping explosive power and flexibility: maximum spike reach (MSR), maximum standing block reach (MSBR), maximum running block reach (MRBR), medicine ball throw 2kg (MEDT2KG), and 1 flexibility test - bench forward bend (BFB). These are standardised, simulated tests that represent fragments of selected motor activities. The applied motor tests were modified according to Metikoš et al. (1989), Đurković T., Rešetar T. (2008) and Marelić, N. and Janković, V. (1997).

For processing the obtained data, the procedures of descriptive statistics, discriminant, correlation and regression analysis were used. Using descriptive statistics, the basic statistical parameters were calculated in order to check the distribution of results. The nature of the relationship between the observed variables was checked by a regression analysis and, based on the obtained coefficients, the prediction of young volleyball players' quantitative abilities was performed. The obtained database was processed by STATISTICA 7 and SPSS 11.0 statistical programmes.

RESULTS

By reviewing the obtained parameters (Table 1), no value of K-S test exceeds the limit value for the tested sample, so it can be concluded that the variables of body dimensions, in addition to the variables of specific motor skills, have a distribution that does not significantly deviate from normal. By reviewing the obtained parameters (Table 1), based on the K-S test, all tested variables have a normal distribution.

The results on the connection between body dimensions and quantitative motor abilities of young volleyball players were obtained on the basis of the values pertaining to the degree of freedom df1 = 4 and df2 = 27 and the limit value of the F-test. For statistically significant values, those whose (limit) value of the F-test is equal to or greater than 2.73 at the significance level of p = 0.05 are accepted.

Table 1: Basic statistical parameters

	Valid N	Mean	Min.	Max.	Std. Dev.	K-S
Body dimensions						
BH	32	187	176	202	6.6	0.08
BW	32	69	59	101	8.4	0.15
AS	32	188	176	209	8.0	0.11
M1AR	32	245	228	272	9.9	0.16
M2AR	32	242	226	267	9.3	0.11
Spec. mot. skills						
MSR	32	300	280	330	12.4	0.12
MSBR	32	282	261	304	10.2	0.11
MRBR	32	288	271	320	11.6	0.19
MEDT2KG%	32	541	470	670	53.3	0.16
BFB	32	24	3	35	7.0	0.09

The limit value of the K-S test for N = 32 is 0.240; p = 0.05;

In Table 2, the value of the multiple regression coefficient between the dependent variable Maximum Spike Reach (MSR) and the system of variables pertaining to the quantitative motor abilities is R = 0.748, which indicates a significant correlation between the observed systems.

The value of R^2 = 0.5596 suggests that 55.96% of the total variability pertaining to the Maximum Spike Reach (MSR) results can be explained by the influence of the predictor variables system. The remaining 44.04% was not explained by the regression model; therefore, the results were influenced by some other unidentified (latent) factors, presumably of a physiological, motor or psychological nature.

From the set of variables pertaining to quantitative motor abilities, it was shown that the results of the Maximum Spike Reach (MSR) test, which was used to estimate the jumping explosive power, can undoubtedly be statistically significantly predicted, and all predictor variables significantly influenced the result. This confirms the realised level of significance for all tests from the space of body dimensions, which measured the longitudinal dimensionality of the skeleton and body volume and mass, as well as the values of Beta coefficients for the same.

In Table 3, the value of the multiple regression coefficient between the dependent variable maximum standing block reach (MSBR) and the system of variables pertaining to quantitative motor abilities is R = 0.866, which indicates a pronounced correlation of the observed systems.

The correlation is also statistically significant at the level of p = 0.000. The obtained value R^2 = 0.7501 suggests that 75.01% of the total variability pertaining to the maximum standing block reach (MSBR) results is determined by the variability of the independent variables system.

The remaining 24.99% is not explained by the

Table 2: Results of regression analysis for the dependent variable Maximum Spike Reach (MSR)

Model	R	R^2	Adjus. R^2	Std. Err. of Est.		
1	0.748100	0.559653	0.474971	8.951794		
Model		**SS**	**df**	**MS**	**F**	**Sig.**
	Regress.	**2648.00**	**5.00**	**529.60**	**6.609**	**0.000**
	Residual	**2083.50**	**26.00**	**80.13**		
	Total	**4731.50**				
	Beta	**Std. Err.**	**B**	**Std. Err.**	**t (26)**	**p-level**
BH	0.706	0.129	1.328	0.24	5.464	0.000
BW	0.426	0.165	0.627	0.24	2.580	0.015
AS	0.702	0.130	1.085	0.20	5.407	0.000
M1AR	0.672	0.135	0.836	0.17	4.970	0.000
M2AR	0.654	0.138	0.864	0.18	4.733	0.000

Legend:

Multiple R - multiple correlation coefficient; Multiple R^2 - coefficient of determination; Adjusted R^2 - corrected coefficient of determination; Std. Err. of Estimate - standard error of regression parameter estimation.
df1 = 4; df2 = 27; f = 2.73; p = 0.05
Legend: SS - sum of squares; MS - values of regression and residual variance; df - degrees of freedom; F - F test; Sig. - realised level of significance

regression model; therefore, the results were influenced by some other anthropological characteristics or abilities of young volleyball players that are not the subject of this research.

It was also shown that the results of the maximum standing block reach (MSBR), which was used to estimate the jumping explosive power, could be statistically significantly predicted (p = 0.044 and p = 0.029) based on the results of young volleyball players' current Body Height (BH) and arm span (AS). This is confirmed by the values of the Beta coefficient for the mentioned independent variables (Beta = 0.667 and Beta = 0.686). Other variables of specific motor space have no statistical significance. In Table 4, the value of the multiple regression coefficient between the dependent variable maximum running block reach (MRBR) and the system of variables pertaining to the quantitative motor abilities is R = 0.871, which indicates a distinct connection between the observed systems.

The correlation is also statistically significant at the level of p = 0.000.

The obtained value R^2 = 0.7600 leads to the conclusion that 76.00% of the total variability pertaining to the maximum running block reach (MRBR) results is determined by the variability of the independent variables system. The remaining 24.00% is not explained by the regression model; therefore, it is influenced by some other anthropological characteristics or abilities of volleyball players.

Further review of the table showed that the results of the maximum running block reach (MRBR) test, which were used to estimate the jumping explosive power, can be statistically significantly predicted (p = 0.012 and p = 0.041) based on the results of Body Height measurements (Beta = 0.836) and the results of the maximum two-arm reach (M2AR) (Beta = 1.358) measurements, which were used to assess flexibility. Other variables of specific coordination space have no statistical significance.

In Table 5, the value of the multiple regression coefficient between the dependent variable medicine ball throw 2kg (MEDT2KG) and the system of variables pertaining to the quantitative motor abilities is R = 0.552, which indicates a weak connection between the observed systems. The correlation is not statistically significant because the value of the coefficient is at the level of p = 0.0759.

The obtained value R^2 = 0.304 suggests that only 30.49% of the total variability pertaining to the medicine ball throw 2kg (MEDT2KG) results is determined by the variability of the independent variables system. The remaining 69.51% is not explained by the regression model; therefore, it is influenced by some other anthropological characteristics or abilities of volleyball players. Further review of the table confirms the conclusions for the variable medicine ball throw 2kg (MEDT2KG) which was used to estimate the throwing explosive power.

Table 3: Results of multiple regression analysis for the dependent variable maximum standing block reach (MSBR)

Model	**R**	**R^2**	**Adjus. R^2**	**Std. Err. of Esti.**		
1	0.86613	0.75018	0.70214	5.56387		
variance	**SS**		**df**	**MS**	**F**	**Sig.**
	Regress.	2417.00	5.00	483.40	15.62	**0.000**
	Residual	804.87	26.00	30.96		
	Total	3221.88				
	Beta	**Std. Err.**	**B**	**Std. Err.**	**t (26)**	**p-level**
BH	0.668	0.316	1.036	0.491	2.112	**0.044**
BW	-0.103	0.146	-0.126	0.178	-0.706	0.486
AS	0.686	0.296	0.875	0.377	2.319	**0.029**
M1AR	-0.039	0.595	-0.040	0.610	-0.066	0.948
M2AR	-0.379	0.643	-0.414	0.702	-0.590	0.560

Table 4: Results of multiple regression analysis for the dependent variable maximum running block reach (MRBR)

Model	**R**	**R^2**	**Adjus. R^2**	**Std. Err. of Esti.**		
1	0.87182	0.76007	0.71393	6.22423		
Variance		**SS**	**df**	**MS**	**F**	**Sig.**
	Regress.	3190.95	5.00	638.19	16.473	**0.000**
	Residual	1007.26	26.00	38.74		
	Total	4198.21				
Variance	**Beta**	**Std. Err.**	**B**	**Std. Err.**	**t (26)**	**p-level**
BH	0.836	0.310	1.480	0.549	2.696	**0.012**
BW	-0.215	0.143	-0.299	0.199	-1.501	0.146
AS	0.580	0.290	0.845	0.422	2.001	0.056
M1AR	0.936	0.583	1.097	0.683	1.607	0.120
M2AR	-1.358	0.630	-1.691	0.785	-2.155	**0.041**

Thus, the values of p and Beta coefficients (Beta) show that the results of the medicine ball throw 2kg (MEDT2KG) test were not obtained under the influence of any predictor variable, but under the influence of some other unidentified factors, which are not the subject of this research.

In Table 6, the value of the multiple regression coefficient between the dependent variable bench forward bend (BFB) and the system of variables pertaining to the quantitative motor abilities is R = 0.27, which indicates a low correlation of the observed systems. The correlation is not statistically significant, and its value is p = 0.825 (Table 6a). The obtained value R^2 = 0.0759 suggests that only 07.50% of the total variability pertaining to the bench forward bend (BFB) results is determined by the variability of the independent variables system.

The remaining 92.50% is not explained by the regression model; therefore, it is influenced by some other anthropological characteristics or abilities of volleyball players.

The values of the Beta coefficients (Beta) also indicate that the results of the bench forward bend (BFB) test, which was applied to assess flexibility, were not affected by any independent variable, i.e., that the obtained test results of a set of predictor variables were not able to predict the value/result of the bench forward bend (BFB) and explain their potential impact.

The values of each independent variable also support the statement.

Table 5: Results of multiple regression analysis for the dependent variable medicine ball throw 2kg (MEDT2KG)

Model	R	R^2	Adjus. R^2	Std. Err. of Esti.		
1	0.55218	0.30490	0.17123	48.50369		
Variance		SS	df	MS	F	Sig.
	Regress.	26830.66	5.00	5366.13	2.2809	0.075986
	Residual	61167.81	26.00	2352.60		
	Total	87998.47				
	Beta	Std. Err.	B	Std. Err.	t (26)	p-level
BH	0.516	0.528	4.185	4.278	0.978	0.337
BW	0.484	0.244	3.074	1.552	1.981	0.058
AS	0.380	0.494	2.534	3.289	0.770	0.448
M1AR	0.028	0.992	0.151	5.321	0.028	0.978
M2AR	-0.887	1.073	-5.055	6.116	-0.826	0.416

DISCUSSION

The results for the dependent variable maximum spike reach (MSR) confirm that the longitudinal dimensionality of the skeleton is one of the key morphological characteristics for a volleyball hitter to be successful. In addition, there should be other predispositions such as reaction speed, high aerobic and anaerobic capacity, motor intelligence, ability to overcome fatigue, stress, etc.

The potential of motor skills (speed, explosive leg strength, coordination, flexibility, precision, endurance) whose proper disposition and interaction ensured success in the game. The skill of performing the tactical and technical elements, as well as maximum training and readiness should certainly be added to this range of characteristics pertaining to a modern volleyball player so as to make optimal use of them. The authors Đurković, Marelić and Rešetar (2007), Kostanić and Vidaković (2008), Sattler, Sekulić, Hadžić, Uljević and Dervišević (2011) agree with this opinion, who, among other things, suggest that all kinematic requirements must be taken into consideration when deciding on the success and realisation of the spike in the game. Đurković, Marelić, Hraski, and Šikanja (2005) confirm that the efficiency of spiking in volleyball can be influenced by other, latent factors (e.g., height of contact with the ball, striking arm elbow angle during swing, spiked ball speed, maximum torso twist knee flexion in damping, flight length, vertical and horizontal component of velocity after reflection, run stride length, arm swing amplitude, etc.).

This opened the possibility of predicting potential results and the efficiency of spiking in young volleyball players of cadet age.

The maximum standing block reach (MSBR) test result mostly depended on body height and arm span. This information is logical because the basic trump cards and predispositions of the middle blocker are

Table 6: Results of multiple regression analysis for the dependent variable to bench forward bend (BFB)

Model	**R**	**R^2**	**Adjusted R^2**	**Std. Err. of Est.**		
1	0.275579	0.075944	-0.101759	7.314808		
Variance		**SS**	**df**	**MS**	**F**	**Sig.**
	Regress.	114.33	5	22.866	0.427363	0.825341
	Residual	1391.16	26	53.506		
	Total	1505.50				
	Beta	**Std. Err.**	**B**	**Std. Err.**	**t (26)**	**p-level**
BH	0.125	0.608	0.133	0.645	0.206	0.838
BW	0.173	0.281	0.144	0.234	0.616	0.543
AS	0.426	0.569	0.372	0.496	0.749	0.460
M1AR	0.483	1.144	0.339	0.802	0.422	0.676
M2AR	-1.111	1.237	-0.829	0.922	-0.898	0.377

body height and long (upper) extremities. Given that a certain percentage of the influence pertaining to some other factors (44%), which are not the subject of this research, has been determined, the assumption is that it can relate to the speed of arm movements, agility, and strength in other forms of manifestation.

It can also be explained by the fact that blocking was performed while standing still (static), which caused more effort to lower players in achieving a good result; additionally, the liberos participated in the testing as specialists only in defence who, as a rule, do not participate in blocking alongside the technicians and recipients who are below the average growth for the observed sample, which certainly affected the significance level and test result.

The maximum running block reach (MRBR) test result mostly depended on body height and the maximum two-arm reach (M2AR). It seems logical, however, that the decisive factor for distinguishing these two variables is probably the quality of the run (correct body position along the net, agility, rhythmicity, coordination of movements, timing of the jump, speed of transition from horizontal movement and vertical jump) upon which the realisation depends. A similar study was conducted by Marelić, Đurković and Rešetar (2008), and it concluded that a statistically significant difference was obtained in the variables body height (BH), maximum standing block reach (MSBR) and maximum spike reach (MSR).

According to them, the existence of differences in these three variables is very logical given that the height and reach in the spike and block are essential for high performance in the game and the specifics of the game, where the height of the net is 243 centimetres and the highest number of points is won in the game on those net elements. They further conclude that, although the jump reach is certainly affected not only by anthropometry, but also by explosive power such as jumping, speed, coordination of movements and

techniques, often in atypical situations of fighting on the net, height is the third key element with spike and block variables.

Two tests, medicine ball throw 2kg (MEDT2KG), and bench forward bend (BFB), showed a statistical correlation with characteristic body dimensions. The reason for the low coefficient should probably be sought first in the fact that almost 70% of the total variability pertaining to medicine ball throw 2kg (MEDT2KG) test results is explained by some other (latent) influences and characteristics. One of them is the natural mechanism of its execution, formed spontaneously, on the basis of numerous everyday human movements.

Whenever it is necessary to throw something quickly, far and precisely, this movement will be mechanically reported as the most natural form of one-handed or two-handed throwing. Therefore, the form of throwing used for testing in this research does not represent any specific element of a special sports game, but a natural form of throwing that can be conditionally marked as the most rational type of throwing light and medium heavy objects (Perić, 2007; 2011; Kuburović, 2015). Secondly, such movements show specific, repetitive torso strength, relative repetitive strength and arms and shoulder girdle strength, specific speed endurance and aerobic endurance, so perhaps, the cause of insufficiently good results should be sought. This conclusion is supported by the research of Marelić, Đurković and Rešetar (2008), who stated that, out of the total research sample, as many as 68% of volleyball players showed a low level of arm and shoulder girdle strength and abdominal muscle strength, which gives coaches clear guidelines for future work.

Explosive power and its modalities have indeed been much researched; however, there is something to which little attention is paid in such and similar research, and it could, with a high probability, be the cause of such test results of the medicine ball throw 2kg (MEDT2KG).
Namely, if we take into account the definition (Zatsiorsky & Kramer, 2009) according to which explosive power represents the ability of an athlete to produce the greatest possible force in the shortest possible time, the ratio of force and speed, and force and time are very important for the ability to express explosive power.

The ratio of force and speed is determined by the maximum isometric stress of a particular muscle. Athletes who do strength sports usually have a higher isometric muscle strain, while beginners and athletes, including volleyball players, who do endurance sports, have a lower power-to-speed ratio. This means that athletes for whom this ratio is higher can develop greater force at the same speed of movement than the athletes for whom this ratio has lower values. (Stefanović, Jakovljević, & Janković, 2010). Considering that the results of the medicine ball throw 2kg (MEDT2KG) showed that there is no significant connection with body dimensions, it can be concluded with caution that such results, i.e., the manifestation of strength, were indirectly influenced by the relationship between force and speed. Marelić, Đurković and Rešetar (2008), Karalić (2010), Karalić, Ljubojević, Gerdijan and Vukić (2016) also speak about this in a direct way.

When it comes to the relationship between force and time, we think about the dependence of the manifestation of force on the time necessary to perform a certain movement activity. Namely, muscles need some time to adjust their force to a certain degree of CNS activation. According to Jarić (1997), large groups of muscles acting in the most important joints of the extremities need approximately 0.20 –0.35 seconds to achieve maximum force intensity. Based on these data, it can be easily noticed that the time for performing the movement in the given examples is less than the time required to generate the maximum force.

Due to such a short time in these movements, the maximum force during muscle strain cannot be reached (Zatsiorsky & Kramer, 2009). Another factor is very important in answering the question about the significance in the medicine ball throw 2kg (MEDT2KG) test. It is about the so-called explosive power deficit (EPD) which shows the percentage of the athlete's power not used in a given attempt. In movements such as the prop throwing phase, the ESD is about 50%. (Zatsiorsky & Kramer, 2009).

When you consider these arguments, the relationship between force, speed and time as well as the ESD value, they can, very easily, be the parameters which make a fundamental difference in terms of two volleyball athletes' strength and, as such, can present useful information in choosing a goal in programming training for the development of explosive forces.

It is generally known that flexibility achieves good muscle and joint mobility, ease of movement and the ability to use maximum body force. As many as 92% of bench forward bend (BFB) results were achieved under the influence of other factors, which unequivocally shows that some volleyball players in the sample achieved a very poor result in performing the bench forward bend (BFB).

Unfortunately, in the professional and scientific volleyball community, flexibility is a motor ability that does not attract much attention of researchers and is often not so important, especially in working with young volleyball players.

From the point of view of experts, reduced flexibility can cause certain disorders and disturb the balance of the locomotor system. In addition, as such, it limits the body in terms of increasing strength and endurance, but also the range of motion (total width of possible joint mobility) in physical activities, but also in everyday life. Precisely because of these facts, but also due to scientific studies (Lee, Etnyre, Poindexter, Sokol, & Toon, 1989; Quinn, 2010; Volker, 2011; Schirm, 2011; Phil, 2012; Manshouri, Rahnama, & Khorzoghi, 2014; Rupesh & Rajesh, 2016) which indicate the importance of general and specific flexibility, the awareness of this motor ability should change among teachers, coaches and sports workers, giving it, if not priority, then certainly, treating it on an equal footing with other motor skills.

CONCLUSION

Exploring the connection and influence of the dimensions pertaining to the overall anthropological status of volleyball players is a continuous procedure which is regulated according to certain principles, but above all, according to the exercise system affecting the body of a young volleyball player.
The cadet age of volleyball players is, in a sense, advantageous because, in that period, it is possible to produce significant transformations both physically and mentally.

The research concludes that the manifestation of jumping explosive power is, more or less, influenced by a number of manifest factors from the space of body dimensions, but also latent ones from the field of anthropometrics, anthropology, kinematics, physiology or psychology.

The obtained results can be widely applied in the practice of primary and secondary school teachers, faculties and volleyball clubs with the aim of better, more comprehensive and quality planning, programming and diagnostics of volleyball training for all age categories.
It can be especially good for directing, controlling and adequately selecting training activities for learning or training, as well as noticing and showing mistakes when performing some of the volleyball techniques.

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PREDIKCIJA KVANTITATIVNIH MOTORIČKIH SPOSOBNOSTI MLADIH ODBOJKAŠA NA OSNOVU BAZIČNIH ANTROPOLOŠKIH OBILJEŽJA

Svrha ove studije bila je utvrditi predikciju kvantitativnih motoričkih sposobnosti na osnovu nekih bazičnih antropoloških obilježja kod mladih odbojkaša. Istraživanje je provedeno na uzorku od 32 odbojkaša starosti od 15 do 17 godina (±6 mjeseci), polaznika Odbojkaškog kampa "Trebinje" 2016. godine. Sudionici su testirani u 5 morfoloških varijabli, i to: tjelesna visina (ATV), tjelesna masa (AMAS), raspon ruku (RAR), maksimalan dohvat jednom rukom iz mjesta (MDOH1RM), maksimalan dohvat sa dvije ruke iz mjesta (MDOH2RM), 4 testa eksplozivne snage, i to: maksimalan dohvat u smeču (MDOHSM), maksimalan dohvat u bloku iz mjesta (MDOHBLM), maksimalan dohvat u bloku iz zaleta (DOHBLZ), bacanje medicinke 2kg (BAMED2KG) i 1 testu fleksibilnosti - pretklon na klupi (PRKL). Utvrđene su značajne veze između varijable maksimalan dohvat u smeču (MDOHSM) (R=0,748), maksimalan dohvat u bloku iz mjesta (MDOHBLM) i (R= 0,866) maksimalan dohvat u bloku iz zaleta (MDOHBLZ), kao i sistema varijabli kvantitativnih motoričkih sposobnosti (R= 0,871). Nije bilo značajnih veza između bacanja medicinke 2kg (BAMED2KG) (R= 0,552) i varijable pretklon na klupi (PRKL), kao i sistema varijabli kvantitativnih motoričkih sposobnosti (R= 0,27). Bacanje medicinke 2 kg u ovom istraživanju ne predstavlja niti jedan specifični element posebne sportske igre, već se pri takvim pokretima, pored eksplozivne snage, ispoljava i specifična, repetitivna snaga trupa, relativna repetitivna snaga i snaga ruku i ramenog pojasa, a koje nisu dominantne u odbojkaškoj igri kao eksplozivna snaga tipa skokova. Kada se sagledaju odnos sile, brzine i vremena te vrijednost ESD-a, oni vrlo lako mogu biti parametri koji prave suštinsku razliku u pogledu ispoljavanja eksplozivne snage.

Ovo je istraživanje potvrdilo da se na osnovu eksplozivne snagu tipa skokova može vršiti predikcija uspjeha u kvantitativnim motoričkim sposobnostima mladih odbojkaša te na taj način usmjeravati trening na razvoj eksplozivne snage. Istraživanje može poslužiti za usmjeravanje, kontrolu i adekvatan izbor trenažnih aktivnosti za učenje ili usavršavanje neke od odbojkaških tehnika.

Ključne riječi: predikcija, eksplozivna snaga, kvantitativne motoričke sposobnosti

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BIKE-SHARING SYSTEMS AND URBAN MOBILITY IN SPAIN

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ABSTRACT

Growing pollution in cities and rising obesity and overweight causes political actions to be directed towards the use of active means of transport. This work consists of a review of the literature published within the Spanish context in relation to public bicycle systems and urban mobility. In order to select studies, a search was carried out with different descriptors in the main Spanish and international databases, namely Scopus (Elsevier), Web of Science (WoS) and Dialnet. Some of the analysed works examine the efficacy of public bicycle systems as an efficient and sustainable alternative in cities; other works study the impact on individual and public health of shared bicycle schemes via increased physical activity engagement. Likewise, infrastructures and facilities for cyclists are also analysed as they favour perceptions amongst the population of greater road safety within their environment. Bicycle-sharing systems can help maintain healthy habits amongst the population. Better infrastructure, technology and appropriate policies can favour the use of these systems.

Keywords: urban transport, public health, public transport, bike-sharing systems, physical activity

INTRODUCTION

Healthy lifestyles have emerged as an important topic in today's society. Given this circumstance, governments and institutions promote the revitalisation of public spaces which encourage engagement in physical activity and the development of human interrelationships (Braçe, 2016; Curto et al., 2016). Thus, an active lifestyle, such as walking or cycling, has become a key factor in reducing the impact of chronic diseases, obesity and/or coronary problems linked to human behaviour such as those produced by a lack of physical exercise. In the same way, when such activities are used as a means of transport, they favour a less congested urban environment and reduce greenhouse gas emissions which cause climate change. All of this has a positive effect on human health (Anaya & Castro, 2012; Curto et al., 2016; Sanmiguel-Rodríguez, 2015, 2019; Seguí et al., 2016). The field of study relating to urban mobility and active transport in cities has begun to emerge as a relevant area of research. Growing interest in environmental care has produced a sociological change in large sectors of society, which now prefer to walk or use non-polluting means of transport such as bicycles (Herranz, 2015; Zozaya, 2016, 2017).
In the same way, the increasing rise of fuel use makes the bicycle an ideal means of transport with regard to sustainability of the urban environment.

Given the enormous consumption of fuel in Spain, where there is a high external dependence on oil, encouraging cleaner cities is crucial (Herranz, 2015).

In a review (Anaya & Castro, 2012) on bike-sharing systems carried out in Spain, a detailed analysis of the different systems existing in 2011 has already been presented. In Spain, 196 systems have been implemented. According to the city profile, 51% of the systems are located in urban centres which consist of less than 50,000 inhabitants. 21% are found in populations of 50,000 to 100,000 inhabitants, 24% in populations between 100,000 and 500,000 and 4% in centres made up of more than 500,000 inhabitants.

However, most of the Spanish cities that have bike-sharing systems are poorly equipped with bicycle infrastructure. According to Castillo-Manzano, López-Valpuesta and Sánchez-Braza (2016), a strategy that has started to achieve good results in the promotion of bicycle use, along with the construction of bicycle lanes and availability of bicycle parking, is the implementation of public bike-sharing systems, which coexist with the private use of bicycles.

The findings from this research (Castillo-Manzano, López-Valpuesta & Sánchez-Braza, 2016) showed that the average duration of trips on private bicycles was higher than those made using public bicycles; however, there is a complementary relationship between the two modes of transport in regard to distance. Following on from this research, the results of another study (Braun et al., 2016; Curto et al., 2016) showed that the modal competition between cycling and public transport, through the presence of more public transport stops, and better cycling infrastructure and stations for bicycles, is associated with greater active displacement within the urban environment.

Bike-sharing systems have recently become a key issue in urban mobility and the related research activity. Due to its relative novelty, most scholars focus on the characteristics of the supply side without taking the demand into account. Data on this subject has not yet been analysed in detail, as most of the systems have only recently been introduced (Munkácsy & Monzón, 2017). Ferrando, Anaya and González (2010) have pointed out that the approach to the implementation of bicycle systems in Spain is currently under development. The obtained data have shown a series of trends that characterise Spanish public bicycle systems.

For example, it is noted that there are many types of systems, and that the evolution of those that are perceived as successful is usually towards automation. It has also been noted that not only in medium and large cities are these systems successfully implemented, but that small cities can also implement systems adapted to their context capable of producing good results. In a survey carried out by Curto et al. (2016) in Barcelona, favourable perceptions of travellers towards public bicycles were reported.

Further, the most important facilitators for the use of bicycle-sharing systems were reported as follows: avoiding bicycle theft and vandalism and maintaining low cost of the system. According to Braçe (2016), public bicycle programmes have begun to receive increasing attention in recent years due to the great interest of urban planners in developing and improving active transport systems in the urban environment. These measures would help reduce dependence on private vehicles and encourage non-motorised journeys, thus maintaining the three pillars of sustainable development - environmental, economic and social (Braçe, 2016; Castillo-Manzano, López-Valpuesta & Sánchez-Braza, 2016; Morales, L., 2011; Norveto, 2010). As a result, bike-sharing systems have experienced relevance and popularity in European countries and around the world (Castillo-Manzano, Castro-Nuño & López-Valpuesta, 2015; Faghih-Imani et al., 2017). Further, bicycle infrastructure has also been shown to be an extremely important element in sustainable mobility strategies in the urban sphere (Ballester & Peiró, 2008; Braun et al., 2016; Luque, 2016; Morales, 2010, 2011; Munkácsy & Monzón, 2017; Norveto, 2010; Seguí et al., 2016; Zozaya, 2016, 2017) and as part of strategies targeting less polluted environments. It fits in with research on the design of urban spaces and how this influences health, improving understanding of the physical and social elements that condition people's lives (Anaya & Castro, 2012; Ballester & Peiró, 2008; Braun et al., 2016; Curto et al., 2016; Herranz, 2015; Munkácsy & Monzón, 2017).

Thus, it was decided to review bicycle systems found in the Spanish context, given that the climatic characteristics of this country favour the practice of physical activity and outdoor cycling. In addition, many planning policies are being developed in Spain within the urban environment as a means to promote less congested traffic environments, whilst simultaneously favouring public health.
At the same time, these active means of transport (walking or cycling) favour a less congested urban environment, reducing emissions of greenhouse gases causing climate change. This also has a positive effect on human health (Anaya & Castro, 2012; Curto et al., 2016). The choice of this environment for the study of urban mobility relating to bicycle use is due to the fact that Spain enjoys situational, climactic and topographic characteristics that favour outdoor sports throughout the year.

The objective of this work is to review the literature published in recent years in relation to Spanish bike-sharing systems. Specifically, the objectives which our article aims to address are as follows:

a) Compile research studies conducted on public bicycle systems and better understand the status of issues relevant to this research field within the Spanish context.

b) Classify the main lines of research developed around the subject.

c) Document the background of investigations relating to the current public bicycle systems for future investigations.

MATERIALS AND METHODS

The development of this article was based on the realisation of a bibliographic review based on searching and analysing information relating to bike-sharing systems within the Spanish context. Different search descriptors were used, among which the following keywords are highlighted: [Shared Bicycles, Public Bicycles, Bicycle Systems, Physical Activity and Bicycles, Active Transport and Public Health and Bicycles]. Works published up until 2019 were included. The inclusion criteria used in the research were as follows:

a) Scientific articles published within the Spanish context up until 31 December 2019.

b) Addressing any type of research related to bicycle systems and urban mobility in the Spanish context incorporating quantitative, non-experimental, descriptive, prospective, longitudinal, cross-sectional and/or case studies.

c) Published in English or Spanish.

After the application of these criteria, a total of 179 documents on the subject, published in English and/or Spanish up until December 2019, were included. The work schedule for the information search consisted of four distinct phases:

1st Phase: Search and selection of the aforementioned descriptors using the UNESCO Thesaurus.

2nd Phase: The search carried out using general search engines and in the following databases: Scopus, Web of Science and Dialnet, using the inclusion criteria described above.

3rd Phase: Analysis of articles' content and classification according to themes.

4th Phase: Categorisation of the articles and preparation of the manuscript. It should be noted that, in general, attempts were made to use the article itself as a reference. However, in some cases, due to the difficulty in accessing the content of some articles, the corresponding abstracts were analysed and evaluated.

The work schedule for the information search consisted of five differentiated stages.

These are described next and can also be observed in the flow diagram which provides a graphical representation of the process in Figure 1.

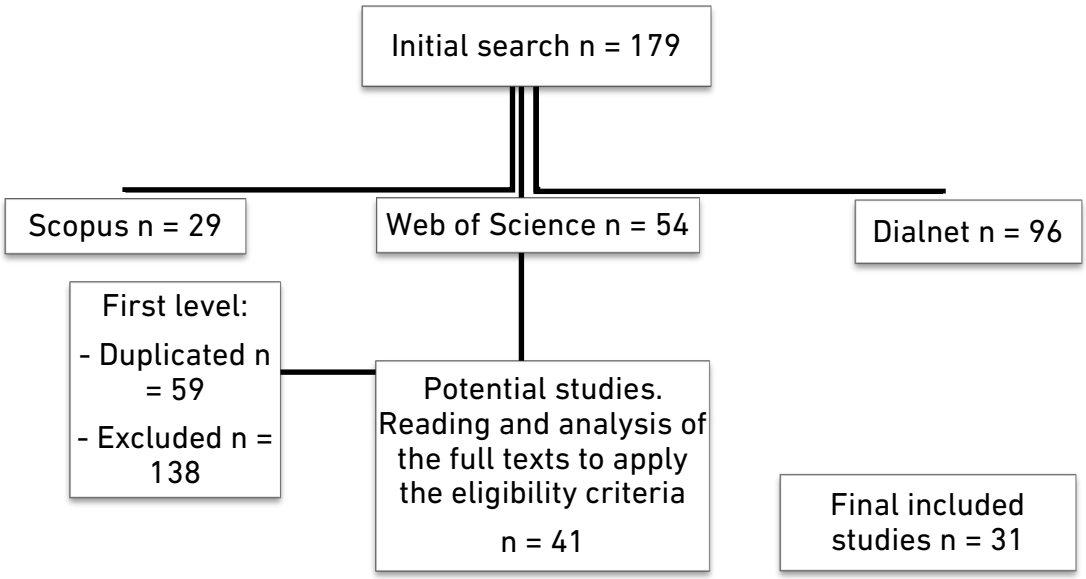

Figure 1 - Flow diagram of the systematic search process

The research was carried out by dividing it into five large blocks of content to try to answer the different issues that we believe to be the most important.

The first section dealt with the current state of Spanish bicycle systems. In the second section, we analysed the importance of cycling infrastructure, accessibility and facilities within bicycle-sharing systems in the urban environment as a means of favouring active policies within the Spanish population. In the third, studies addressing the importance of road safety and new technologies within the Spanish system of public bicycles were addressed, as well as the social impact it has within its population.

The fourth point related to the benefits of bicycle-sharing systems as a means of promoting healthy habits within urban environments, as well as the educational vision that different professionals and students have about cycling as an active means of transport.

Finally, in the fifth section, we tried to explore whether correct political planning within the urban environment can favour healthy practices and the use of public bicycle schemes, with reference being made to the sustainable mobility and ecology offered by these systems.

RESULTS

Once the flow chart pertaining to the systematic review of bike-sharing systems and urban mobility in Spain was made, the result was 31 publications. All of them were included in the process of categorisation by subject, and we finally found five categories of analysis pertaining to the scientific literature. The results of the carried out systematic review are detailed below, specifying the publications that belong to each of the five analysed categories (Table 1).

Table 1: Synthesis of the studies found on bike-sharing systems and urban mobility in the Spanish context

Categories	Number of articles	Authors and year
Research on urban mobility and public bicycle systems	7	Álvarez-Valdés et al., 2016; Brey, Castillo-Manzano and Castro-Nuño, 2017; Castillo-Manzano and Sánchez-Braza, 2013; Munkácsy and Monzón, 2017; Rojas-Rueda et al., 2011; Sanmiguel-Rodríguez and Arufe, 2019; Seguí et al. 2016
Accessibility, public spaces and infrastructures of bicycle systems and public facilities in the urban environment	6	Braçe, 2016; Manuel, González and Donadei, 2016; Munkácsy and Monzón, 2017; Orzanco et al., 2018; Zozaya, 2016, 2017
Social factors, installation of bicycle systems, new technologies and road safety	7	López and Monzón, 2014; I. Morales, 2011; Munkácsy and Monzón, 2017; Orzanco et al., 2018; Osorio-Arjona and García-Palomares, 2017; Reboreda et al., 2016; Tironi, 2015
Planning policies in the urban environment and studies of sustainable mobility, environment and ecology	6	Braçe, 2016; Ballester and Peiró, 2008; Herranz, 2015; Munkácsy and Monzón, 2017; Rojas, 2013; Seguí et al., 2016
Healthy habits, benefits of the practice of physical activity and educational vision	11	Chillón et al., 2017; Luque, 2016; Mallada, 2012; Mira and Tortosa, 2009; Moreno and Bernal, 2016; Rodríguez-López et al., 2013; Ruíz-Ariza et al., 2017; Sanmiguel-Rodríguez, 2015, 2019; Villa-González, Ruíz and Chillón, 2016; Villescas et al., 2016

DISCUSSION

A synthesis of the main lines pertaining to the reviewed research is presented below. After reading and analysing each of them, different degrees of development and evolution are indicated.

a) Research on urban mobility and public bicycle systems

In relation to this first theme, a number of articles which analysed various aspects relating to bicycle systems in Spain are cited. Rojas-Rueda et al. (2011) evidence a large degree of success in terms of the number of subscribers and the frequency of travel on shared bikes in Barcelona. Castillo-Manzano and Sánchez-Braza (2013) analysed the Sevici bicycle-sharing system in the city of Seville. Surveys analysing the weather were administrated to students, professors and administrative staff. They showed that the low levels of rainfall in Seville make it a favourable place for bicycle use as a sustainable means of transport, although two factors could alter this aspect. The findings of Brey, Castillo-Manzano and Castro-Nuño (2017) show that users of public bicycles in Seville are predominantly young men with a high level of education who use

public bicycles to a great extent due to its greater inter-modality. On the other hand, women used private bicycles as the means of regular transport and preferred it for their daily needs. Munkácsy and Monzón (2017) carried out a survey on BiciMAD in Madrid, analysing the system's uses (leisure, sport, tourism, work or school), topography, infrastructure and the challenges posed to the Madrid government when attempting to promote cycling. In another investigation (Seguí et al., 2016) carried out in Palma de Mallorca, the sustainability of the city's bicycle mobility over recent years was examined, together with increases in bike lanes and specific parking. According to Álvarez-Valdés et al. (2016), the quality of service is drastically affected by imbalances in the distribution of bicycles between stations. BiciPalma has made it possible to improve the image of the bicycle in the city and to expand its use to other user groups who previously did not opt for this means of transport, for instance, to work. Sanmiguel-Rodríguez and Arufe-Giráldez (2019) examined the outcomes of the Vaibike system in Vilagarcía of Arousa in relation to age, gender, route taken, hours, weeks and climatic variables. Furthermore, its effect on meeting WHO physical activity recommendations was identified.

b) Accessibility, public spaces and infrastructures of bicycle systems and public facilities in the urban environment

According to the framework developed for this theme, many programmes exist for the implementation or promotion of increased citizen participation related to cycling in cities. However, each and every one of these initiatives have the same essential purpose: to create a network of efficient and useful cycling paths which will enable bicycles to be used safely on main roads, incorporating the bicycle into the model of urban transport inter-modality. There has been a progressive introduction of bike lanes and many people have begun to take advantage of them to move around the city. Despite this, all structural modifications require a period of adaptation and, in reality, the network of cycling lanes is full of obstacles for the cyclist. Along these lines, Munkácsy and Monzón (2017) also showed that parking and inter-modality were the most relevant factors for BiciMAD users. Indeed, the designation of shared lanes on busy roads in the centre of the city of Madrid was highly criticised by participants. In order to make the service more attractive for future users and attract as many people as possible, the development of appropriate infrastructure must be encouraged by the local government. However, many people are more concerned about the flexible, economic and ecological nature of cycling.
In another investigation (Zozaya 2016), it has been shown that cycling infrastructure is an element of growing importance in the development of sustainable mobility strategies in urban areas. An increasing number of cities are encouraging the use of bicycles through various initiatives, including municipal bicycle rental systems. The hybrid nature of the bicycle as a means of transport, halfway between the pedestrian and the motorised vehicle, induces a rethink of the current configuration of urban roads and public spaces.

Another study by Zozaya (2017) showed that bicycle systems can become a key element in the sustainable mobility strategy of cities. In addition, the visibility of public bicycles and stations serves to publicise the commitment to sustainable mobility in the municipality, generating interest in the public regarding this means of transport, with the system even becoming incorporated into the "brand" and the attractiveness of the municipality. However, the decision to incorporate a public bicycle system in the city must take into account the difficulties involved in the implementation project, such as achieving the acceptance of citizens and demonstrated economic sustainability, which will depend on maintenance and replacement costs, obtaining significant revenues and commitment to the system of future administrations, amongst others. Although a public bike system will probably not become linked at a state and international level in the same way that the modern railway network has been, its scope for potential action within urban groups often exceeds the municipal perimeter in which many present initiatives operate. Thus, the creation of a standard is a necessary step if we want to guarantee the maximum utility of public bicycle systems in the metropolitan environment. Standardisation would allow greater investment in bicycle systems based on initiatives at a local level with the certainty of being able to integrate them later on within a metropolitan network. It would also force different types of stations and vehicles to work together to find solutions, facilitating competition and innovation.

Orzanco et al. (2018) show that the development of infrastructures which facilitate the mobility of pedestrians is associated with greater bicycle use for commuting. Following these conclusions, the results of another investigation (Braçe, 2016) have shown that low-density urban areas, a lack of local services, scarcity of public transport and low-quality public spaces reduce the likelihood of displacement through physical activity (walking and cycling) and increase dependence on private vehicles. On the other hand, Manuel, González and Donadei (2016) pointed out that there is a direct relationship between the use of public spaces and the mobility model in the Alcosa neighbourhood in Seville. In order to reactivate public spaces at the level of urban neighbourhoods, it is necessary to adapt the model of metropolitan mobility so that it favours alliances between public transport and active mobility. This will encourage the reduction of public spaces for motor vehicles and improve pedestrian and bicycle accessibility, thereby activating the use of public spaces.

c) Social factors, installation of bicycle systems, new technologies and road safety

Regarding this theme, Osorio-Arjona and García-Palomares (2017) highlight that increasing demand for mobility in cities has led to an unsustainable dynamic, both socially and environmentally. To promote actions towards sustainable mobility, it is necessary to use dynamic information sources with a high spatial and temporal detail that allow for efficient diagnoses of the mobility situation in our cities. Information and Communication Technologies and Big Data appear as new interactive sources that respond to these needs. This article reviews the state of the art in the use of these new data sources for the analysis of urban mobility, comparing its usefulness with respect to traditional sources, classifying them, presenting the research topics they offer, and identifying challenges for the future. Other authors (López and Monzón 2014) point out the need to introduce greater inter-modality within public transport in the urban environment. The article forms part of the search for transport solutions, within what has been termed intelligent mobility, and incorporates some type of communication and information technology. Bicycles as a means of transport were analysed and, in particular, the issue how ICTs have enabled the development of public rental systems, which, in effect, have been equipped with some type of technological innovation. According to Munkácsy and Monzón (2017), smart technologies make it easy to use shared bike systems, since they allow the bicycles location and tracking, intelligent access and the development of online applications. They enable the integration of bicycle-sharing systems within the urban transport system, both from the user's (route planning, rates, etc.) and the operator's point of view. Other researchers (Reboreda et al., 2016) have created a system aimed at the prevention of traffic accidents amongst cyclists and motorcyclists. According to their study, the number of injuries sustained on the road in Spain has been maintained over time. To address this, they have tried to introduce a technological system that helps improve road safety for cyclists.

On the other hand, Orzanco et al. (2018) have stated that perceptions of intense traffic are more prevalent within groups that spend less time walking to move from one place to another. However, the development of infrastructures that facilitate the mobility of pedestrians is associated with greater bicycle use for travel. Another research study (Tironi, 2015) demonstrates the essential work that takes place behind the scenes by those who maintain and repair urban resources, such as bike-sharing systems.

This research makes us aware of those almost artisanal practices that, without much marketing, allow us to enjoy smart cities or sustainable transport systems. On the other hand, I. Morales (2011) highlights the considerable social acceptance of the population to the use of bicycles as a means of ecological transport, showing the benefits of using this means of transport, both at an energy and environmental level.

d) Planning policies in the urban environment and studies of sustainable mobility, environment and ecology

The purpose of this theme is to analyse studies on policy and spaces identifying predictive factors in the urban environment. Ballester and Peiró (2008) propose the development and maintenance of a public transport system that is faster, safer, cheaper and less polluting than private transport, which should be an important goal in the current public policies. According to Rojas (2013), active transport policies can produce great benefits for the health of the population. These benefits are mainly associated with the increase in levels of physical activity. Munkácsy and Monzón (2017) point out that the European Union's transport policies, campaigns and awareness-raising events are factors that influence the use of a non-polluting means of transport by members of society.

According to these researchers, the BiciMAD was not popular when it was inaugurated in July 2014 because there was no relevant public participation in the planning of the project and it was not directly advertised before being presented, with only a few press releases being published. Although BiciMAD is considered a mobility management tool that is designed to be attractive to urban travellers, the local government or service provider did not directly approach the issue of public acceptance of the bicycle-sharing system when developing the service. According to Seguí et al. (2016), sustainable urban transport planning and the political decisions for its implementation materialise through a set of measures and interventions (dissuasive parking, traffic calming, car sharing, improvement of pedestrian areas and public transport or parking management) that can change and improve the habitability of cities.

Following these contributions, Herranz (2015) states that public authorities often proceed in a contradictory manner when promoting active means of displacement. Whilst communication is positive, the actions put into practice fail to offer an adequate response to social demands. Braçe (2016) states that there is also a relationship between urban morphology, physical activity and the use of transport types that involve some physical activity, such as walking and cycling. These results should be useful for territorial and urban planners and managers when taking measures aimed at avoiding the increased dispersal of urban areas and the promotion of centrality nuclei.

These measures would help reduce dependence on private vehicles and encourage non-motorised journeys, thus maintaining the three pillars of sustainable development (environmental, economic and social).

In recent years, growing interest in environmental care has produced a sociological change in large sectors of society, which prefer to walk or use non-polluting means of transport such as bicycles (Herranz, 2015). According to Rojas (2013), active transport (walking, cycling or public transport) may have the capacity to reduce greenhouse gas emissions and climate change, and may bring with them benefits for the environment and health. Influencing these ideas, the study of Ballester and Peiró (2008) shows the negative impact on health that the current type of transport has in terms of traffic injuries, climate change, air pollution, noise, and interfering with daily activities and physical activity, for instance, by making walking or cycling more difficult.

These actions will help achieve a change in societal transport habits, a healthier population and a more sustainable environment. However, to promote active displacement, it will be necessary to reduce the use of private cars and develop quiet traffic spaces which connect cities and nearby towns.

e) Healthy habits, benefits of the practice of physical activity and educational vision

This area of investigation deals with aspects which include the benefits of bike systems and engagement in physical activity. Previous research (Sanmiguel-Rodríguez 2015, 2019) has shown that bicycle systems are an active and sustainable means of transport with could help individuals to fulfil the 2010 World Health Organisation (WHO) recommendations for physical activity. According to Rodríguez-López et al. (2013), active transport between home and school can improve the health of school children and represent an important percentage of their daily physical activity. Moreover, this practice has been associated with a better cardio-metabolic profile and an improvement in the general physical condition.

In corroboration, Chillón et al. (2017) indicate that the promotion of daily physical activity in young people, such as active displacement to school (walking or cycling), can have important health benefits.

The results of this study showed that active displacement to school was inversely associated with stress.

Likewise, in another study (Ruíz-Ariza et al. 2017), it is shown that active displacement is defined as the action of going to the educational centre by means of transports that involve metabolic expenditure, such as walking or using a bike. The average daily time of active displacement in adolescents is 18 minutes and it could increase total daily physical activity by 13%. Active displacement has been associated with better health and cognitive performance in Spanish girls in secondary education. Research by Villa-González, Ruíz and Chillón (2016) came to the same conclusions, in that it was observed that regular engagement in physical activity (walking or cycling) had numerous health benefits in young students, and that long-term engagement generated mental, academic, cognitive, psychological and social benefits for the young person.

Moreno and Bernal (2016) proposed that education should be focused on active transport and on generating critical awareness based on the characteristics of the city pertaining to space or time.

They considered a community-focused pedagogical procedure that attends to interdisciplinary relationships and the collaborative generation of knowledge between all the parts, to be indispensable. Luque (2016) reports that Spain is falling behind other European countries in the use of this means of sustainable transport and states that schools have an obligation to encourage the use of bicycles, not only in Physical Education classes but also as an excellent means to promote transportation to school.

Teachers in general, and Physical Education teachers in particular, have one more reason to invite students and the rest of the educational community to use bicycles to promote sustainable mobility. Other authors (Mira & Tortosa, 2009) highlight that professionals in Physical Education and Sports have an ethical and moral obligation to promote the use of bicycles as a means of physical activity, transportation, education and health. Children traveling to school, teenagers traveling to college and adults traveling to work will find the means to meet the recommended daily physical activity levels and achieve a healthy and sustainable lifestyle in accordance with the basic competences of the Organic Law of Education (LOE) and the principles of the WHO.

Mallada (2012) found significant associations between the contents of Physical Education at a secondary school, especially in the modules undertaken in nature, and the acquisition of basic competences. At the same time, bicycle use is promoted as a means of ecological transport and as a way to develop the physical condition through play. Villescas et al. (2016) declare that children adapt easily to the reality presented to them and that education plays a decisive role in generating a transport model, via the new streams of sustainable mobility and in accordance with a balanced lifestyle.

CONCLUSIONS

From the review of previous research, the following conclusions can be drawn:

1. The reviewed studies highlight a clear predominance of active transport sustainability, healthy mobility habits and the benefits of engaging in physical activity.

2. Many studies indicate the great potential of bicycle systems, with studies on bicycle sharing systems and urban mobility generally gaining increased attention from international researchers due to its innovative nature. In addition, given the favourable climatic conditions, Spain is one of the countries with the most potential to encourage engagement in outdoor physical activity. This includes the use of bicycles or bicycle-sharing systems as an active means of transport throughout the entire year.

3. Active transportation to school is presented as a healthy habit and promotes improvements in students at an academic, cognitive, social and psychological level. However, there are studies which show that a large amount of young people do not practice physical activity on a regular basis and do not actively travel to their school or place of study.

4. The proper use of new technologies and advice from experts on the subject can help public bicycle systems to undergo major developments and integrate successfully within the urban environment.

5. Regarding spaces and policies in the urban environment, several studies show a clear positive correlation between the creation of infrastructures designed to favour the sustainability of the environment and perceived safety, with higher levels of physical activity. In addition, given the great benefits to public health, policies should focus on creating active means of transport (such as bicycle-sharing systems) in order to reduce the rates of obesity and engagement in sedentary behaviour amongst the Spanish population.

6. In general, we have detected that there are few publications on urban mobility and bicycle-sharing systems in the Spanish context. This may be due to the fact that public bicycle systems have begun to emerge during recent years.
The present study intends to create more knowledge about bicycle systems and their application within the urban environment in order to favour less congested traffic and pollution environments.

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SISTEMI JAVNIH BICIKALA I GRADSKA MOBILNOST U ŠPANIJI: SISTEMSKI PREGLED

Povećavanje zagađenja u gradovima te sve veća pretilost i gojaznost su razlog da se političke aktivnosti usmjere na korištenje aktivnih prevoznih sredstava. Ovaj rad se sastoji od pregleda literature objavljene unutar španskog konteksta u odnosu na sisteme javnih bicikala i gradsku mobilnost. Kako bi se odabrale studije, pretraženi su različiti deskriptori u glavnim španskim i međunarodnim bazama podataka, i to Scopus (Elsevier), Web of Science (WoS) i Dialnet. Neki od analiziranih radova ispituju učinkovitost sistema javnih bicikala kao efikasnu i održivu alternativu u gradovima; drugi radovi proučavaju uticaj sistema javnih bicikala na javno i zdravlje pojedinca putem povećanog bavljenja fizičkim aktivnostima. Također, infrastrukture i sadržaji za bicikliste su analizirani s obzirom da daju prednost percepciji stanovništva o većoj sigurnosti na cesti unutar njihove okoline. Sistemi javnih bicikala mogu pomoći u održavanju zdravih navika stanovništva. Bolja infrastruktura, tehnologija i prikladne politike mogu dati prednost korištenju ovih sistema.

Ključne riječi: gradski prevoz, javno zdravlje, javni prevoz, sistemi javnih bicikala, fizička aktivnost

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SPORTS AND RECREATIONAL ACTIVITIES AS THE LEISURE TIME CONTENT OF MIDDLE-AGED PERSONS IN BOSNIA AND HERZEGOVINA

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ABSTRACT

In order to determine certain aspects related to the individual perception of sports and recreational activities as the free time content of middle-aged persons in Bosnia and Herzegovina, an empirical transversal study was carried out. On a stratified sample of 1940 respondents (M = 1107; W = 833), which encompassed both entities (Federation of BiH and Republika Srpska) and larger urban centres, a questionnaire was specially structured for this research. The questions were formulated in such a way that they left the possibility of choosing between the offered answers (closed-ended), and the obtained data enabled the construct of indicators in the form of nominal scales. The variables surveyed by the respondents in the research (relevant for this paper) were: gender, age, assessment of the possibilities for engaging in sports and recreational activities, self-assessment of the character of participation in sports and recreational activities, estimation of the aerobic sports and recreational activities frequency and free time characteristics in relation to the possibility of engaging in sports and recreational activities. During the statistical processing of empirical data, descriptive procedures (frequency distribution) and comparative statistics were used (dominant contingency analysis of the X2 test, since the variables arranged as nominal scales were among the empirical constructs). The results showed that most respondents do not regularly use sports and recreational content, and that they are not sufficiently represented within their leisure time. Additionally, the respondents do not recognise the importance of sports and recreational aerobic exercise content as one of the most effective activities for improving health and maintaining the quality of life, and the most preferred recreational items are ball games (dominant in men) and hiking and Pilates (in the female part of the population). The majority of respondents think that, in their living environment (place of residence), there are possibilities for engaging in sports and recreational activities. Regarding the self-assessment of the available leisure time which could be used to implement the sports-recreational activities, there is a dominant view on the existence of sufficient leisure time budget in the sample. So, the reasons for not engaging in sports and recreational activities must be sought in other socio-psychological areas of this part of the population.

Keywords: leisure time, sports and recreational activities, middle age

INTRODUCTION

The contextual nature of the notion and essence of free time is covered by various interpretations. When taking into account the approach to the time budget (Ješić, 2000), leisure time is then considered as the time which remains within the twenty-four-hour period when the following are deducted: working hours, the time spent on psychophysiological needs, housekeeping and other duties. During the time that remains, it is possible to engage in some of the sports and recreation contents. Therefore, one can accept that leisure time is characterised by the tendency to freely choose an activity in relation to the needs, interests and possibilities of an individual. In other words, it implies creating and ensuring effective opportunities for achieving the desired aim (Vidulin-Orbanić, 2008: 19).

There is no doubt that the issue of defining free time is a very complex process. If it is accepted that it implies a time which is exempted from any obligation and coercion, then the key determinants of this term are in the outward-time construct which remains at an individual's disposal upon being released from all obligations, and which he can use for the goals of the action he has chosen and determined which, in the first place, serve to fulfil its authentic, essential forces, possibilities and needs (Koković, 2006: 12). In this regard, it is possible to speak about the conditional context of the leisure time structure, which is in correspondence with the value aspects of sports and recreation, and relates to the following: (1) leisure time as a time which is completely free from direct work obligations (represents the end and completion of work) (2) belongs to a person who, in certain circumstances, is completely free to dispose of this time as they see fit, (3) is free from compulsory satisfaction of human needs, which are related exclusively to the reproduction of workforce (preservation of life and working ability), (4) is left full freedom to change the order of meeting their needs and, if necessary, even postpone the satisfaction of individuals, (5) it contains the possibility of individualisation and has a personal character which, in a sociological perspective, leads to the destination of defending the integrity of human personality, (6) is connected with certain hedonistic values (joy, satisfaction, search for personal happiness, etc.), (7) represents a person's attitude or motivation (for satisfaction or dissatisfaction) and (8) can represent a symbol of social position, professional success, layered and classical differentiation, and the like. (Ibid: 13).

Leisure time is a complex phenomenon determined by three key dimensions: (1) time, (2) activity (involvement), and (3) state of mind. As time and activity, its specificity is reflected and expressed through the freedom of individual choice in relation to the availability of time and activities, while the state of mind indicates a subjective feeling of involvement in a certain activity during a certain period of time (Nikolić-Maksić, 2015: 58).

In such a theoretical context (Gunter & Gunter, 1980), the specifics of free adult time dominantly belong to the dimensions of time (selection) and activity (involvement), although the component of the individual's state of mind must not be established (as the starting point for the selection of activities and inclusion in the same). According to Kelly (2003), modern understanding of the specific leisure time of adults/middle-aged people determines experience as a significant determinant of their life. Free time is no longer a part of the time that can be filled only by activities which we exclusively choose based on internal motivation, but also the space in which it becomes possible to permeate active performance and creative construction (Nikolić-Maksić, 2015). Different aspects of considering adult leisure time, and therefore that of middle age, must be viewed from different angles. One of the reasons is that this part of the population understands, experiences and uses leisure time. Life experience, social positions and other circumstances can be a significant factor in experiencing and using leisure time.

Some andragogical studies pointed to the diversification of leisure time context in specific conditions, stating that the period of the adult life span is characterised by the specific features of leisure time (Kačavenda-Radić, 2006). Adults have different leisure time; they experience and use it differently. Thus, for example, the use of the free time for employed persons is different from the unemployed and, among the employees, there is a difference in the time available for those who work in the state sector in relation to individuals working in the private sector; it is different for those who legally work in relation to those who work by way of "moonlighting"; it differs in the case of employees according to the type of job, position occupied during work (sitting, standing, on the move, etc.), work norms, work complexity, dominance of intellectual or physical activities, and the like (Jorgić, 2015). Also, full differentiation can be a significant determinant of how to use leisure time.

Purposeful conduction of leisure time is especially important for middle-aged people because of the ability to manifest and develop their physical capacities. If people in this age do not "open the space" and find ways to practice sports and recreational activities, they create possible prerequisites for the negative impacts of modern life and work (inadequate leisure time). Today it is quite clear that most middle-aged people are less and less organised in their leisure time (in terms of applying the appropriate content of sports and recreation) and that they prefer to consume the contents of a highly professional "entertainment machine". Thus, the space for physical inactivity and adoption of sedentary lifestyle (with all its consequences) is realistically opened up.

The results of recent research indicate, for example, that most people between the ages of 40 and 65 do not employ the recommended daily activity level of one hour, and that some of the regular sports and recreational activities involve only about 15% of people in this population (Sjostrom et al., 2006).

Physical activities, especially sports and recreational contents, represent an important factor for the quality of life pertaining to middle-aged people, which is especially evident in the context of: (1) health promotion, (2) the means of recovery, rehabilitation and recreation, and (3) working abilities (Anastasovski, 2003). Physical exercise or sports and recreational activities, in this sense, represent a desirable model of human functioning (WHO, 2006). The dominant positive effects of physical activity, especially sports and recreational content, as a form of physical exercise, relate to balancing the psychophysical capacities of humans. They also contribute to the improvement of the socialisation process and, in connection with the natural environment, help improve the quality of the general health situation. Understanding the content of physical activities is determined by socio-economic conditions, acquired habits and the needs of the population, as well as educational, instructional, cultural, religious and other factors. In this regard, sports and recreational contents represent a cultural active rest method, thus knowingly achieving a beneficial effect on health. As the free time content, they represent an important incentive that reflects on the autonomy and existence of humans as the basis of individual identity related to the lifestyle (Perasović & Bartoluci, 2008).

In this segment of social existence, Bosnia and Herzegovina (BiH) is trying to keep up with the developed countries. However, relevant data show that the health context pertaining to the quality of life of the middle-aged population in this area, related to physical activity (especially for sports and recreational activities), is very low and is not correlated with a closer geographical environment. The lack of physical activity is marked as one of the most prominent health risk factors for the adult population in this area (Pehar et al., 2016). Although some (ad hoc) studies (Farkić, Romanov, & Nešić, 2014; Nešić & Rajić, 2015; Nešić, Nešić, & Perić, 2016; Srdić, Nešić, & Radoš, 2016; Zrnić, Srdić, & Nešić, 2016) and a number of strategic documents related to health policy (a pen of authors, 2008; a pen of authors, 2012) pointed out (albeit a lot of anxiety) the importance of physical activity as a way to improve health (quality of life), so far, it was not possible to distinguish relevant studies (especially in the context related to the coverage of a part of the population considered to be comprised of middle-aged people). In order to identify some issues which may be relevant for this study, they should relate to the following facts: (1) there are no relevant data on the level of physical activity pertaining to the middle-aged population in Bosnia and Herzegovina, (2) scientifically verified information treating the level of sport and recreational activities as well as subjective assessment of the quality of leisure time usage by middle-aged people are not evident in Bosnia and Herzegovina; (3) there is a clear lack of organised and/or imagined participants of adequately individually accessible sports and recreational programmes, (4) research that explicitly identifies the wishes and needs of the middle-aged population for sports and recreational programmes and facilities.

METHODS

Within a wider research study, one segment of the empirical part of the research was aimed at identifying the existence of some peculiarities pertaining to sports and recreational activities as leisure time for middle-aged people. The selected survey method was applied on a stratified sample made up of middle-aged persons from the area of Bosnia and Herzegovina, aged between 40 and 65 years (according to WHO, 1982, Erikson, 1993), with a total of 1940 respondents.

As a research instrument, a questionnaire was used, specifically designed for this research. A dedicated research questionnaire was used as the basic research instrument. The questions were formulated in such a way that they left the possibility of choosing between the offered answers (closed-ended), and the obtained data enabled the construct of indicators in the form of nominal scales.

The variables surveyed by the respondents within the research field (relevant for this paper) were: gender, age, assessment of the possibilities for engaging in sports and recreational activities, self-assessment of the character of participation in sports and recreational activities, estimation of the aerobic sports and recreational activities frequency and free time characteristics in relation to the possibility of engaging in sports and recreational activities.

The selection of statistical procedures for processing empirical data was conditioned by their nature. Descriptive and comparative statistics have been applied. Frequency distribution (absolute and relative) was calculated from the space of descriptive statistics, while in the framework of comparative statistics, a discriminatory procedure - X2- test analysis of contingency (since the variables arranged as nominal scales were among the empirical constructs) was used. Using cross-tabulation, the obtained data are arranged and presented in the form of a contiguity table of dimensions, with the statistical conclusion at a significance level of 0.05 (Sig. = 0.05).

RESULTS

The character of the research required the need to identify certain characteristics of the sample, which were significant as the criterion of its sub-assimilation: (1) in relation to gender and (2) in relation to age. Out of the total number of respondents (N = 1940), there were 1107 men (57.1%) and 833 women (42.9%). According to age, three age groups were created with the subsamples (using the Visual Binnning statistical procedure): a) from 40 to 49 years (N = 956), b) from 50 to 59 years (N = 450) and c) 60-65 years (N = 534). For this distribution in the sample, it can be concluded that it was in relative accordance with the age-based population trends in Bosnia and Herzegovina (Federal Institute of Statistics, 2017; Republika Srpska Institute of Statistics, 2017), that is, it corresponds to a part of the population which includes middle-aged people. Moreover, during sample stratification, it was taken into consideration that the respondents from both Entity Strata (Republika Srpska and Federation of Bosnia and Herzegovina) pertaining to larger urban areas were included. Distribution of the respondents' responses to the indicator that sought to determine their perception of dealing with leisure and recreational activities indicates that most (58.6%) recognise themselves as physically inactive (in the context of regular physical exercise or engagement in sport and recreational activities). Persons of male gender (35.8%) dominate in such a disadvantageous position. For the respondents who consider themselves physically active, the distribution of responses shows that there is no significant difference in the context of gender differentiation (Table 1). When it comes to age, the tendency is that the most physically inactive respondents are in age range of 40-49 years (31.4%), and with the increase in chronological age, this percentage decreases (and stabilises) at the level of about 13% (Table 2). This result significantly draws attention to an important issue since the stated period of life is considered to be the most productive in people, and the consequences of physical inactivity can significantly affect the quality of life. The observed differences were also recorded at a statistically significant level (Sig. = 000).

Table 1: Engaging in Sport and Recreational Activities According to Gender

Engaging in sports and recreational activities	Gender		Σ
	Men	Women	
Yes	413 21.3%	390 20.1%	803 41.4%
No	694 35.8%	443 22.8%	1137 58.6%
Σ	1107 57.1%	833 42.9%	1940 100.0%

Chi = 17.723 Sig. = .000

Table 2: Engaging in Sport and Recreational Activities According to Age

Engaging in sports and recreational activities	Age			Σ
	40-49	50-59	60-65	
Yes	346 *17.8%*	181 *9.3%*	276 *14.2%*	803 *41.4%*
No	610 *31.4%*	269 *13.9%*	258 *13.3%*	1137 *58.6%*
Σ	956 *49.3%*	450 *23.2%*	534 *27.5%*	1940 *100.0%*

Chi = 34.231 Sig. = .000

Although the causes of this result are found in a complex multifactor socio-economic space, one of the essential factors must, of course, be sought within the organisation of leisure time for middle-aged people. As this is still an active part of the population, who put personal and family existence at the top of life's priorities, it is mostly safe to spend time at the workplace. Also, they spend time on the activities which function as additional work engagement, seeking them to provide material existence.

They spend most of their time in the form of passive rest and thus, physical exercise is not generally an integral part of their life habits. Some studies in the world have shown that adults are, only later in life (after the age of 65), more intensely devoted to greater care about health and quality of life, including the appropriate forms of physical exercise (Kahan, Fogelman, & Bloch, 2004; Kim, Choi, & Davis, 2010). The results of our research have shown the correspondence with the known attitudes that leisure time organisation, or the representation of regular physical exercise, can be attributed to adopted habits and directly linked with the preferred lifestyle (Piero, Mannetti, & Livi, 2003; Sharkey & Gaskill, 2008, 2014; Farkić, Romanov, & Nešić, 2014).

Distribution of the respondents' responses to the available free time budget that could be directed at the use of sports and recreational content unambiguously indicate that almost half of them think that they have enough free time (beyond regular work). In this context, the respondents, in the absolute majority (89.9%), estimate that there are adequate conditions for such activities and contents (sports and recreational activities) at their place of residence. Only 3.4% of the respondents stated that they did not want to engage in sports and recreational activities during leisure (Table 3).

Table 3: Opinion on the possibilities for engaging in sports and recreational activities during leisure

Sports and recreational activities during leisure	Possibilities for engaging in sports and recreational activities in the place of residence		Σ
	There are possibilities	There aren't any possibilities	
He has leisure	962 *49.6%*	94 *4.8%*	1056 *54.4%*
He has no leisure	782 *40.3%*	36 *1.9%*	818 *42.2%*
He does not want to engage in sports and recreational activities	0 *0.0%*	66 *3.4%*	66 *3.4%*
Σ	1744 *89.9%*	196 *10.1%*	1940 *100.0%*

Chi = 618.280 Sig. = .000

Recent research has found that positive life habits, especially those that are focused on health (proper nutrition, regular physical activity, avoidance of risk behaviours, etc.), represent important determinants for assessing the quality of life of the population. In this context, special physical activities, primarily dosed exercise, focused on the development of aerobic abilities (Nešić, Nešić, & Perić, 2016) occupy a special place. Certain studies on healthy lifestyle issues are also confirmed (Godin & Kok, 1996; Boot & Chakravaty, 2002; Sharkey & Gaskill, 2008), placing regular physical exercise (sports and recreation) to the forefront with dominant recommendations about the positive impact of aerobic activity (hiking, swimming, running, cycling, etc.).

Leisure created in such a way determines the healthy (active) lifestyle as a multi-dimensional system of individual behaviour. Although not conditioned due to physical activity, those that are focused on the development of aerobic capacities (and abilities), however, represent its dominant determinant (Nešić et al., 2014). The results of our research have shown that participation in sport and recreational activities which include aerobic exercise is not sufficiently present in the respondents. Almost two-thirds of them declared that such content was very rare (67.6%), while only 20.5% of the respondents considered this type of sports and recreational content as having been adopted as a regular habit of exercising during leisure time. In this segment of the research, men also dominate as inactive (41.3%), compared to women (26.3%) (Table 4), while in the area of belonging to a certain age group, it is also noted that the designation "aerobically inactive" dominantly belongs to the group aged from 49 to 50 years old (32.8%) (Table 5). The observed differences are also recorded in this research segment at a statistically significant level (Sig. = 000).

Table 4: Respondents' engagement in aerobic recreational content according to gender

Engagement in aerobic recreational content	Gender		Σ
	Men	Women	
very often	234 *12.1%*	163 *8.4%*	397 *20.5%*
occasionally	72 *3.7%*	159 *8.2%*	231 *11.9%*
rarely	801 *41.3%*	511 *26.3%*	1312 *67.6%*
Σ	1107 *57.1%*	833 *42.9%*	1940 *100.0%*

Chi = 72.308 Sig. = .000

Table 5: Respondents' engagement in aerobic recreational content according to age

Engagement in aerobic recreational content	Age			Σ
	40-49	50-59	60-65	
very often	165 *8.5%*	96 *4.9%*	136 *7.0%*	397 *20.5%*
occasionally	155 *8.0%*	28 *1.4%*	48 *2.5%*	231 *11.9%*
rarely	636 *32.8%*	326 *16.8%*	350 *18.0%*	1312 *67.6%*
Σ	956 *49.3%*	450 *23.2%*	534 *27.5%*	1940 *100.0%*

Chi = 44.478 Sig. = .000

Compared to the previous indicators, respondents were also asked to declare what sports and recreational contents they would prefer to use when choosing

regular sports and recreational activities (regular exercise) during free time. From the obtained answers, it can be concluded that there is a (conditional) hierarchical manifestation of preferences for certain sports and recreational contents. Out of the total number of 12 most frequently practiced recreational activities offered, the respondents would primarily opt for ball games (football, basketball, volleyball, and the like) (37.3%), while hiking (18.4%) takes the second place. In the zone of moderate interest, activities of aerobics, dancing and swimming are present (about 10%), while the respondents are much less interested in the other contents In men, the dominant content of the game is ball games (mostly indoor soccer and basketball) (29.3%), while women are the most likely to have a potential interest in hiking programmes (10%) (Table 6).

Table 6: Preferred sport and recreational contents of the respondents according to gender

Preferred sport and recreational activities	Gender		Σ
	Men	Women	
	234 *12.1%*	163 *8.4%*	397 *20.5%*
Ball games	569 *29.3%*	155 *8.0%*	724 *37.3%*
Pilates	128 *6.6%*	80 *4.1%*	208 *10.7%*
Aerobics	3 *0.2%*	21 *1.1%*	24 *1.2%*
Yoga	8 *0.4%*	18 *0.9%*	26 *1.3%*
Swimming	59 *3.0%*	140 *7.2%*	199 *10.3%*
Dance	56 *2.9%*	145 *7.5%*	201 *10.4%*
Martial sports	14 *0.7%*	43 *2.2%*	57 *2.9%*
Team sports	29 *1.5%*	0 *0.0%*	29 *1.5%*
Mountaineering	70 *3.6%*	8 *0.4%*	78 *4.0%*
Hiking	163 *8.4%*	194 *10.0%*	357 *18.4%*
Running, cycling	8 *0.4%*	29 *1.5%*	37 *1.9%*
Σ	1107 *57.1%*	833 *42.9%*	1940 *100.0%*

Chi = 414.758 Sig. = .000

DISCUSSION AND CONCLUSIONS

The World Health Organisation's data on the physical activity of the population in a number of countries in the region of Eastern Europe (WHO, 2002) show that, out of five adults, only one is involved in minor or almost no form of physical activity which could be considered regular physical exercise. Sjöstrom et al. (2006) state that research carried out in the European Union countries (2003 and 2006) showed that 2/3 of adult population did not reach the recommended level of daily physical activity. In this respect, it is necessary to permanently and intensively emphasise the importance and role of physical activities for human health, especially regular physical exercise (suited to the needs, abilities and health of the individual). Also, it is necessary and appropriate to provide educational guidance in all parts of the population on the concept and essence of physical exercise as a planned, structured, repetitive and purposeful form of physical activity whose main aim is the maintenance and/or improvement of one or more components of the form, that is, maintenance and improvement of physical fitness and health status (American College of Sports Medicine, 2005). In this context, sports and recreational activities occupy a very important place.

It is especially important to update these issues through the context of the quality of life and the purposeful use of leisure time for middle-aged people. One of the reasons is that this part of the population is the driving power of every society since it has the largest percentage of the working population. It is therefore very useful and advisable to acquire the appropriate level of knowledge about the importance of physical exercise and its impact on the overall quality of life. Among other things, it is due to the understanding of the differences between mass and elite forms of physical exercise (competitive and sports versus sports and recreational contents) and their exercise in leisure time. Hence, a holistic approach to the social context of the quality of life pertaining to middle-aged people and their relationship with leisure time is necessary (in which "balance of mind and body" is sought).

The way of life and the degree and character of everyday activities (especially at the workplace) are often the key factors that determine the level of health of these individuals. This includes, inter alia, working conditions, rest quality, access to education, health care, standards of the cultural sphere of life, the ways of social behaviour, consumption levels, diet, ways of using spare time, etc. (Mišigoj-Duraković et al., 2000).

In support of these findings, there are discoveries found in recent research that addressed the problems of physical exercise/sports and recreational activities in middle-aged people through correspondence with free time and quality of life.

First of all, in terms of health, quality of life and leisure time self-assessment, where satisfaction is found in the relationship between the activities performed at work and sports and recreational activities in leisure time (Vuillemin et al., 2005). That is, pointing to a significant contribution to the use of sports and recreational content to reduce stress and fatigue caused by the work environment (Okano, Miyake, & Mori, 2003), and the positive impact of regular physical exercise on reducing the risk of factors that can impair physical health in later life cycles (Leino-Arjas et al., 2004). One of the research, corresponding with our study findings, is about the level of participation in physical activities in the European Union (Martinez-Gonzalez et al., 2001), whose goal was to assess physical activity during the free time of a middle-aged person in fifteen European countries. The results showed greater involvement in regular physical activities (sports and recreation facilities) of the inhabitants of Northern European countries in relation to the inhabitants of Southern European countries. Participation in physical activity was more common among the respondents with a higher level of formal education.

Additionally, the World Health Organisation has identified certain tendencies that are associated with the level of physical activity of the European population (WHO, 2002). For example, it has been found that, in most Eastern European countries, only one in five people are involved in some kind of physical activity during their free time, that is, in the countries of Eastern and South-Eastern Europe, almost 2/3 of the adult population do not engage in physical activity/physical exercise in a healthily recommended range (Sjostrom et al., 2006). Similar information was obtained from the United States citizens. Less than 1/3 of the American population sufficiently engages in physical activities necessary for a healthy life (a minimum 60 minutes of physical activity per day), and one of the main causes of such habits is the sedentary lifestyle and work, which has become one of the main risk factors for physical health disorders (Neville & Dunstan, 2002).

The results and our studies have drawn attention to the importance of permanent indication of positive life habits, especially those that are directed towards health (regular physical activity), as determinants of the quality of life and leisure time of the BiH population. In this regard, special physical activities/dosed exercise are focused on the development of aerobic abilities, which is in accordance with a number of previous studies emphasising regular physical activities (sports and recreation programmes) dominated by the aerobic character (Piero, Mannetti, & Livi, 2003; Sharkey & Gaskill, 2008; Nešić, Nešić, & Perić, 2016).

Data from the World Health Organisation (WHO, 2007) speak of growing tendencies, stating that, in a large proportion of the adult population, especially middle-aged women, there are habits that do not appropriately represent adequate physical activity, especially during free time (Nešić & Rajić, 2015). Research shows a trend indicating that, in developed environments (where there are no major material or cultural barriers), a small number of middle-aged people regularly exercise in sports and recreational facilities during leisure time (daily and weekly vacations). Similar tendencies have been observed in our study which supports the view that, for the promotion of a healthy lifestyle and physical activities as its integral part, organised social actions and programmes are necessary as a way of motivating this part of the population (Campbell et al., 2001).

A study on a sample of middle-aged people in Bosnia and Herzegovina aimed to identify certain aspects related to the individual perception of sports and recreational activities as leisure content. On a stratified sample of 1940 respondents aged 40-65 years, a survey was conducted.

Empirical data were processed by the appropriate initial procedures of descriptive and comparative character, and the results showed the following: (1) The research sample is dominated by people who do not engage in sports and recreational activities in their spare time, which corresponds to some statistical indicators at the level of Bosnia and Herzegovina on physical inactivity of the largest part of the adult population. This is especially noticeable for a part of the sample which is included in the 40-49 years of age group; (2) It was found that respondents do not recognise the importance of aerobic sports and recreational content as one of the most effective activities for improving health and maintaining the quality of life. Hiking, swimming, cycling, etc. are not high-rated categories of sports and recreation content, that is, they rarely practice them as leisure and recreational activities.

Of the preferred recreational content, the most common are ball games (dominant in men) or hiking and Pilates (in the female part of the population). In this context, gender can be considered as an important determinant for the choice of sports and recreational activities content; (3) Most respondents consider that, in their living environment (place of residence), there are opportunities for engaging in sports and recreational activities.

Despite the statistical significance of the distribution of responses at the level indicating the differences, it is primarily attributable to the sample construct, so that, in essence, it is not possible to talk about the conditions and possibilities of the environment as a reason for non-participation in sports and recreational activities;

(4) Regarding the leisure time that could be used to implement sports and recreational activities in the sample, there is a dominant view of the existence of a sufficient leisure time budget. Therefore, the reasons for not engaging in sports and recreational activities must be sought in other socio-psychological areas of this part of the population. This study attempted to contribute to the analysis of the Bosnia and Herzegovina environment in terms of identifying certain characteristics that are important for the development of sports and recreation, primarily by collecting information on the characteristics of the physical activity pertaining to the population belonging to the middle-aged stratum which is mostly a still active part of the population. This is the first step in the possible design of the sports development strategy in Bosnia and Herzegovina. The obtained results can be the starting point for further research.

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SPORTSKO-REKREATIVNE AKTIVNOSTI KAO SADRŽAJ SLOBODNOG VREMENA OSOBA SREDNJE ŽIVOTNE DOBI U BOSNI I HERCEGOVINI

Sa ciljem utvrđivanja određenih aspekata vezanih sa individualnu percepciju sportsko-rekreativnih aktivnosti kao sadržaja slobodnog vremena osoba srednje životne dobi u Bosni i Hercegovini, realizovana je empirijska transverzalna studija. Na stratifikovanom uzorku od 1940 ispitanika (M = 1107; Ž = 833), koji je obuhvatio oba entiteta (Federacija BiH i Republika Srpska) i veće urbane centre, primijenjen je upitnik posebno strukturiran za ovo istraživanje. Pitanja su bila tako formulisana da se ispitanicima ostavila mogućnost izbora između više ponuđenih odgovora (zatvorenog tipa), a dobijeni podaci su omogućili konstrukt indikatora u vidu nominalnih skala. Varijable koje su ispitanici posmatrali u okviru istraživanja (relevantne za ovaj rad) bile su: pol, godine života, procjena mogućnosti za bavljenje sportsko-rekreativnim aktivnostima, samoprocjena karaktera učešća u sportsko-rekreativnim aktivnostima, procjena učestalosti upražnjavanja sportsko-rekreativnih aktivnosti aerobnog karaktera i karakteristike slobodnog vremena u odnosu na mogućnost bavljenja sportsko-rekreativnim aktivnostima. Prilikom statističke obrade empirijskih podataka primjenjeni su postupci deskriptivne (distribucije frekvencija) i komparativne statistike (dominantno kontingencijska analiza X2-testa budući da su među empirijskom građom dominirale varijable uređene kao nominalne skale). Rezultati su pokazali da većina ispitanika ne upražnjava redovno sportsko-rekreativne sadržaje te da oni nisu dovoljno zastupljeni u okviru njihovog slobodnog vremena. Također, ispitanici ne prepoznaju značaj sportsko-rekreativnih sadržaja aerobne usmjerenosti kao jedne od najefikasnijih aktivnosti za unaprjeđenje zdravlja i održavanje kvaliteta života, a od preferiranih rekreativnih sadržaja najzastupljenije su igre sa loptom (dominantno kod muškaraca), odnosno pješačenje i pilates (kod ženskog dijela populacije). Najveći broj ispitanika smatra da u njihovom životnom okruženju (mjestu stanovanja) postoje mogućnosti za bavljenje sportsko-rekreativnim aktivnostima. U pogledu samoprocjene raspoloživog slobodnog vremena koje bi moglo biti iskorišteno za upražnjavanje sportsko-rekreativnih aktivnosti, u uzorku se dominantno uočava stav o postojanju dovoljnog budžeta slobodnog vremena. Tako da se razlozi za neupražnjavanje sportsko-rekreativnih aktivnosti moraju tražiti u drugim socio-psihološkim prostorima ovog dijela populacije.

Ključne riječi: slobodno vrijeme, sportsko-rekreativne aktivnosti, srednja životna dob

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TAI CHI EXERCISE: A BETTER ALTERNATIVE FOR MANAGING PHYSICAL EXERCISE PROGRAMMES IN PATIENTS WITH CHRONIC HEART FAILURE

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ABSTRACT

Cardiovascular disease causes more people to die each year than any other cause. Chronic heart failure has been one of the deadliest diseases impacting millions of people worldwide. Deaths due to chronic heart failure can be reduced through the promotive, preventive, curative, and rehabilitative approach. An important factor in chronic heart failure recovery is to increase cardiac functional capacity fitness. This study aims to measure the effects of tai chi, treadmill, and stationary bicycle exercises on the functional capacity in patients with chronic heart failure. The research respondents total 40, and the study was conducted for 12 weeks. Group 1 was given tai chi exercise, group 2 was given treadmill exercise, group 3 was given stationary bicycle exercise, and group 4 was set as the control group. The patients were in the age range of 50 to 60 years, with the provisions of the New York Heart Association (NYHA) class I and II, without a history of chronic comorbidities (post-stroke, diabetes mellitus and chronic lung disease). A 6-minute walking test (6MWT) was used for the measurement. The Statistical Product and Service Solutions (SPSS) programme for Windows was used for data description. The finding shows that all treatment groups had the same effect on the heart function capacity ($p < 0.05$). However, there was one group receiving the most influential effect compared to the other treatment groups, namely, the tai chi exercise group, with a value of $p = 0.000$. Based on the results of data analysis, it can be concluded that tai chi exercise has a more significant effect on heart function capacity than treadmills and stationary bike.

Keywords: chronic heart failure, physical exercise programme, tai chi, treadmill, stationary bike, functional capacity

INTRODUCTION

Chronic heart failure causes more people to die each year than any other cause (Segiet et al., 2019). In 2017, chronic heart failure in Indonesia itself was ranked first as the main cause of death followed by diabetes mellitus (DM), chronic lung disease and stroke in all age ranges with a diagnosis of chronic or non-communicable diseases (Sumartono, Sirait, Holy, & Thabrany, 2011). It is estimated that morbidity and the number of chronic heart failure patients will continue to increase in the coming year due to fast-growing urbanisation in Indonesia which will cause a very serious

burden on public health (Mao et al., 2017). In hospitals, the average mortality rate of patients with chronic heart failure is very high, despite being given rehabilitation and discharged from the hospitals (Sinan et al., 2019). An important factor in the treatment of chronic heart failure is to increase the cardiac functional capacity fitness, namely VO2Max or VO2 peak, blood pressure, and heart rate (Pandey et al., 2017).

Various efforts have been made by practitioners and academics related to the management and maintenance of chronic heart failure, but these still become obstacles in overcoming the problem of chronic heart failure disease (Permadi, 2020). So far, physiotherapists specialising in cardiovascular diseases have various effective training methods for recovery cases of chronic heart failure that affect body function and movements (Travensolo, Goessler, Poton, Pinto, & Polito, 2018). Physiotherapy has established a collaboration with cardiac rehabilitation exercise programme after hospitalisation which refers to aerobic physical exercise, but there has been no research comparing the effect of tai chi, treadmills, and stationary bike exercises (Dzubur & Poronsky, 2018), (Menezes, Lavie, Milani, Arena, & Church, 2012). In this study, we aim to evaluate the overall clinical impact of the exercises and compare them to find out which exercise programme has a better impact on chronic heart failure patients. So, starting from the problem, this study tries to focus on finding which group is the best by comparing of exercise programmes.

METHODS

Study Design

The respondents (men = 22 and women = 18) were patients or clients who were diagnosed with chronic heart failure at the outpatient clinic at Sanglah General Hospital, located specifically at the Integrated Heart Service, Denpasar, Bali. All were given exercises twice a week for 12 weeks. In this study, 40 patients were divided into four groups. Group 1 was given the treatment of tai chi exercise (Yang style), group 2 was treated with treadmill exercise (low - Bruce protocol), group 3 was given stationary bicycle training (YCMA), and group 4 was set as the control group. The patients were in the age range of 45 to 65 years, with the provisions of the New York Heart Association (NYHA) class I and II, without a history of chronic comorbidities (post-stroke, diabetes mellitus and chronic lung disease). All participants were educated on the risks and benefits of the training. During the follow-up, all patients received 6MWT. Informed consent was obtained from the participants before they took part in the study. This study has been tested through a review of proposals involving human subjects and it has been approved by the Research Ethics Committee of the Udayana University Medical School or Sanglah Hospital.

Measurement

A 6-minute walking test (6MWT) was used for the measurement. This running test was evaluated thoroughly and it integrated all the systems involved during exercises, including the pulmonary and cardiovascular system, systemic circulation, peripheral circulation, blood, neuromuscular units, and muscle metabolism (Babu, Desai, Maiya, Guddattu, & Padmakumar, 2016). Patients were given training for 24 meetings according to each group. Then, the patients were retested for evaluating the heart function capacity, which was then tested for data analysis. The Statistical Product and Service Solutions (SPSS) programme for Windows was used for data description. The data obtained from the group were tested by a Shapiro-Wilk normality test, with a significance level of 0.05. Data on the frequency test results indicated the heart function capacity before and after the treatment of all study groups. Finally, a Duncan post-hoc ANOVA was used to find out which variable or group has the most significant impact.

Statistical Analyses

The data were analysed using SPSS for Windows. A normality test was used to assess continuous variables for normal distribution fitting, and for normally distributed continuous variables. Duncan post-hoc ANOVA, in this case, was employed to find out which variable or group had the greatest impact on the treatment groups.

RESULTS

From the homogeneity test (Levene's Test), the blood pressure, pulse and VO2Max of all the treatment groups showed $p > 0.05$, indicating homogeneous data. Meanwhile, the normality test results of the total value pertaining to functional capacity before treatment and after treatment in each treatment group showed a p value greater than 0.05 ($p > 0.05$), which means that the functional capacity value data, before and after the treatment, were normally distributed. The data which had a normal distribution were then tested using the parametric test (Table 1).

In Table 2, good results occurred in research subjects, proving that all treatments, except the control group, had a good impact on blood pressure. In the pulse category, it was found that all treatments had a positive impact on the pulse of the study subjects. A significant impact on the VO2Max category after treatment can be seen in several subjects, which proves that all treatments have a very good impact, except those in the control group.

The results of the cardiac functional capacity category before and after treatment (Table 3) show the mean difference of all groups that had a p value less than 0.05 ($p < 0.05$). This showed that, in all groups, there were significant changes before and after treatment. Thus, on average, all treatments had a good impact on blood pressure, pulse, and VO2Max of patients with chronic heart failure.

Table 4 shows that the tai chi group had the lowest average blood pressure of 110.43; the highest (134.32) was measured in the control group. In terms of the pulse variable, the tai chi exercise group had the lowest value of 68.47, while the highest (75.57) one was measured in the control group. On the VO2Max variable, the control group showed the lowest VO2Max, with a value of 20.87, and the tai chi exercise group showed the highest VO2Max, with a value of 30.37. The average of all groups shows that the tai chi exercise group obtained a value of $p = 0.000$ ($p < 0.05$), which proves that the tai chi exercise group had a significantly different effect than the other treatment groups on the heart function capacity.

Table 1: Homogeneity and Normality Test Results Pre- and Post-Treatment of All Groups

Cardiac Functional Capacity Category	p Homogeneity Test (Levene's Test)	p Normality Test (Kolmogorov-Smirnov)
pre		
Blood pressure	0.674	
Pulse	0.150	
VO2Max	0.537	0.308
post		
Blood pressure	0.468	
Pulse	0.239	
VO2Max	0.249	

Table 2: Heart Function Capacity Frequency Test in All Groups

Cardiac Functional Capacity Category	Pre	Percentage (%)	Post	Percentage (%)
Blood pressure				
Optimal			20	50.0
Normal	8	20.0	14	35.0
Mild Hypertension	32	80.0	6	15.0
Moderate Hypertension				
Severe Hypertension				
Isolated Systolic Hypertension				
Pulse				
Very good	6	15.0	27	67.5
Well	33	82.5	12	30.0
Moderate	1	2.5	1	2.5
Less				
VO2Max				
Very Poor				

Poor	28	70.0	5	12.5
Fair	12	30.0	12	30.0
Good			20	50.0
Excellent			3	7.5
superior				

Table 3: Comparison Test of Cardiac Functional Capacity Categories Before and After Treatments in All Groups

Cardiac Functional Capacity Category	All Groups		t	p
	Mean	Standard Deviation		
Pre-Treatment Blood Pressure and Post-treatment Blood Pressure	15.8	14.0	8.3	0.000
Pre-treatment pulse and post-treatment pulse	7.1	3.3	9.0	0.000
Pre-VO2Max Post-VO2Max	-6.3	6.1	-10.1	0.000

Table 4: Duncan post-hoc ANOVA of post-treatment comparisons

Group After Treatment	Variable(s)		
	Blood pressure	Pulse	VO2Max
ANOVA	0.000	0.000	0.000
Tai chi	110.43[a]	68.47[a]	30.37[c]
Treadmill	130.00[c]	72.87[b]	27.37[b]
Stationary bicycle	122.51[b]	71.37[b]	29.67[b]
Control	134.32[d]	75.57[c]	20.87[a]

Annotation:
1. p value < 0.05 is called significantly different or significant
2. The numbers followed by the same notation belong to the same group
3. The notation "a" shows the lowest mean
4. The notations "c" and "d" indicate the highest mean

DISCUSSION

Patients with chronic heart failure tend to experience complex instability of heart function (Achttien et al., 2015), (Permadi, 2019). Generally, the tai chi, treadmill and stationary bicycle exercises provide similar benefits to heart function (Zheng, Lal, Meier, Sibbritt, & Zaslawski, 2014), (Krishnaswami et al., 2017). In theory, tai chi, treadmill, and stationary bicycle exercises are aerobic exercises used to optimise the overall capacity of heart function for chronic heart failure patients (Salisbury et al., 2018).

Studies focusing on the three exercises have been conducted, but only one or two comparisons of exercises have been given (Vanroy et al., 2017), (Ma, Zhou, Tang, & Huang, 2018), (Grazzi et al., 2018). There is evidence explaining the difference between treadmill training and stationary bicycle exercises, stating that both exercises have better effects on blood pressure and VO2Max (Bittencourt et al., 2014), (Forestieri et al., 2016).

This study shows that tai chi, treadmills and stationary bicycles exercises impact heart function.

However, our results show that tai chi is better than treadmills and stationary bicycle exercises in patients with chronic heart failure.

A tai chi programme is effective for improving heart function fitness among elderly patients, given that tai chi is easy to practice (G. Li, Yuan, & Zhang, 2014), (J. Li, Hsu, & Lin, 2019). To determine the intensity of tai chi exercise, we measured the participants during the exercise on Week 4, Week 8, and Week 12. The tai chi group showed different blood pressure, pulse and VO2max responses than the treadmill and static bicycle groups (Ma et al., 2018), (Ren et al., 2017). In the literature, it is explained that tai chi can optimise blood pressure, pulse and VO2max of patients with chronic heart failure (Wong, Chow, & Chung, 2016). Recent findings show that tai chi experts can impact heart function in cardiovascular disease, suggesting that tai chi may be an important alternative medicine for the prevention and treatment of chronic heart failure (Zhang et al., 2019). One mechanism that explains the changes in heart function is that tai chi exercises have a good effect on brain health and anxiety/depression reduction (Liu, Li, & Shnider, 2010), (Hu et al., 2016).

Preliminary evidence supporting this study shows that the difference in impact when the test is performed for six minutes in a controlled clinical trial sample evaluating 100 outpatients proves that functional capacity and quality of life in patients given tai chi exercises experienced a greater improvement caused by stable blood pressure and normal pulse (Yeh et al., 2011). The study also explained that, according to the data collected from the Framingham Heart Study and other prospective studies, most patients would die three years after cardiac rehabilitation (Salmoirago-Blotcher et al., 2015). These preliminary findings suggest that future studies should assess the efficacy of tai chi interventions delivered by the community in increasing overall physical activity and the proportion of chronic heart failure patients who achieve current recommendations for physical exercise (150 minutes of moderate-intensity aerobic physical activity per week) (Huang, Wang, & Wu, 2011), (Zheng et al., 2014), (Lian et al., 2017). Other findings also prove that tai chi exercise performed for 16 weeks has a significant effect of 40% on pulse and VO2Max (Liu et al., 2010).

This is because tai chi exercises maintain balanced body performance by prioritising concentration so that the increase in VO2Max is more optimal (Almodhy, Ingle, & Sandercock, 2016). Literature or previous research shows that tai chi has a high potential to be a safe and effective exercise option for optimising blood pressure, pulse and VO2Max (Chan et al., 2018). Research comparing tai chi, treadmills, and stationary bikes exercises has never been done. Therefore, the results of this study can only be compared with the results of previous studies comparing two exercises. Data from various studies that have been carried out still show different findings and no such research has been published in Asia, especially in Indonesia. Thus, this trial provides an introduction to the benefit of tai chi as a potential exercise for chronic heart failure patients who cannot or do not want to attend conventional heart rehabilitation programmes such as treadmills or stationary bicycle exercises.

CONCLUSION

From the study conducted for 12 weeks, it can be concluded that among aerobic physical exercises, such as tai chi, treadmills and stationary bicycles exercises, it is found that tai chi exercises have the most significant impact compared to treadmills and static bicycles in optimising the functional capacity of patients with disease chronic heart failure.

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TAI CHI VJEŽBA: BOLJA ALTERNATIVA ZA UPRAVLJANJE PROGRAMIMA TJELOVJEŽBI KOD PACIJENATA SA HRONIČNIM ZATAJENJEM SRCA

Svake godine, kardiovaskularne bolesti uzrokuju smrt sve više ljudi nego bilo koji drugi uzrok. Hronično zatajenje srca je postalo jedna od najsmrtonosnijih bolesti koja pogađa milione ljudi širom svijeta. Smrtnost prouzrokovana hroničnim zatajenjem srca se može smanjiti promotivnim, preventivnim, kurativnim i rehabilitacijskim pristupima. Važan faktor oporavka od hroničnog zatajenja srca je povećavanje funkcionalne sposobnosti srca. Ova studija ima za cilj izmjeriti efekte vježbanja korištenjem tehnike tai chi, pokretne trake za trčanje i stacionarnog bicikla na funkcionalnu sposobnost pacijenata sa hroničnim zatajenjem srca. Ispitanici istraživanja su brojali 40, a studija je provedena tokom 12 sedmica. Grupa 1 je podvrgnuta tai chi vježbama, grupa 2 je podvrgnuta vježbama na pokretnoj traci za trčanje, grupa 3 je podvrgnuta vježbama na stacionarnom biciklu, a grupa 4 je postavljena kao kontrolna grupa. Pacijenti su bili u starosnom rasponu od 50 do 60 godina, sa odredbama I i II klase Kardiološkog udruženja iz New Yorka (engl. NYHA - New York Heart Association), bez anamneze hroničnih komorbiditeta (stanje nakon moždanog udara, diabetes mellitus i hronična bolest pluća). Za mjerenje se koristio 6-minutni test hoda (6MWT). Za opis podataka se koristio program SPSS (engl. SPSS - Statistical Product and Service Solutions) za Windows. Pronalasci su pokazali da su sve tretirane grupe imale isti efekat na sposobnost rada srca ($p < 0,05$). Međutim, postojala je jedna grupa koja je imala najveći efekat u odnosu na ostale tretirane grupe, i to grupa koja je podvrgnuta tai chi vježbama sa vrijednošću $p = 0,000$. Na osnovu rezultata analize podataka može se zaključiti da tai chi vježba ima značajniji uticaj na sposobnost rada srca od vježbi na pokretnoj traci za trčanje i stacionarnom biciklu.

Ključne riječi: hronično zatajenje srca, program tjelovježbe, tai chi, pokretna traka za trčanje, stacionarni bicikl, funkcionalna sposobnost

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THE EFFECTS OF K-1 SUBJECT IMPLEMENTED TEACHING ON BODY COMPOSITION AND MUSCLE PERFORMANCE OF MALE AND FEMALE FIRST-YEAR STUDENTS

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ABSTRACT

The aim of this research is to determine the effects of K-1 subject implemented teaching on body composition and muscle performance of first-year students. The sample (n = 39) consists of male (n = 32) and female (n = 7) first–year students of the Faculty of Sports and Physical Education from Sarajevo. They all attended K-1 theoretical and practical classes during the 2019/20 academic year. The sample of variables consists of (n = 14) variables out of which (n = 12) variables are intended to estimate body composition and (n = 2) variables are used to estimate the explosive power of lower extremities. Data to assess body composition were collected using a "Tanita scale" (Tanita BC-418, Tokyo, Japan) and "Just Jump System" by Perform Better, USA, and were used to estimate the explosive power of lower extremities. The research results showed that jump height (.007) and duration of flight in the final measurement (.006) significantly increased in students, in comparison to the initial measurement. Changes in the final measurement were also present in body composition, being as follows: fat free mass (.005), muscle mass (.006) and basal metabolism (.006). In female students, changes in the final measurement were noted in five variables of body composition, specifically in: body weight (.032), fat free mass (.034), muscle mass (.036), basal metabolic rate expressed in KJ (.031), basal metabolic rate expressed in KCAL (0.031) and flight duration variable (.017) to assess the strength of lower extremities. The obtained results indicate that the implemented curriculum of the K-1 teaching subject had a positive effect on body transformation, i.e., reduction of muscle mass and performance of muscle strength pertaining to lower extremities. Constant monitoring of the effects of class implementation in higher education is essential and important in K-1 as well as in other subjects, not only to evaluate the students at the end of a semester, but also to understand the effects in other latent segments of students' anthropological status, especially at the Faculty of Sports and Physical Education. On the basis of the results obtained in this research, and thanks to its positive transformational effects, as well as undemanding organisational and material requirements, K1 sport may be recommended for use in the teaching process of primary and secondary schools in Bosnia and Herzegovina.

Keywords: transformations, effects, body composition, muscle performance, martial arts, gender

INTRODUCTION

In its essence, teaching represents a specific transformational process in which the effects are to be achieved by specific means. Managing this transformational process is maximally efficient if there is feedback, which enables information to flow from teachers to students and vice versa. In order to achieve that, it is necessary for the teacher to have information about the condition of the subject being taught. This means, among other things, that the teacher can manage the exercise process, determine the optimal contents, loads and forms of work and perform constant control, if he was informed about the condition of the subject in an objective manner at each stage of the work. The plan implies a certain period of time within which it is necessary to achieve a goal that has already been set in advance. The total time period can be divided into shorter three-month periods - quarters (during one year) or into even shorter, definite periods or "terms" (time units during the day). A separate goal can be set for each quarter (such goals must be set in accordance with the achievement of the main goal). There are several already elaborated definitions for the meaning of the word “plan”. (Rašidagić et al., 2016).

Martial arts, being part of the overall sports articulation of the human motion, represent a special phenomenon with a large number of elements from different anthropological spheres (Shim, 2003). The basic meaning and purpose of practicing martial arts and skills is to acquire specific motor skills, harmonious psychosomatic development, competence and fulfilment of motives (Kapo, 2010). Martial arts can have a positive effect on physical fitness and health (Woodward, 2009). The curriculum represents a school document that prescribes three basic didactic dimensions of education: the scope or quantity of knowledge and facts that students must acquire, the depth of knowledge and skills that students must acquire and the order of the curriculum (linear, concentric and combined). The curriculum consists of the field of study, teaching unit, teaching topic and a lesson. It consists of instructions, i.e., contents that are realised in a certain period of time, and for successful writing (development) of a programme, it is necessary to set goals on the basis of which tasks, means and methods are determined. (Rašidagić et al., 2016).

The objectives of K-1 subject teaching are:

a) Education of students through philosophy, codes and principles of martial arts with emphasis on a healthier lifestyle, better physical fitness, increased self-confidence, setting and achieving goals, increasing maturity, perseverance, adaptation and affirmation in the community, respect for oneself, the others and the environment, as well as the quality of interpersonal relationships;
b) Education of students through the history and rules of K-1 sport, analysis of K-1 sport/structural analysis, anthropological characteristics, analysis of martial arts participating in K-1, technical - tactical elements of K-1 sports, basic methods in K -1 sport, specific training methods in K-1 sport, assessment of technical readiness in K-1 sport, as well as obtaining information, through the study of K-1, regarding eight martial arts on the basis of which it is easier to decide on further training and studies related to martial arts;
c) Master basic modern theoretical, scientific and practical (empirical) knowledge and skills on sports training and development of K-1 sports;
d) Master the specialties and specifics of K-1 sports didactics in technique, tactics and motor skills;
e) To enable students to successfully use the knowledge acquired in theoretical, practical classes and exercises in implementation of the educational process for male and female students of different ages.

From the aspect of structural analysis, K-1 was created by consolidation of eight martial arts: Karate, Kempo, Kickboxing, Taekwondo, Kakutogi, Boxing, Kung fu, Thai boxing. The best characteristics of these movement structures were merged into one dominant structure at the top of the pyramid, called K-1. All advantages of martial arts and skills were defined and then shaped into unique K-1 rules. The rules are not of limiting character in order to show the maximum performance of technical and tactical elements. K-1 requires application of fast, perfect and efficient techniques and technical and tactical complexes, and also requires omission of slow techniques and passive defences. Within the frame of poly-structural acyclic movements, K-1 belongs to the group of discontinuous activities, representing sporting activity in which a fighter directly reacts to external changing conditions, and actively directs his/her own actions.

Actions are performed in direct conflict with the opponent, whose resistance has to be defeated, while at the same time, one has to implement one's own intentions and anticipate the intentions of the opponent in order to disable him/her and achieve the goal, i.e., win (Kapo, 2010). According to the curriculum of the Faculty of Sports and Physical Education, the K-1 subject course consists of a practical and theoretical part. The teaching units from practical classes are: basic technical elements of sports that participate in K-1 sports (karate, taekwondo, boxing, kick-boxing, Thai boxing, kung fu) in Colloquium I, while seven teaching units encompassing basic technical elements of K-1, basics of K-1 sports methodology (characteristic phases of learning, principles of learning techniques, methodical procedures in training, error correction methods), K-1 devices and their application, specific training methods in K-1, sparing with the coach work method and use of K-1 elements in self-defence

are present in Colloquium II during the eight week. Practicing the K-1 martial art develops general and situational motor skills, intellectual and functional abilities, and has an influence on the formation of a specific structure of personality traits, the value system and motivation (Kapo, 2010). The most important factors that determine morphological characteristics and body composition are genetic factor and environmental factor (diet and exercise). The amount of adipose and muscle tissue increases rapidly in the first 6 months after birth and in early adolescence (Haywood & Getchell, 2019). It is especially important to point out that, in the period from 10 to14 years of age, active boys (who have 6 hours of training per week) significantly increase muscle and total mass during 4 years while their adipose tissue remains at the same level in contrast to inactive boys (Pařízková & Roth, 1972). Hence, physical activity has a positive effect on the quality of body composition in the period of growth and development.

Body composition is one of the five components of health fitness that describes the body tissue components. Body composition, also known as kinanthropometry, involves an assessment of body composition and body components. This includes muscles, bones and fat, while considering the size, shape and proportions of each tissue, which gives us an insight into the correlation between the two components, fat and non-fat mass. Under the influence of programmed trainings, positive transformations can be expected within indicators of body composition (Kapo et al., 2015; Kapo et al., 2018; Mrković, 2015).

The transformation process involves planning, programming, implementation and control of the exercise process to achieve a predefined goal, which is to achieve such subject changes that are closest to the ideal final state (Malacko et al., 2004). Transformational processes can result from sports classes. The object of exercise transformation is a person. Transformational processes of exercise create two types of changes: 1) quantitative changes, which relate to changes in the level of development of a particular ability and trait or the degree of adopted motor knowledge and 2) qualitative changes, which most often relate to changes in relations between abilities, traits and motor skills.

K-1 practice can initiate transformational processes that cause either to develop or to maintain the achieved level of functional ability, morphological characteristics and motor skills, among which the most dominant is the development of strength (Kapo, 2010). Strength as motor ability is defined as the greatest force a muscle can generate in the shortest unit of time and it is determined by the relationship between maximum effort and time (Rađo, 2000). Numerous researchers (Matvejev, 2000; Antekolović, 2003; Kapo, 2016) point out that explosive power is the most dominant dimension in most sports activities. Vertical jump is usually used as an index of strength pertaining to lower extremities or explosive strength of legs (Roschel et al., 2009; Noorul et al., 2008; Dizon et al., 2012; Marković et al., 2007). In accordance with the theoretically defined principles of K-1 martial art, teaching and transformational processes in exercise, the aim of this research is to determine the effects of the implemented K-1 lessons on body composition and muscle performance of first-year students.

METHODS

Sample of participants

The research sample was selected from the population of first-year students of the Faculty of Sports and Physical Education, University of Sarajevo. During 2019/20 academic year, they attended K-1 theoretical lectures and practical classes. The total number of students was (n = 39), out of which (n = 32) were male (average height: 180.59 cm; average age: 19.93 years) and 7 were female (average height: 173.57 cm; average age: 19.00).

Sample variables

In this study, 14 variables were used, out of which 12 variables were used to assess body composition:
Body weight - WEIGHT
Fat percentage - FAT
Fat mass - FATMASS
Fat free mass - FFM
Muscle mass - MUSCLEMASS
Total body water - TBWKG
The proportion of water in total body weight - TBW
Basal metabolic rate expressed in KJ - BMRKJ
Basal metabolic rate expressed in KCAL - BMRKCAL
Metabolic age - METAGE
Visceral adipose tissue - VISFAT
Body mass index - BMI
Two variables were used for estimating the explosive power of lower extremities:
Flight duration - TRLET
Jump height - VISSKOK

Data collection method

The body composition of male and female students was measured with a Tanita scale (Tanita BC-418, Tokyo, Japan) which is a bioelectric scale that uses a bioelectric impedance to measure the body conductivity through hydrated muscle and creates resistance while passing through adipose tissue.

After being measured, this resistance, known as impedance, is entered into scientifically validated Tanita equations to calculate body composition measurements (Kelly et al., 2012). Preparation for the measurement required the students to remove metal jewellery because the lack of metal improves the accuracy of the analysis, and to avoid exercise or other activity that leads to sweating at least 8 hours before the test because it was important to get accurate results in body fluid. Students were required to wear only underwear (female students to also wear undershirts), and to stand barefoot on Tanita scales. The muscular strength of male and female students was expressed as flight time and jump height performed using a squat jump.
The squat jump was performed on a specially designed mat (Just Jump System by Perform Better, USA) which is portable and easy to use, and does not require external power charging. The procedure of testing squat jump explosive power is performed in such a way that the subject takes the initial position in the squat at an angle of 90 degrees with his/her hands positioned above the level of the hips. After taking the starting position, the subject makes a voluntary maximum jump. The test was performed three times and the best result was recorded. A controller with a small display was connected to the jump pad. Immediately after the jump, the flight time and jump height were displayed at the previously prepared list. Data were collected during regular K-1 classes implemented at the Faculty of Sports and Physical Education, as part of the regular classes during a fifteen-week period. During the first week, the initial testing of male and female students with a Tanita scale and jump mat was performed, after which theoretical and practical classes were implemented during 15 weeks, and the final testing of male and female students was conducted in the fifteenth week. All classes were implemented in accordance with the curriculum.

Research ethics

All procedures were performed in accordance with the recommendation of the Helsinki Committee and ethical standards of the University of Sarajevo Ethics Committee.

Statistical Analysis

Descriptive statistical values were expressed in the form of arithmetic mean (AS) and standard deviation (SD), and the t-test for dependent samples was used to determine the differences between arithmetic means. The level of statistical significance was set at conventional $p < 0.05$ and $p < 0.01$. The statistical programme SPSS 22.0 was used for data analysis.

RESULTS

Table 1 shows statistically significant differences between the initial and final testing results of students after 15 weeks of implemented K-1 classes, within three variables assessing body composition: fat free mass (.005), muscle mass (.006), basal metabolic rate expressed in KJ (.006) and 2 variables assessing performance of lower extremity muscle strength: flight duration (.007), and jump height (.006).

Table 2 shows statistically significant differences between the initial and final testing results of female students after 15 weeks of implemented K-1 classes, where the statistical significance in the body composition is noticeable in five variables assessing body composition: body weight (.032), fat free mass (.034), muscle mass (.036), basal metabolic rate expressed in KJ (.031), basal metabolic rate expressed in CAL (0.031) and one flight duration variable (.017) for the evaluation of lower extremity muscle strength performance.

Table 1: Results of arithmetic mean, standard deviation and t-test for related samples in students (N = 32).

	Initial		Final				
	AS	SD	AS	SD	t	df	p
WEIGHT	75.37*	10.49	74.55	10.37	1.978	32	0.057
FAT	12.16	5.05	12.37	4.92	-0.772	32	0.446
FATMASS	9.96	4.99	9.68	4.97	-0.256	32	0.8
FFM	65.76	6.19	64.91	6.05	3.024	32	0.005**
MUSCLEMASS	62.48	5.92	61.69	5.77	2.977	31	0.006**
TBWKG	45.13	3.88	44.82	3.8	0.961	32	0.344

TBW	60.68	3.87	60.56	3.85	0.568	32	0.574
BMRKJ	8173.5	821.46	8069.59	796.55	2.918	32	0.006*
BMRKCAL	1891	352.31	1928.41	190.37	-0.58	32	0.566
METAGE	15.78	4.91	15	6.01	-0.49	32	0.627
VISFAT	1.72	1.98	1.78	1.36	-0.32	32	0.751
BMI	23.16	2.7	13.12	1.71	0.336	32	0.739
TRLLET	0.67	0.06	0.69	0.49	-2.895	32	0.007**
VISSKOK	55.64	9.52	59.22	8.15	-2.98	32	0.006**

*p < 0.05; **p < 0.01

Table 2: Results of arithmetic means, standard deviation and t-test for related samples in female students (N = 7).

	Initial		Final				
	AS	SD	AS	SD	t	df	p
WEIGHT	65.5	1.29	64.14	4.62	2.773	7	0.032**
FAT	22.13	2.93	22.33	2.47	-0.412	7	0.694
FATMASS	13.57	2.55	14.37	2.32	0.589	7	0.577
FFM	50.93	2.61	49.77	3.09	2.735	7	0.034**
MUSCLEMASS	48.43	2.46	47.25	2.97	2.685	7	0.036**
TBWKG	29.43	11.3	32.83	11.34	-0.783	7	0.463
TBW	51.61	2.45	51.32	2.34	0.721	7	0.498
BMRKJ	6527.71	310.18	6392	369.66	2.806	7	0.031**
BMRKCAL	1560.14	74.15	1527.71	88.32	2.811	7	0.031**
METAGE	13.57	2.22	13.57	2.57	0	7	1
BMI	21.76	1.54	21.71	1.33	0.297	7	0.777
TRLLET	0.55	0.04	0.59	0.04	-3.284	7	0.017**
VISSKOK	41.39	9.25	44.1	5.6	-0.712	7	0.503

*p < 0.05; **p < 0.01

DISCUSSION

The research was implemented in accordance with the rules and norms of the authorities in charge and Faculty of Sports and Physical Education. The process of data operationalisation was done by registration in the main centre for research of humanistic character. Ethical standards and moral normative were taken as a standard by which the results of the research are considered valid, reliable and, above all, acceptable and applicable in modelling new problems. Scientific and mathematical/statistical methods are valid and used in precise and adequate manner. Although in practice, research from the field of sports medicine takes 99% accuracy to be the level of statistical significance, this is not the case in this research. Measurement error is minimised by using the most advanced measuring instruments. The instruments used in the research support the highest standards in terms of measurement features, reliability, sensitivity and accuracy.

The main goal of this study was to determine the effects of the implemented K-1 classes on body composition and muscle performance of first-year students. The study showed that the K-1 subject curriculum, during 15 weeks of exercising, produced statistically significant changes on body composition in the form of weight loss and subcutaneous adipose tissue. The programme produced changes in lower extremity muscle strength performance. The results of the research are as expected considering the structure and combinations of movements within K-1 sport itself, being composed of several martial arts. Exercises of strength and specific endurance used in K-1 classes influence perseverance and resilience, resulting in sufficient energy consumption to produce changes in body composition. K-1 may be a good instrument to manage physical exercise processes. In order to trigger changes, it is important to know what, how and how long to exercise, as well as how to control variability in both qualitative and quantitative terms. This was confirmed by the research (Kapo et al., 2015) on a sample of young female karate students (n = 22) (13.6 ± 2.1 years) who performed specific karate training with exercises for the development of motor skills for 60 minutes 3 times a week during 12 weeks.

The aim of the study was to evaluate the effects of a three-month karate programme on body composition. The results indicate that there was a statistically significant decrease in results in following variables: body mass, adipose tissue percentage and BMI; while the body water percentage variable indicated a statistically significant increase in results.

Changes in anthropological characteristics in the teaching process represent a varying dynamic process, which is characterised by appropriate quantitative and qualitative indicators. More intense forms of physical activity provide greater benefits regarding weight reduction and individual health status than moderate-type activities (Bompa, 2009). This primarily refers to reducing the risk of cardiovascular diseases (Swain et al., 2006), as well as an increase in functions of the locomotor system (Wojtek et al., 2009).

Also, the positive effects of high-intensity activity on reduction and maintenance of optimal body weight in both women and men are well known (Donnelly et al., 2009). In addition to general warming-up exercises, when performing teaching units according to the K-1 curriculum, students also had specific forms of warming-up, and during the main part of the class, variable work methods were applied in which the student's body was subjected to different volume and intensity of exercise. During the final part of the course, special attention was paid to performing exercises that had the task of strengthening muscle parts which are important for K-1, and special attention was paid to exercises for the central part of the torso, abdominal and back muscles as well as flexibility and relaxation exercises. The mentioned work method most likely influenced the obtained results in both male and female students in regard to body composition and changes in lower extremity muscle strength performance. The obtained results are in accordance with the results of the research (Zrnić, 2011) which determined the statistical significance of differences in four of the seven applied variables. Tabata et al. (1996) and Shaw, et al. (2009) suggest that high-intensity intermittent exercise has the potential to be classified as an exercise group that has more economical and effective benefits in reducing adipose tissue, body weight, and improving functional motor abilities.

Such type of exercise consists of a warming-up period and period of submaximal and maximum loads, and all this was applied during the implementation of K-1 curriculum. Exercise increased fat mobilisation and utilisation, causing adipose fat loss. Regular exercise conducted by students also slowed down the loss of muscle tissue (Petković, 2013). Research results on the implemented K-1 curriculum indicate quality and well-planned work that contributed to statistically significant changes in students and had a positive effect on the improvement of students' lower extremity muscle strength in both variables - flight duration and jump height, while in female students, statistically significant changes happened only in flight duration. This is confirmed by research in which the differences in body composition and explosive power of lower extremities were identified (Tota, 2014) at the beginning and at the end of the semester. The movements in K-1 are complex and intense, and characterised by varying involvement of almost all muscle parts of the body.

Such stresses have the character of an irregular interval, requiring alternating work in a place with maximum involvement of muscular strength, followed by lightning-fast body moves. Power is a motor ability which, in specification equation, has a significant share in K-1. The most important form of power for K-1 is so called explosive power. In order for strikes and blocks to be effective, in addition to being performed quickly, they must be performed with certain force, which is necessary for a good and strong "access to the opponent", avoiding duels, firm blocking, and performing all strikes, especially while jumping. While in the K-1 fight, the repetitive strength of the arms, legs and torso is not particularly important because the fight lasts only two or three minutes (depending on age and gender), in the training process, it is very important because it allows constant repetition of strikes, blocks, combinations and counterattacks, which leads to complete automation of movement. The vertical jump performed by men is significantly higher than the vertical jump performed by women (McMahon et al., 2017). The difference in gender regarding jump height is related to the body fat percentage. Generally, women have a higher percentage of body fat, especially due to the accumulated fat in the hips and chest, and therefore men, having lower body fat, have an advantage in vertical jump (Noorul, 2008). Vertical jump is an important indicator of leg strength in martial arts athletes. Body fat percentage is an anthropometric factor that has a significant negative relationship with vertical jump height (Abidin et al., 2013). Reduction of body fat through proper physical training and diet planning will help in improving leg strength or kicks (Abidin et al., 2013).

In martial arts, it is necessary to have extraordinary leg strength, which is useful for kicks while standing or in the air (Roschel, 2009; Noorul, 2008; Dizon, 2012). Body composition research is very important in relation to the general population, as well as the population of athletes of different levels and different sports disciplines. In relation to the general population, the phenomenon of body structure is studied in order to investigate the relationship with non-communicable diseases, i.e., health status, as well as in relation to methods of measuring and modelling body structure in different races, but also in curriculum assessment. In athlete population, the research is focused on the phenomenon of body structure adjustment in training. Adequately planned and programmed training processes in K-1, which are performed regularly with appropriate volume and load intensity, can significantly affect the overall morphological status and changes in individual motor skills in male and female students. Quality statistical indicators for both male and female students indicate the uniqueness of the K-1 curriculum, which is most likely reflected in the methodology of training various technical elements of martial arts being an integral part of K-1 (karate, taekwondo, boxing, kickboxing/ from the discipline of kickboxing/Thai boxing and kung fu) and the methodology of training the technique of K-1 itself and the specifics of preparation that resulted in statistically significant results in both male and female students in body composition and performance of lower extremity muscle strength.

The results obtained in this research show very good indicators because the participants were mostly already active in some of the sports before testing. Characteristics of their morphological anatomical structures are of the rank of well-trained athletes, which gives even greater value to the K-1 teaching process. The above mentioned clearly shows that the strength and endurance exercises used in K-1 classes influence perseverance and resilience and trigger energy consumption that affects changes in body composition. K-1 can be a good instrument to manage physical exercise processes. Based on previous results, as well as the results of this research, we can conclude that each designed and professionally programmed physical activity has significant influence on the transformation of anthropological dimensions of exercisers.

CONCLUSION

Adequately planned and programmed teaching process as well as the realisation of this process can have a significant effect on the transformation of the students' anthropological status. In this way, students, in addition to being aware of the changes in their body structure and the quality of their motor skills, learn that, in their future work, they can plan and programme in a quality manner the transformation processes of the people with whom they will work. Constant monitoring of the effects in the implementation of K-1 curriculum in higher education represents an essential need, not only in the K-1 subject but also in other subjects in which it is important to have a teaching staff evaluation conducted by students at the end of the semester, and also the need to see the effects in other latent segments of the students' anthropological status, especially the students of the Faculty of Sports and Physical Education. Based on the results of this research, thanks to the positive transformational effects, as well as low organisational and material requirements, K-1 can be recommended for use in the teaching process of primary and secondary schools. Research with the same variables can be conducted on the population of primary and secondary school students. If the positive transformational effects of the participants' anthropological status were confirmed, realistic conditions would be created for recommendations to complement the curricula in primary and secondary schools with the contents of the K-1 subject

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EFEKTI PROVEDENOG PODUČAVANJA IZ PREDMETA K-1 NA SASTAV TIJELA I UČINKOVITOST MIŠIĆA STUDENATA I STUDENTICA PRVE GODINE

Cilj ovog istraživanje je utvrditi efekte provedenog podučavanja iz predmeta K-1 na sastav tijela i učinkovitost mišića studenata prve godine. Uzorak (n = 39) se sastoji od studenata (n = 32) i studentica (n = 7) prve godine Fakulteta sporta i tjelesnog odgoja iz Sarajeva. Oni su pohađali teorijsku i praktičnu nastavu iz predmeta K-1 tokom akademske godine 2019/20. Uzorak varijabli se sastoji od (n = 14) varijabli od kojih je (n = 12) varijabli namijenjeno za procjenu sastava tijela, a (n = 2) varijabli je korišteno za procjenu eksplozivne snage donjih ekstremiteta. Podaci za procjenu sastava tijela su prikupljeni upotrebom Tanita vage (Tanita BC-418, Tokio, Japan) i podloge "Just Jump System" proizvođača Perform Better, SAD, a korišteni su za procjenu eksplozivne snage donjih ekstremiteta. Rezultati istraživanja su pokazali da su visina skoka (,007) i trajanje leta u finalnom mjerenju (,006) značajno povećani kod studenata, a u poređenju sa početnim mjerenjem. Promjene u finalnom mjerenju su također bile prisutne u sastavu tijela, i to: masa oslobođene masnoće (,005), mišićna masa (,006) i bazalni metabolizam (,006). Kod studentica, promjene u finalnom mjerenju su zapažene u pet varijabli sastava tijela, i to: tjelesna težina (,032), masa oslobođene masnoće (,034), mišićna masa (,036), bazalna metabolička stopa izražena u KJ (,031), bazalna metabolička stopa izražena u KCAL (0,031) te varijabla trajanja leta (,017) za procjenu snage donjih ekstremiteta. Dobiveni rezultati ukazuju da je provedeni nastavni plan i program iz predmeta K-1 imao pozitivan efekat na transformaciju tijela, tj. smanjenje mišićne mase i učinkovitost mišićne snage donjih ekstremiteta. Neprekidno praćenje efekata provođenja nastave visokog obrazovanja je ključno i važno za K-1 i druge predmete, ne samo za procjenu studenata na kraju semestra, nego i za razumijevanje efekata u drugim latentnim segmentima antropološkog statusa studenata, a posebno na Fakultetu sporta i tjelesnog odgoja. Na osnovu rezultata dobivenih u ovom istraživanju te zahvaljujući njihovim pozitivnim transformacijskim efektima kao i nezahtjevnim organizacionim i materijalnim uslovima, K-1 sport se može preporučiti za korištenje u nastavi osnovnih i srednjih škola u Bosni i Hercegovini.

Ključne riječi: transformacije, efekti, sastav tijela, učinkovitost mišića, borilačke vještine, spol.

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ACUTE EFFECT OF RESISTANCE VS AEROBIC TRAINING ON EXECUTIVE FUNCTIONS OF OLDER ADULTS

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ABSTRACT

Different exercise models has been investigated in regard to their effects upon cognitive performance being a great part of those related to executive functions (EF); however, most of the questions imply that literature lacks more complete explanations. Objectives: To determine the acute effects of resistance training (RT) or moderate-intensity continuous training (MICT) on the inhibitory control (IC) of older adults. Methodology: Sixty subjects were randomly divided into 3 groups (n = 20), Control (CON) that was kept in sedentary state, Resistance Training (RT) that performed Resistance Training, and Moderate-Intensity Continuous Training (MICT) that perform MICT, and all of them were subject to EF tests, Go/No-Go (GNG), Reaction Time (RET) and Flanker (FLK) to determine the function of inhibitory control before and immediately after their respective exercise session. The statistical analysis was performed by means of the Kolmogorov-Smirnov test and three-way ANOVA with the Dunn's posterior test with a significance of 5%, examined by use of the Graph Pad Prism 5.0 programme. Results: The MICT did not improve the RT response speed, GNG, the congruent and incongruent FLK ($p > 0.05$); however, the RT improved the response time to GNG ($p < 0.05$) in RT ($p < 0.05$), congruent ($p < 0.0001$) and incongruent ($p < 0.001$) FLK. Conclusion: Our data agree with part of the literature in which some types of exercise improve the function of inhibitory control, although, as it was seen here, only the RT demanding intense exercise improved the inhibitory control of the older adults, a fact that indicated a link between cognitive enhancement and exercise intensity.

Keywords: executive function, inhibitory control, intense exercise, motricity

INTRODUCTION

Among the variety of impairments associated with dementia, cognitive decrease is one of the most traumatic adverse effects which is very close to frailty. This is because these impairments occur in a close relationship with a number of cognitive deficits, as well as some other notable sensory dysfunctions and consequent psychological disorders (Curcio et al., 2019). Understood as being a condition with a very high prevalence of degenerative and progressive dementia (Lee et al., 2018), its global prevalence is currently reported as being very high and predicted to increase 4 times by the year 2050 (Kumar & Tsao, 2018). With the progression, the severity of neural deterioration tends to be associated with some serious cognitive problems, among which learning and EF are the most common (Kochhann & Wilson, 2019).

In this context, EFs, also known as cognitive planning, refer to highly hierarchical mental processes that are part of brain functioning which enables mental planning, the concatenation of ideas and the reduction of time between thought and action, thus being one of the most important functions of the human mind. When one needs to pay attention at performing cognitive or motor tasks, or when we are not at demands of intuitive activities, it would be more difficult to perform these tasks if it is at the expense of poor EF functioning (Diamond, 2013; Lima et al., 2017). However, as it would be obvious, EF requires greater effort than performing tasks in an automated way, so that maintaining attention or focus on a task requires a greater effort than in automated ones (Diamond, 2013).

It is a consensus that there are three main nuclei of EF; (i) inhibition or inhibitory control (Ghacibeh et al., 2007) mainly linked to motricity, (ii) interference control such as selective attention and working memory (Wambach et al., 2011) and (iii) cognitive flexibility, a condition that is closely linked to creativity (Diamond, 2013; Lima et al., 2017). Such cognitive abilities are fundamental skills for a person to obtain physical and mental success at school as well as in day-to-day tasks, mainly in the ones related to cognitive activities, social interactions and adequate psychological development (Collins, Roberts, Dias, Everitt, & Robbins, 1998).

Different possibilities have been described as positively influencing the capability of using and improving cognition and EF; among those possibilities, exercise of various nature appears with some frequency (Alves et al., 2012; Lima et al., 2017; Liu-Ambrose et al., 2010; Nouchi et al., 2014; Vestberg, Gustafson, Maurex, Ingvar, & Petrovic, 2012). For most of the researchers in cognition and specifically in EF, the immediate beneficial effects of exercise on these factors relate to acute and chronic changes in some neural mechanisms that may occur in consequence of a potential stimulation that flows from body exercitation to the brain, a condition that has allowed researchers to affirm that EF may be improved by physical exercises even after only a session of adequate exercises (Jäger, Schmidt, Conzelmann, & Roebers, 2014; Wen et al., 2018).

In fact, the potential benefits of exercises upon functional and structural improvements of the entire brain in the function of practices using different approaches are also seen in results coming from special populations, including normal or children with ADHD, healthy or pathological elderlies suffering from conditions such as Alzheimer's or dementia due to frailty; this last considered a possible ultimate condition for entering the Alzheimer's Disease (Boone et al., 2017; El-Sayed, Larsson, Persson, & Rydelius, 2002; Flöel et al., 2010; Jäger et al., 2014; Liu-Ambrose et al., 2010; Liu et al., 2017; Nouchi et al., 2014).

Despite intense literature indicating an unequivocal beneficial relationship between exercise and cognitive enhancement, there are some authors that disagree with this notion. In a particular position, Diamond (2013) affirms that exercise is an inefficient way to improve EF, a statement that addresses the question to be verified in this present paper. Therefore, the present study aimed to determine the acute effects of resistance training (RT) or moderate-intensity continuous training (MICT) on the inhibitory control (IC) of older adults.

METHODS

Study type and participants

The present study was of experimental type because it had experimental and control groups chosen at random. This study was conducted at a Higher Education Institution in Rio Branco, Acre, Brazil. Sixty volunteers of 25.55 + 3.22 years of age and 76.44 + 15.39 kg of body mass, of both sexes, all residents of Rio Branco, Acre, Brazil, participated in this study.

Design, instruments, and study procedures

The volunteers were instructed to wear light clothing, not to perform vigorous physical exercises or to consume large amounts of caffeine or products containing caffeine, such as chocolate, soda, and guarana, at least 72 hours before the tests. The tests were performed at three separate distinct times with 15 days between them to avoid any interference that one experimental situation could have on the other. The initial group of 60 volunteers was randomly divided into three groups.

The first group, hereinafter referred to as CON (n = 20), was kept in sedentary situation, RT group (n = 20) performed resistance training, and MICT (n = 20) group performed moderate-intensity continuous training. To measure changes in the inhibitory control, the participants completed the Reaction Time, Go/No-Go and Flanker tests, the latter, in its congruent and incongruent version, were applied. Initially, before data collection, the subjects went through two consecutive sessions of habituation with 50 tests each, and then, another 50 experiments were carried out, the latter 50 counting as results.

The same procedure was performed for the pre- and post-test. All three tests were performed on computers, inside a computer laboratory of the UNINORTE University Centre, with controlled temperature, light, and sound to avoid interference.

The Go/No-Go test required a binary decision on each stimulus. According to the type of stimulus, the subject should react (Go) or not (No-Go). Therefore, this test is considered a measure of inhibition response and is generally used to evaluate the ability to inhibit the "overbearing" response.

Specifically, the test required the participants to respond quickly, as quickly as possible and accurately to a circle of 5.5 cm in diameter with a massive green colour that occurred in between 40 and 60% of the trials and not respond to a non-target circle of 5.5 cm with a different colour pattern and that diameter occurred between 40 and 60% of the trials, randomly and with different stimulus times, so that there was no prediction of when the circle would appear.

As for the t-test of R and simple choice, the volunteer should react to a stimulus as soon as possible. This stimulus was the appearance of a 5.5 cm ball, black in colour, on the computer screen, with different stimulus times, so that there was no prediction of when the circle would appear. Finally, the Flanker has two versions, the congruent in which the test presents equal stimuli and the incongruent, in which the test presents different stimuli to which the volunteer must identify the stimulus before making the decision.

The stimulus is a screen with black arrows of varying size and quantity in which the subject should press the arrow of the computer keyboard according to the side on which the centre arrow of the screen appeared. If the centre arrow was pointing left, the left arrow of the keyboard should be pressed, and otherwise, if the centre arrow was pointed to the right, the right arrow of the keyboard should be pressed. In the congruent version, all arrows would point to the same side; however, in the incongruent one, the arrows would appear in different directions, forcing the subject to first identify the arrow to the right side.

Exercises protocols

Training was monitored using heart rate and the target training zone based on the equations proposed by Tanaka (Florindo, Latorre, Jaime, Tanaka, & Zerbini, 2004). To monitor heart rate during training, a ROSSMAX finger oximeter that performs measurements every 5 seconds was used as previously described (Marques et al., 2018).

A standardised 5-minute warm-up with stretching exercises and calisthenics was performed for 5 minutes. After that, the RT main work out was performed, consisting of the following exercises in sequences: forward-backward running, squats, push-ups, sit-ups, jumping jacks, walking lunges, dips, six-point support planks, pulse lunges, reverse lunges, skipping, mountain climbers, arm and leg raises, side steps, direction-changing footwork and going up and down the steps (25 cm), always among 80 to 90% of cardiac frequency.

Each exercise was performed for 60 seconds and the recovery always lasted 120 seconds. To MICT, a walk challenge of 40 minutes was performed from 60 to 65% of maximal cardiac frequency. Finally, a 5-minute cool down was carried out to promote calmness.

Statistical analysis

To verify the normality of the data, the Kolmogorov-Smirnov statistical test was performed. For data processing, a three-way ANOVA variance analysis with a significance of 5% was used. All tests were performed with a significance of 5% in the Graph Pad Prism 5.0 programme.

Ethics

This research complied with all mandatory requirements in accordance with the Law No. 466/2012 of the National Health Council of Brazil and was approved by the Ethics Council duly consolidated under the number of CAAE: 44907715.2.0000.5653 on 07/27/2015. All volunteers signed the free and informed consent form, were informed of the risks and benefits of the research, as well as all phases of the research, where they could decline their participation at the time they wished without entailing any penalty on the volunteer or any of the researchers and that their participations would not be remunerated. Additionally, all terms of the Declaration of Helsinki were followed to perform this investigation.

RESULTS

For all tests, the CG and MICT did not have difference ($p > 0.05$). However, the RT decrease the time speed response in Go/No-Go (Fig. 1A) ($p < 0.05$), reaction time (Fig. 1B) ($p < 0.05$), congruent flanker (Fig. 1C) ($p < 0.0001$), and incongruent flanker (Fig. 1D) ($p < 0.0001$), when comparing the before to after moment. Additionally, the RT display difference to all posterior tests in intergroup comparisons.

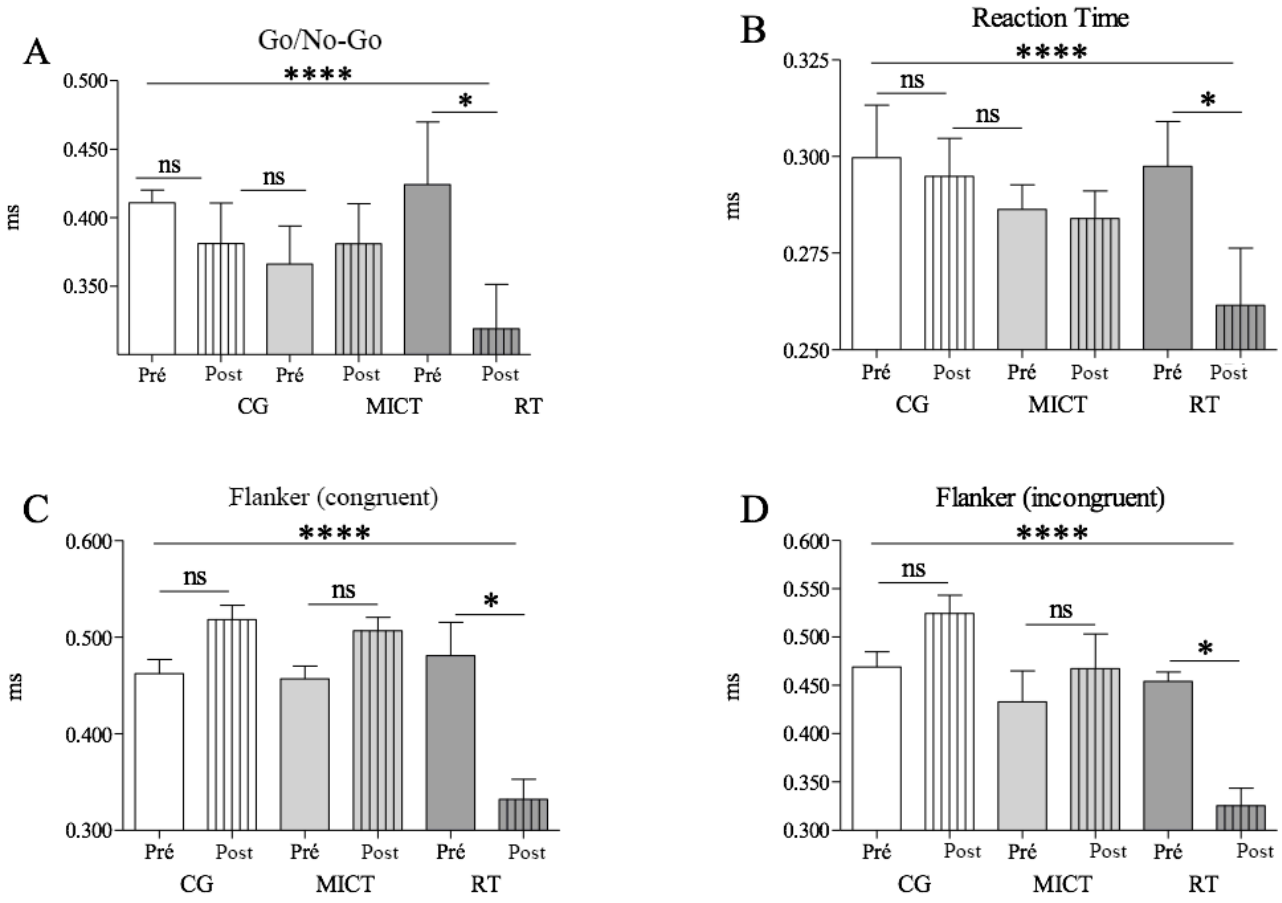

Figure 1 - Inhibitory Control. Sixty subjects were divided into three groups, Control (CON, n = 15), Resistance Training (RT, n = 20), and Moderate-Intensity Continuous Training (MICT, n = 20), and subjected to IC tests: (A) Go/No-Go, (B) Reaction Time, (C) Congruent Flanker and (D) Incongruent Flanker, immediately before and after the experimental situations. The three-way ANOVA and Dunn's subsequent test with 5% significance was used to determine the possible differences between the pre- and post-test. (ns = not significant) (1A, 1B, 1C, and 1D * = $p < 0.05$ **** = $p < 0.001$)

DISCUSSION

The present study aimed to determine the acute effects of resistance training (RT) or moderate-intensity continuous training (MICT) on the inhibitory control (IC) of older adults. Here, it is evident that the RT is able to improve the IC; however, the MICT was not. This suggests that the exercise intensity has an influence on brain functional modifications. Although the mechanisms by which the behaviour described here were not investigated, according to the literature, the compounds used here are neurostimulants, that is, with their activity primarily concentrated in the central nervous system (Graham, 2001; McLellan et al., 2016; Nehlig, Daval, & Debry, 1992).

Otherwise, it seems that the physical component present in exercise has some influence on the inhibition control as previously demonstrated (Chang et al., 2015; Guiney, Lucas, Cotter, & Machado, 2015; Loprinzi & Kane, 2015) and the data of this investigation provides similar evidence. Different actions can improve EF in an acute or chronic way, in people with different ages and physical and mental conditions; however, they did

not improve it in an acute way (Boone et al., 2017; Lima et al., 2017; Verburgh, Königs, Scherder, & Oosterlaan, 2014; Wen et al., 2018). Regarding the improvements observed, Jo, Chen, Riechman, Roig and Wright (Jo et al., 2018) described that an exercise session can reduce the interference between cognition and learning, that is, it is able to facilitate the acquisition of the flow of information necessary to do well in the procedures of a motor task execution. This reduction of interference was somewhat confirmed here since considering the inhibition control as a part of the superior cognitive functions seems to have had a positive influence of the exercise, and it can be admitted here that this improvement could have played an important role on the cognition and motricity of the group which participated in this research.

Another study demonstrated that cognitive performance may be related to exercise intensity, and this fact undoubtedly has implications for the sports, educational and occupational environment (Rattray & Smee, 2016) important for future work, as well as implications for the discussion of the present study. The data shown here appear to support this notion, although the experimental design used here does not exactly parallel those studies, but is similar to anterior studies that used resistance or aerobic exercises with intense approach as a priority.

Specifically for aerobic exercises, there is an abundant number of studies proving that an acute session of this kind of exercise can improve EF, including inhibitory control in different populations (Byun et al., 2014; Hyodo et al., 2012; Tsukamoto et al., 2017; Yanagisawa et al., 2010). Crush and Loprinzi, (2017), in an extensive investigation that sought to determine the effect of moderate intensity exercise exposure time, recovery time and different combinations of these two factors, noted that all training regimens benefited the subjects' planning capacity, memory, inhibitory control and also described that there is an effect dose exercise response and recovery on the EFs, which also corroborate our data currently under discussion.

In addition, it has been previously demonstrated that the improvement of inhibitory control induced by exercise is related to the improvement of neural activity (Hyodo et al., 20102; Yanagisawa et al., 2010). Also, along the same lines, Byun et al. (2014) demonstrated that the increase in cerebral neural activity induced by aerobic exercise is related to increased neural arousal, a condition that can be expected in studies relating to neural activity and inhibitory control. Based on these findings, previous studies have proposed that the potential mechanism underlying the improvement of the inhibitory control is associated with increased cerebral neuronal activation and stimulation control, a statement that can perhaps be a mechanism linked to the behaviours observed here for the inhibitory control gains induced by our experimental manipulation.

This has been proposed by a series of studies stating that an increase in neural excitability can be mediated by a number of different mechanisms, such as increased cerebral blood flow (Guiney et al., 2015), neurogenesis, synaptic plasticity, cell proliferation, acute increase in brain-derived neurotrophic factor (Tsai et al., 2014), and associated neural efficiency, which may be partially dependent on cardiorespiratory fitness (Tsai, Pan, Chen, Wang, & Chou, 2016). However, due to what was observed for the exercise itself, the increase in the blood flow, to which Tsai et al. (Tsai et al., 2016) refer, should be the main mechanism that provided the aforementioned improvement in the inhibitory control of the older adults studied here, a conclusion derived from the observation that, in relation to the exercise practice proposed here, its subsequent data collection occurred immediately after the practice.

Together, the data just described give theoretical support to its related findings in such a way that it almost unequivocally state that exhaustive exercise with short duration promotes immediate positive effects on the inhibitory control of the older adults who participated in this study. This is a result that promotes consistent evidence that short-term exhaustive exercise improved the inhibitory control and decision-making of those older adults, the conditions which can be associated with their level of cognition and brain health.

CONCLUSION

The data exposed here agree with part of the literature in which some types of exercise improve the function of inhibitory control, although, as it was seen here, only the RT demanding intense exercise improved the inhibitory control of the older adults, a fact that indicated a link between cognitive enhancement and exercise intensity.

To progress in this direction, it is suggested to conduct a strong dose of research centring on this modality of exercise in reference to advanced cognition compounds as well as to other human executive functions.

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AKUTNI EFEKAT TRENINGA IZDRŽLJIVOSTI NASPRAM AEROBNOG TRENINGA NA IZVRŠNE FUNKCIJE STARIJIH ODRASLIH OSOBA: KONTROLISANO ISPITIVANJE

Uvod: Različiti oblici vježbanja su istraživani u odnosu na njihove efekte na kognitivnu učinkovitost što predstavlja veliki dio onih vezanih za izvršne funkcije (EF), međutim, većina pitanja povlači za sobom činjenicu da u literaturi nedostaje potpunijih objašnjenja. Ciljevi: Utvrditi akutne efekte treninga izdržljivosti (RT) ili neprekidnog treninga umjerenog intenziteta (MICT) na inhibitornu kontrolu (IC) starijih odraslih osoba. Metodologija: Šezdeset ispitanika je nasumično podijeljeno u 3 grupe (n = 20), Kontrolna (CON) koja je bila fizički neaktivna, Trening izdržljivosti (RT) koja je podvrgnuta treningu izdržljivosti te Neprekidni trening umjerenog intenziteta (MICT) koja je podvrgnuta MICT treningu, a sve su bile podvrgnute EF testovima, Go/No-Go (GNG) testovima, testu vremena reakcije (RET) i Flanker (FLK) testu kako bi se utvrdila funkcija inhibitorne kontrole prije i odmah nakon provođenja njihovih pripadajućih treninga. Statistička analiza je provedena putem Kolmogorov-Smirnov testa i trostruke ANOVA-e uz Dunnov test sa značajnosti od 5%, kao i korištenjem programa Graph Pad Prism 5.0. Rezultati: MICT nije poboljšala RT brzinu reakcije, GNG, kongruentni i nekongruentni FLK ($p > 0,05$), međutim, RT je poboljšala vrijeme reakcije za GNG ($p < 0,05$) u RT ($p < 0,05$), kongruentnom ($p < 0,0001$) i nekongruentnom ($p < 0,001$) FLK. Zaključak: Naši podaci se slažu sa dijelom literature u kojoj neki oblici vježbanja poboljšavaju funkciju inhibitorne kontrole iako je, kao što smo ovdje i vidjeli, samo RT zahtjevna intenzivna vježba poboljšala inhibitornu kontrolu starijih odraslih osoba, a što je činjenica koja ukazala na vezu između kognitivnog poboljšanja i intenziteta vježbe.

Ključne riječi: izvršna funkcija, inhibitorna kontrola, intenzivna vježba, motorika

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SPORT IN THE AGE OF THE CORONAVIRUS (COVID-19)

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ABSTRACT

This paper analyses the impact of coronavirus (COVID-19) on sports events, athletes and all social activities related to sports. Aspects of the sport that led to the massive spread of COVID-19 were analysed. The results of the research indicate that the mass which accompanies sports events is the main cause of such a rapid spread of the COVID-19 pandemic. The negative effects of the pandemic on the economic aspect of sports, the sports industry and all its participants were also analysed. The paper presents results that indicate the same vulnerability of professional athletes as all other categories of the population. The rules set by the World Health Organisation (WHO) for all categories of the population were also analysed.

Keywords: sport, coronavirus, COVID-19, pandemic

INTRODUCTION

The COVID-19 pandemic has affected the organisation and functioning of all social spheres, including sports. Preventing the transmission of COVID-19 represents a necessity so as to decrease the risk of spreading the disease to individuals within the community who are exposed to the high risk of infection and death. The most vulnerable categories of the population are older people and people with chronic diseases. COVID-19 prevention is also important for competitive athletes in order to decrease disruptions in the training process and reduce the harmful effect it could have on the respiratory tract and aerobic capacity.

Its indirect significance is also reflected in preventing the possibility for athletes or spectators to, as the participants of a sports event, become potential carriers, i.e., pose a danger for all the people with whom they come into contact. The spread of the pandemic poses a danger on various grounds: health, social, economic and political.

Health represents the most important part of human habitation and functioning. With impaired health, the possibility of development for an individual, group or the entire population in other spheres (social, economic, cultural, etc.) is reduced or even eliminated. In a situation when an individual's, group or the health of the entire population is impaired, all energy and focus is directed towards keeping or regaining health.

THE IMPACT OF COVID-19 ON SPORTS ACTIVITIES

The COVID-19 virus has spread all over the world, directly affecting everyday life of a large part of the population. Most countries have imposed strict social distancing measures so as to prevent the spread of the virus. Social distancing implied a series of measures: staying home, closing schools and businesses.

These measures also included sport as a part of social activities.

Thus, the livelihood in this area was significantly jeopardised. Everyday functioning was disrupted in terms of numerous activities: gyms, leisure time and recreational content. Additionally, professional and group sports were suspended. This had numerous economic and social repercussions. A lot of problems occurred in the sports sector:

• Sports and leisure facilities are temporarily closed, not generating revenue.

• Sports facilities still have to pay maintenance and basic expenses despite the lockdown (e.g., golf courses).

• The sports sector is strongly associated with the hospitality, tourism and the recreation sectors.

All major sports leagues and tournaments have been suspended or cancelled due to COVID-19 since the beginning of March 2020. Initially, the decisions were such that competitions could still be held, but without spectators, and later, all sports competitions were completely suspended. In the case of the National Basketball Association (NBA), the season was cancelled shortly after one player has been tested positive for COVID-19. Apart from local and national competitions, even the major sports competitions were postponed. The Tokyo Olympic and Paralympic Games, which should have been held in 2020, have been postponed to summer 2021 based upon the decision of the International Olympic Committee .

COVID-19 affects all sports, especially group sports. It is impossible to hold team training, and in many countries, indoor and outdoor training has been banned. In such instances, athletes, such as swimmers, cyclists and team athletes, can especially suffer major negative effects. The different approach employed by countries in terms of restriction measures gives rise to different rights of athletes in certain countries. Thus, athletes in some countries, in which measures undertaken so as to prevent the spread of the COVID-19 pandemic are less restrictive, have significantly greater opportunities for training and keeping fit than the athletes in countries imposing rigorous and absolute measures .

THE SPREAD OF COVID-19 AND THE ACCOMPANYING ROLE OF SPORTS

The first European cases seemed to be associated with a Chinese individual who had infected several employees of a company near Munich at the end of January 2020. Despite the attempts made by health workers to identify and quarantine this individual and all the people with whom the person came into contact, the infection spread to others. The following two examples indicate how sports events contributed to the rapid spread of COVID-19. An Italian "patient 1" probably became infected in Munich, moved to Northern Italy and then met an estimated 600 people. This was the initiator which caused the outbreak of the epidemic. Similar phenomena took place in other countries. Like other mass gatherings, sports events have contributed to the rapid spread of SARS-CoV-2.

THE BERGAMO CASE

The Bergamo case is an example of the strength and potency pertaining to the virus spread. On 19th February, at the Champions League match between Atalanta and Valencia in Milan, a rapid spread of the coronavirus occurred. Around 40,000 fans from Bergamo, who travelled to Milan in order to watch their team, Atalanta, playing against the Spanish team Valencia, were exposed to the COVID-19 virus. "It was crowded in the stadium and then afterwards in the bars.

For sure, that night there was a strong escalation of contagion between people", Giorgio Gori, the mayor of the city of Bergamo pointed out. A few days prior to this match, the virus had spread to Codogno which is about 64 km from Bergamo. About 2,500 Valencia fans travelled to Milan for the game, several of whom also tested positive, including a Spanish journalist .

THE ISCHGL CASE

The second example for a sports-related spread of SARS-CoV-2 is linked to the Austria ski resort of Ischgl. On the first of March 2020, officials in Iceland discovered that 14 out of 15 passengers who tested positive for SARS-CoV-2 had been in Ischgl. Norway stated in its daily report on 18th March, 2020 that 531 (40%) of its 1326 positive cases at the time had probably become infected in the Austria ski resort.

These two examples highlight the potential dangers that could be initiated at sports events and during mass sports activities in a relatively limited space .

THE IMPACT OF COVID-19 ON THE ECONOMY

National health is most clearly assessed in crisis situations when statistical data is observed with particular attention. It is precisely in such circumstances that most attention and calculation is paid to prevention, the price of health services and the cost of an unhealthy lifestyle. Research has demonstrated that every £1 spent on sport generates £1.91 in health and social benefits. Engaging in sports significantly reduces the risks of congenital heart disease/stroke, breast cancer, colon cancer, type 2 diabetes and dementia, and overall generally better health. Other social benefits include reduced crime and improved education, personal development, social capital and well-being . The fact that the value of the global sports industry

has been estimated at USD 756 billion annually explains how much COVID-19 affected the economy of numerous countries. Numerous jobs have been jeopardised, and not only for professional athletes. The pandemic has also affected the employees of sporting services industries connected with sports leagues and events, which include travel, tourism, infrastructure, transportation, hospitality and media broadcasting, among others.

Professional athletes are prevented from training and competing. This directly affects the risk of losing professional sponsors who may not support them as initially agreed . The negative effects of COVID-19 on tourism are partly caused by cancellation of all league competitions and major international sports events. The connection of sport and tourism confirms the causal relationship with negative results. Global GDP losses under the most optimistic tourism reduction scenario amount to $1.17 trillion, (1.5% of the global GDP).

THE WHO SETS THE RULES OF THIS "MATCH"

All countries in the world have, more or less, been faced with COVID-19. This "match" was played by all countries. Organisers of sports events, in those countries which decided to continue holding sports competitions without spectators, must abide by certain measures prescribed by the World Health Organisation (WHO). In cooperation with medical staff, competition organisers must promote adherence to the following guidelines and preventive measures:

Hand hygiene: General guidelines include washing hands often with soap and water for at least 20 seconds or using a hand sanitiser (at least 60% alcohol). As the virus can survive for days on surfaces, frequently touched objects and surfaces should be regularly cleaned and disinfected.
Social distancing: Avoiding mass gatherings and maintaining distance (approximately 6 feet) from others when possible. This practice is being advocated by governments and promoted by professional athletes as well.

Travel: Many countries have imposed travel restrictions. Measures have ranged from suspending flights and banning travellers from affected countries to in-home isolation for 14 days after returning from specific destinations.
Face mask: Asymptomatic athletes should not be advised to wear a mask to prevent becoming infected with COVID-19.

Inappropriate use of masks can affect supply and demand to the point where health care workers will have inadequate protection.

A conservative approach implied advising athletes to limit training sessions to <60 minutes and to <80% of maximum ability. The management of COVID-19 infection depends on the severity of symptoms. Managing symptoms in athletes primarily involves symptomatic treatment with rest and without the use of antipyretics. .

The COVID-19 pandemic has caused the closure of gyms, stadiums, swimming pools, dance and fitness studios, physiotherapy centres, parks and playgrounds. This significantly disrupted everyday habits and needs of individuals in terms of engaging in sports and recreational activities. These circumstances have directly affected the individuals' health regarding obesity, and increased cholesterol, and indirectly affected sleep disorders, anxiety, etc.

ALTERNATIVE EXERCISE METHODS

In cases when exercising is not possible in outdoor areas and indoor halls, rooms and gyms, many find that exercising at home is the only remaining alternative.

For people who remain sedentary for a large number of hours per day due to the nature of their job, stretching exercises, climbing stairs, doing housework or dancing to music represent the only and significant forms of engaging their body (muscular and cardiovascular mechanism) in physical activity.

As a communication channel, the Internet enables accessing and engaging in various forms of home exercise with a wide range of content related to this topic. These possibilities are especially important for older people and persons with physical disabilities who already have restricted movement options .

ARE ATHLETES IMMUNE TO COVID-19?

Are athletes immune to the severe symptoms of COVID-19 due to their cardiorespiratory fitness?

The following examples only represent some of the cases proving that even professional athletes succumb to infection and vulnerability:

- "Patient 1" of the Italian COVID-19 outbreak was 38 years old. The person in question was a marathoner who spent more than two weeks in intensive care with severe pneumonia.
- Mark Stubbs, a fit 28-year-old marathoner, also required intensive care.
- Former Olympic Gold and Silver medallist swimmer Cameron Van der Burgh proclaimed on 22nd March 2020 that she has been struggling with COVID-19 for 14 days and that this is, by far, the worst virus she has ever endured despite having healthy lungs (no smoking, engaging in sports, leading a healthy lifestyle).
COVID-19 has become the respective opponent for all countries. The human population has faced the pandemic which claims many lives. COVID-19 has pointed to the real weaknesses of the healthcare system and vulnerability of individuals and groups.

A lot of people have lost their jobs. Many companies have been extinguished. Apart from the negative context, COVID-19 can be observed with regard to positive consequences. The positive aspects of COVID-19 for individuals and the entire population are:

• Increased prevention and hygiene
• Realistic reflection of deficiencies in the healthcare system and institutions
• Individuals' orientation towards themselves, their family and nature
• Development of national tourism
• Development of small-scale agriculturalists and entrepreneurs
• Development of electronic (Internet) business - selling products and offering services.

CONCLUSION

"Nothing is as it was, nor will it be so again!" COVID-19 represents a real problem faced by individuals, groups and entire nations.

The pandemic has also significantly affected sport as the unavoidable segment of social activity. Sports events have represented an increasing factor for the spread of the pandemic. Sports organisations and clubs have faced the obstacles in the form of World Health Organisation measures adopted with the goal to contain the pandemic.

Sport has become a victim of its specificity with regard to spatial limitation, mass spectators and profitability imperatives.

Professional athletes have been left at the merciless hands of the pandemic repercussions regarding sponsorship agreement termination, financial collapse and psychophysical quarantine.

The results have shown that the relationship between sports, tourism and hospitality is an excellent combination under normal circumstances, but also a recipe for disaster under extraordinary (pandemic) circumstances.

COVID-19 has prompted individuals and groups to initiate an active analysis of health, existence, vulnerability, relationships, conditions, meaning and all other philosophical and real issues.

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SPORT U DOBA KORONAVIRUSA (COVID-19)

Ovaj rad analizira uticaj koronavirusa (COVID-19) na sportske manifestacije, sportiste i sve društvene aktivnosti vezane za sport. Analizirani su aspekti sporta koji su doveli do masovnog širenja COVID-19. Rezultati istraživanja upućuju na činjenicu da su mase ljudi koji prate sportske manifestacije uzrok brzog širenja pandemije COVID-19. Nadalje, analizirani su negativni efekti pandemije na ekonomske aspekte sporta, sportsku industriju i sve učesnike. Rad predstavlja rezultate koji upućuju na istu ranjivost profesionalnih sportista i svih drugih kategorija populacije. Analizirana su i pravila Svjetske zdravstvene organizacije za sve kategorije populacije.

Ključne riječi: sport, koronavirus, COVID-19, pandemija

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FINGER TEMPERATURE WHEN SHOOTING FROM A RIFLE IN THE COLD: THERMAL RECOMMENDATIONS

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ABSTRACT

In frosty weather, biathletes may have a decrease in athletic performance due to local cooling of the fingers, which is caused not only by frosty air but also by a cold rifle. The degree of local cooling and the risk of finger frostbite increases as the frost, wind and snowfall increase, and as the duration of their contact with cold objects increases. To maintain high sports results in the winter season, it is recommended to monitor the local temperature dynamics of biathletes' fingers using a thermal imager. Cross-country skiing, the quality of aiming and accuracy of rifle shooting during training and competitions should take into account not only the general and local cooling associated with the weather, but also the local progressive cooling of the index finger of the athlete's working hand associated with its contact with the handle of the ski stick and the trigger mechanism of the rifle. The dynamics of local temperature in the fingers when holding products in frosty weather, based on modern data found in the literature, is described in practical detail. In addition, it is necessary to upgrade the handles of ski poles and triggers of winter rifles to reduce the degree of cooling, the risk of finger frostbite and improve the accuracy of shooting biathletes. The purpose of this work is to give practical recommendations on the preparation of training sessions and sports competitions for professional biathletes in the winter season.

Keywords: winter, sports training, temperature, fingers, trauma, injury prevention

INTRODUCTION

The optimal temperature of all parts of the body is a very important factor for maintaining the health of athletes and achieving high results during training and sports competitions, since temperature greatly affects the intensity of the metabolism and the functional activity of all body systems. In particular, temperature changes the physical, chemical, physical-chemical and biochemical properties of all chemical elements, materials, substances, as well as organs and tissues of all living objects. In classical chemistry, the most well-known law on the role of temperature for life on Earth is the Arrhenius law which states that the rate of chemical reactions increases by an average of 2 times with each increase in the temperature of the interaction medium by 10 °C [1].

People are warm-blooded animals, so normally an athlete can keep his body temperature within + 37.0 ± 0.5 ° C, and in cold conditions with intense physical activity, his body temperature can rise to + 40.0 °C [2-4].

The fact is that hyperthermia allows you to fight hypothermia. In addition to this, the warmer parts of the athlete's body are tuned to higher performance of skeletal muscles and more precise execution of mechanical movements, which increases athletic performance [2, 5, 6].

At the same time, an increase in a person's body temperature above +40.5 °C or a decrease in body temperature below +35.0 °C can reduce athletic performance and cause thermal damage to tissues [2-4, 7].

The most likely reasons for an excessively high increase in body temperature of athletes during training and sports competitions is a very high intensity of physical work they perform. It is shown that the probability of temperature increase is highest if the athlete performs work in a very high ambient temperature. Similarly, the most likely cause of excessive cooling of body parts is an excessively low ambient temperature (usually air and/or water), combined with an excessively low intensity of muscle work or lack of it.

Therefore, in conditions of excessive heat and frost, it can be difficult for an athlete to maintain the "necessary" temperature level in the "working" areas of his body [7]. Moreover, cold weather conditions are more dangerous for athletes than warm ones. It is shown that the probability of cold damage increases with increasing wind strength, rain and/or snow intensity. Frostbite most often occurs in exposed parts of the body, such as the nose, ears, and fingertips [3, 8, 9].

That is why athletes who train or take part in sports competitions in the cold, high humidity and strong winds are more likely to be at risk of injuries caused by exposure to cold [10]. It has long been known that frostbite is most likely to occur in military personnel and athletes involved in traditional winter sports such as cross-country skiing, biathlon and orienteering [9, 11, 12]. At the same time, an additional cause of cold injuries in athletes is cold objects that their hands come into contact with in the cold (most often these are ski poles and firearms).

To prevent finger frostbite, military personnel and athletes wear winter gloves and/or winter mittens. However, modern mittens and gloves are not designed for shooting small arms, so the fingers are always cooled while firing weapons. In this regard, clarifying the dynamics of local temperature in the fingers when in contact with metal objects in the cold will allow athletes and competition coordinators to more reliably avoid cold damage, and medical workers to prevent and treat this disease [13, 14].

The importance of this problem has also increased in recent years because the scale of people's physical activity in the open air is currently increasing. The fact is that people's life expectancy has increased. This has led to an increase in the proportion of older people in society.

And older people have more free time and can devote it to their physical health. In particular, in recent years, it has become fashionable for older people to engage in Nordic walking in the open air. At the same time, they go all year round, including in frosty weather.

In parallel, the number of young people involved in extreme sports and adventure racing is growing. In this regard, young people and the elderly spend more and more time outdoors every year, which in winter conditions increases the likelihood of cold injuries [11, 15].

Thus, a more in-depth analysis of the causes for cold hand injuries is needed to prevent, recognise and treat them. This information is not only needed for athletes. Sports coaches, event organisers, and sports doctors should also be aware of these risks, as this will help them implement a better strategy to prevent cold injuries [10]. In addition, manufacturers of sports clothing and sports equipment should be aware of the causes for cold damage [16].

FEATURES OF HUMAN THERMOREGULATION IN COLD CONDITIONS

Natural adaptation to the cold (natural thermoregulation) plays an important role in the prevention of cold damage to the body of athletes engaged in winter sports in frosty weather [17-20]. It has long been known that the natural adaptation to frosty conditions is different in people living in Northern and Southern latitudes.

At the same time, people who traditionally live in Northern latitudes have a higher resistance to cold. In addition, it is shown that, regardless of the initial resistance to cold, adaptation to frost can be increased by increasing the duration of people's stay in the cold. In particular, it was shown that the probability of cold injuries to the hands of adults who were in Antarctic conditions for 53 days decreased as the duration of the total period of periodic daily stay in the cold increased [21]. These results allowed us to conclude that a decrease in the damaging effect of cold on the hands with an increase in the duration of stay in the cold is associated with a partial general acclimatisation of people to the cold.

In addition, the local reaction of blood vessels to acute cooling plays an important role in preventing cold damage to the hands. It is known that cooling the hands when they are lowered into cold water initially causes a spasm of blood vessels, the duration of which varies from person to person. Strong vasoconstriction contributes to even greater cooling of the hands and reduces survival in the cold.

At the same time, people who have a very long duration of this phase suffer from the effects of cold more than other people for whom this phase is short or absent, and instead the vessels expand.

This vasodilation was first described almost 100 years ago and has been termed the hunting response or cold-induced vasodilatation (CIVD) [22]. However, this is still debated and there are no clear ideas about the significance of this phenomenon for athletes involved in winter sports, in particular, those such as biathlon. In recent years, it has been shown that cold can cause a spasm of blood vessels in the hands without the participation of general thermoregulation mechanisms. In particular, it was possible to reduce the vasoconstrictive effect of cold by a pre-local treatment of the hand skin with low-melting fats (mink, goose, bear) or vegetable oil. At the same time, "The method of modelling the redness" (SU 1705857) was invented. In this invention, low-melting animal fat or vegetable oil is applied to the skin of the hands in a dose of 50-100 mg/cm2 for 6-12 hours before the local temperature drops to +18 - +20 °C.

Then it was shown that the effect of fusible fats can be enhanced by a combination with an anaesthetic drug. The first patent for such an invention was issued in 2018. This invention is called "Cream for frostbite prevention" (RU Patent 2647372). This invention is a liquid cream for frostbite prevention containing an oil phase, structure-forming emulsifiers and an aqueous phase with lidocaine hydrochloride, characterised in that the oil phase is a fused bearish fat, and lidocaine hydrochloride is contained in both phases in a ratio of 0.5–10.0 % by weight.

In this regard, it can be considered that one of the symptoms of adaptation to cold may be early and pronounced cold vasodilation occurring in the fingers after vasoconstriction which initially occurs in them [23, 24].

INFRARED IMAGING OF HAND TEMPERATURE IN ATHLETES

Detailed information about the dynamics of local temperature in the fingers can only be obtained if it is continuously recorded with high accuracy and reliability. However, recording the dynamics of the local temperature of athletes' limbs for a long time was possible only with the help of contact thermometry, which had many limitations and was not highly accurate [25]. In this regard, until recently, there was no detailed and accurate information about the dynamics of local temperature in the hands of athletes during training and sports competitions in frosty weather.

Highly accurate quantitative and qualitative information about the dynamics of local temperature in the hands of athletes appeared only in recent years thanks to the use of thermal imagers [26-30]. The use of thermal imagers for biomedical research has made it possible to expand the scale of highly accurate data on the dynamics of local temperature in various parts of the human body, several times. This was made possible by the enthusiasm and personal contributions of researchers in Europe such as Francis Ring from North Wales, Kurt Ammer from Vienna, Anna Jung from Warsaw, and Antonio Nowakowski from Gdansk [22, 26, 27, 31, 32].

Currently, the leadership in the development of methods for infrared diagnostics of injuries in athletes is firmly occupied by Spanish researchers who are conducting research under the direction of Manuel Sillero Quintana from Madrid [33].

It is shown that infrared thermography, carried out with the help of modern thermal imagers, allows you to safely, with very high accuracy and non-invasively, as well as at a long distance, continuously record the dynamics of the local temperature of any part of the human body surface in a large range of ambient temperatures, including cold weather and frosty days [34].

The only condition for obtaining the necessary information is the bareness and visibility of the selected part of the body surface. In this regard, the dynamics of local temperature of the skin, mucous membranes and open wounds are usually recorded. It is assumed that infrared thermography provides information not only about the local temperature of the surface itself, but also about the temperature of the tissues located under them; however, at a shallow depth: no deeper than 1.5 cm from the surface under study [26, 27].

Previously, NEC and FLIR thermal imagers were widely used for such biomedical research [29, 30]. Currently, the most widely used thermal imagers are of the FLIR brand [35]. At the same time, highly sensitive thermal imaging cameras are selected, providing local temperature recording with an accuracy of at least 0.01 °C.

Thermal imagers allow highly accurate digital recording of body surface temperature in real time, which can be archived, transmitted to any distance, and processed. In particular, NEC brand thermal imagers are equipped with computer programs Thermography Explorer and Image Processor. In addition, thermal imagers provide video recording of the studied body surface in the infrared range of the tissue radiation spectrum, that is, they allow you to shoot a colour video film, which can also be saved in digital format, transmitted to any distance, and the data obtained can be processed using computer programs [26-28].

Infrared diagnostics using a thermal imager is distinguished by the following advantages: contactless, noiseless, secretive information acquisition for the object under study and its

neighbours, portability, the possibility of many hours of continuous monitoring and "endless" observation of several patients at the same time, independence from the object's illumination, high speed of information acquisition, and the duration of its storage in the "digital" version, the ability to instantly analyse it using computer processing and the ability to transport and transmit the received data over a long distance by e-mail.

The ability to get information about the temperature dynamics from a distance of several metres from the person under study is especially convenient for use in sports, and it does not affect the performance of the athlete and increases the accuracy of measuring the local temperature of his body due to the lack of physical contact with him [27, 30, 31, 33]

FEATURES PERTAINING TO THE LOCAL COOLING OF FINGERS WHEN SHOOTING FROM A RIFLE IN THE COLD

Until now, small arms are traditionally produced only in the "summer" version. However, in recent years, there has been a need for "winter" rifles and submachine guns. This is due to the development of sports competitions in biathlon and the development of territories in the Northern latitudes.

The fact is that "summer" rifles are not designed to preserve heat and warm up a person's fingers in the cold. At the same time, the main condition for high performance of an athlete and a soldier in the cold is the preservation of heat not only in the entire body, but also in the fingers. In this regard, the "Winter sniper rifle" (RU Patent 2687227) and "Winter Kalashnikov assault rifle with heat-insulating coating and a set of sealed plastic package" (RU Patent 2714959) were invented.

In order to keep their hands warm in the cold, biathletes and snipers use warm winter clothing, including winter gloves and fur mittens. However, a study on the dynamics of the hand temperature in volunteers, conducted using a thermal imager while holding cold objects in their hands during cold conditions, with winter fur mittens, showed that a cold object accelerates and increases the cooling of the hands [34].
At the same time, it was found that cooling begins with the tips of the longest fingers and starts very quickly, namely, from the first minute after holding a cold object in the hand.

Therefore, to prevent finger frostbite in winter gloves in the cold, a "Winter gauntlet with an internal heated pocket" (RU Patent 2709633) was developed in addition to the "Winter wrench" (RU Patent 2695737). It should be added that, in recent years, in order to keep the fingers of skiers warm in the cold, "Ski poles with heated handles" have been developed (RU Patent 2625089).

However, modern sports rifles and pistols still do not warm the hands of athletes in cold weather and do not protect them from frostbite in the cold. In this regard, during sports competitions in biathlon, modern rifles are able to cool the fingers of athletes, in which cold injuries can occur up to frostbite of the fingers [35]. At the same time, gloves do not guarantee the preservation of heat in the fingers, but they reduce the sensitivity of the index finger, so they reduce the accuracy of pressing it on the trigger and shooting accuracy.

However, cold damage to the fingers of biathletes did not attract the attention of researchers for a long time. At the same time, it has long been known that the most highly accurate shot from a sniper rifle can be made when you pull the trigger with just your bare index finger. Therefore, despite the cold and the risk of frostbite, biathletes and snipers, even in the cold, expose their index finger of the working hand, press the bare finger to the cold trigger and hold the phalanx of the finger in close contact with the trigger for several seconds for accurate aiming.

However, the trigger and trigger guard of small arms have remained metal for more than 200 years. Therefore, in frosty weather, the trigger mechanism of modern rifles can play the role of a "refrigerator" for the fingers of a biathlete's working hand.

It is known that the fingers become harder when the local temperature decreases in them. In addition, they develop a spasm of blood vessels, which is accompanied by the appearance of pain. At the same time, the blood in the blood vessels becomes thicker when the temperature decreases and loses its ability to clot, so it does not turn into a blood clot.

A spasm of blood vessels and blood thickening in the cooled fingers reduces the intensity of blood movement and the flow of warm blood to the fingertips, which contributes to their deeper cooling. It should be added that local hypothermia reduces the sensitivity of tactile receptors, which contributes to the development of anaesthesia. Therefore, lowering the temperature of the fingers reduces their tactile sensitivity, which worsens the quality of pressing the trigger [36-42].

Therefore, cooling the fingers during aiming does not improve the biathlete's accuracy of shooting with a rifle.

DEVICES AND METHODS FOR PROTECTING COLD FINGER INJURIES WHEN FIRING A RIFLE

The first inventions aimed at thermal insulation of a metal trigger or the entire trigger device, together with the bare finger of a sniper's hand, in order to preserve heat in the hand while aiming a rifle, were developed in 2018, and their patents were issued in 2019. "Winter launcher mechanism of the sniper rifle" (RU Patent 2680365) was initially invented.

Outer parts of the sniper rifle trigger are covered with a layer of durable heat insulating material. The cover is made of elastic heat-insulating material with fur, placed on the outer parts. The working side has a self-closing cut for inserting a shooting finger.

Subsequently, a "Winter camouflage muff for the sniper hand" (RU Patent 2677070) was developed. This invention relates to winter outerwear and, in particular, to white snow sniper camouflage systems, as well as the protection of his working hands from frostbite, and is designed to maintain hand heating during long waiting and aiming in order to improve the accuracy of firing from a sniper rifle in the cold.

Its body has the shape of an open hollow conical cylinder with a 3/4 length longitudinal incision of the wall from the base of the cone and with straps, while the body is made of tanned fur sheepskin with inverted fur, has the dimensions that ensure dressing on the breech from the muzzle end, hiding grasp, buttstocks, and a trigger guard for the hand of an adult male in the working position when the index finger touches the trigger guard.

The straps are made of stretchable material. One strap is attached to the entire surface of one plane to the outer surface of the coupling along the edge of the entire perimeter of the hole on the top side and squeezes it to dimensions that provide circular hiding of the barrelling front pertaining to the trigger guard. The other two belts are firmly attached with their ends to the outer surface of the coupling on one side of the section, respectively, in the initial and central parts of the belt in the direction from the section and perpendicular to it.

The free ends of these belts have fastening elements, and the dimensions of the belts and fasteners ensure reliable fixation of the cut edges of the coupling in working condition.
The body, straps and fasteners are white, retain integrity and high elasticity in conditions of repeated flexion-extension at a temperature of 0-80 °C.

In parallel, an invention called "Sniper rifle trigger guard closing device" (RU Patent 2684952) was created. The trigger guard closing device has housing, the straps and fasteners are white in colour, retain integrity and high elasticity under conditions of repeated flexion-extension at a temperature of 0–80 °C, the housing is made in the form of a sheep skin flap folded in half with inverted fur, ensuring that the trigger guard has complete concealment and the sniper's index finger placement inside it.

In the flap, one half of the self-closing cutis is made for the sniper's working hand index finger. A belt of stretching material is attached to the outer surface of each flap, which provides multiple wraps around the breech and the grasp, together with the device housing, and the fastening element, which enables the belts' free ends connection to each other, with all parts of the device body being fixed for the trigger guard closing in working condition.

Then, a "Fur coupling for sniper hand heat insulation when firing a sniper rifle" (RU Patent 2714948) was invented. This invention relates to winter outer clothes and, in particular, to systems for protection of sniper hands against frostbite during firing from sniper rifle and is intended for heat insulation of the sniper hand at prolonged waiting, aiming and execution of several shots in the frost.

The technical result is achieved in the way that the upper part of the right side wall pertaining to the coupling is made through an incision placed in the operating position of the coupling in the area of the projection pertaining to the sleeve-opening window, and the trajectory of reciprocal movement of the rifle arm handle forms a flap of elongated shape with rounded angles and a base in the wall, providing external flap deflection upwards and simultaneous opening in the wall of the hole, having the length and width exceeding 6–12 mm according to the distance between the maximum remote points of trajectory and window, and the distance between the lower and upper edges of the window, as well as due to the presence of a cast plastic permanent zip tape, made in a structural modification of type "A", sewn by its side edges to the free edges of the flap and a hole, respectively, providing multiple attachment to each other and their detachment.

Due to the presence of belts firmly attached by their ends to the external surface of the flap in the front and back parts thereof perpendicular to its longitudinal axis and in the direction from it, providing reliable fixation of the flap in the bent position.

EVALUATION OF HEAT PRESERVATION EFFECTIVENESS IN THE HAND WHEN SHOOTING A RIFLE IN THE COLD

In 2020, a group of researchers led by Professor Kurt Ammer from Austria published the results of a study on the effectiveness of protecting the hands of a group of adult healthy male volunteers from cooling during rifle shooting in the cold [43]. To protect the hands from cooling, a special fur muff was used in one series, which completely covered the rifle trigger device along with the volunteer's hand, while in another series, a layer of foam was used, which covered the trigger as insulation. Aiming with a rifle lasted for 3 minutes at an outdoor temperature of -3 and -13 °C. The dynamics of finger local temperature was studied using a thermal imager. The temperature was measured before, during, and after aiming the rifle. Each episode was attended by 10 volunteers. Observations of temperature dynamics were carried out in 3 series:
Series 1. The bare index finger of the volunteer's bare hand was continuously in contact with the metal trigger inside the rifle's open trigger device; Series 2. The bare index finger of the volunteer's bare hand was continuously in contact with the metal trigger inside the open trigger device of the rifle, but the hook and bracket were previously covered with a layer of solid plastic foam; Series 3. The bare index finger of the volunteer's bare hand was continuously in contact with the metal trigger inside the rifle's trigger device, which was closed with a fur muff. Additionally, a study was conducted on the dynamics of the local temperature pertaining to the volunteers' hands after the rifle aiming was completed at an outdoor temperature of -3 °C. After taking aim with a rifle, each volunteer immediately put on a winter fur mitt and entered the room at room temperature of +24 °C. After that, every 1 minute, the temperature of the volunteer's hand was recorded inside the room for 10 minutes. The obtained results proved that the metal trigger of the rifle quickly takes away the heat from the index finger of the volunteer's hand during aiming in the cold at temperatures of -3 and -13 °C, and the fur mitt sleeve or thermal insulation of the trigger device with foam effectively protect the finger from excessive cooling. In particular, it was shown that aiming a rifle with an open trigger device and a bare hand, with a bare index finger, in the cold leads to their rapid cooling. In this case, local cooling of the hand begins with the fingertips. In parallel, the middle phalanx of the index finger, which is in contact with the trigger, is highly cooled. Moreover, the index finger which was in contact with the trigger was the most cooled for all volunteers. It was shown that when, aiming a rifle at an outdoor temperature of -13 °C, the temperature in the tip of the index finger of some volunteers fell below 0 °C. However, at an outdoor temperature of -3 °C, such excessively deep cooling of the fingers was not detected. At the same time, using a fur muff or applying a layer of foam to the trigger and trigger guard of the rifle effectively protected the volunteers' fingers from excessive cooling while aiming the rifle in the cold at temperatures of -3 and -13 °C. In addition, it was shown that, after performing the aiming exercise with bare hands at an outdoor temperature of -3°C, putting the hands in fur mittens and moving the volunteer to a warm room accelerated their local temperature to room temperature. Moreover, it was shown that, after 3 to 4 minutes, the temperature of the hands rose above this level. However, the index finger point of contact with the rifle trigger remained the coldest for 7 minutes after putting on a fur mitt and moving the volunteer to a warm room. Consequently, the metal trigger and metal bracket of the rifle trigger device contribute to local hypothermia of the fingers during aiming and shooting rifles in the cold. These factors of heat loss from the shooter's hands should be taken into account when designing sportswear, winter shooting equipment, and rifles designed for use in cold conditions.

The fact is that, unfortunately, modern rifles do not protect your fingers from cooling during aiming and shooting in the cold. Therefore, there is a risk of cold injuries to the hands of athletes during training and sports competitions in the cold. Infrared thermography can provide information about the degree of cooling in an athlete's fingers when shooting a rifle in the cold during training and sports competitions. In addition, thermal monitoring of the local temperature dynamics pertaining to the volunteers and athletes' fingers when aiming and shooting rifles in the cold can be used for a comparative assessment of methods for protecting their hands from frostbite so as to prevent cold injuries to the hands.

CONCLUSION

When aiming rifles on a frosty day, athletes may experience deep cooling in the tips of their fingers, as well as in the middle of the index finger that contacts the trigger. It is shown that the thermal imager provides registration of the local temperature dynamics pertaining to the fingers when shooting from a rifle, diagnostics of local cooling zones in the fingers, as well as an evaluation of the effectiveness of protective interventions against finger cooling when shooting from a rifle in the cold. Today, there are no officially recognised modifications of rifles that exclude cold injuries to the fingers when shooting in the cold. Therefore, it is obvious that further research is needed on this issue. Problems that we will need to solve in the future are reliable thermal insulation of the butt and trigger mechanism of rifles, as well as reliable fur covering of the trigger mechanism along with the shooter's bare hand during aiming and shooting in the cold.

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TEMPERATURA PRSTA TOKOM PUCANJA IZ PUŠKE NA HLADNOM VREMENU: TERMALNE PREPORUKE

Biatlonci na hladnom vremenu mogu imati smanjenu atletsku izvedbu zbog lokalnog hlađenja prstiju, a što je prouzrokovano ne samo hladnim zrakom nego i hladnom puškom. Stepen lokalnog hlađenja i rizik od promrzlina prstiju se povećava sa jačanjem mraza, vjetra i snježnih padavina te produžavanjem kontakta sa hladnim predmetima. Kako bi se održali visoki sportski rezultati tokom zimske sezone, preporučuje se praćenje dinamike lokalne temperature prstiju biatlonaca koristeći uređaj za termalni prikaz. Za skijaško trčanje, kvalitet ciljanja i preciznost pucanja iz puške tokom treninga i takmičenja se treba uzeti u obzir ne samo opće i lokalno hlađenje povezano sa vremenskim uslovima nego i lokalno progresivno hlađenje kažiprsta dominantne ruke sportiste koje nastaje u kontaktu sa ručkom skijaškog štapa i mehanizmom okidača puške. Dinamika lokalne temperature prstiju prilikom držanja predmeta na hladnom vremenu je detaljno opisana na osnovu modernih podataka koji se mogu pronaći u literaturi. Nadalje, potrebno je poboljšati ručke skijaških štapova i okidača puški koje se koriste tokom zime kako bi se smanjio stepen hlađenja, rizik od promrzlina prstiju i poboljšala preciznost biatlonaca koji pucaju iz puške. Svrha ovog rada je dati praktične preporuke za pripremu treninga i sportskih takmičenja profesionalnih biatlonaca tokom zimske sezone.

Ključne riječi: zima, sportski trening, temperatura, prsti, trauma, prevencija povreda

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STUDENT ATTITUDES ON SATISFACTION WITH THE QUALITY OF LIFE AND EXERCISE CULTURE

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ABSTRACT

Attitudes on satisfaction with the quality of life and exercise culture were analysed on a total sample of respondents consisting of 200 female students from the Faculty of Educational Sciences of the University of Sarajevo, divided into two subsamples comprising 100 students from the Department of Education and Rehabilitation and 100 students from the Department of Early Childhood Education and Care. A survey questionnaire consisting of 21 questions encompassing the mentioned areas was created for the purpose of the research. The survey was conducted during the academic year 2020/21. The aim of this paper is to determine the differences in attitudes on the quality of life and life satisfaction as well as exercise culture between the female students of the Department of Education and Rehabilitation and the female students from the department of Early Childhood Education and Care of the University of Sarajevo's Faculty of Educational Sciences.
The research results indicate that there are statistically significant differences between the examined groups at the level of Sig. = .001 on the quality of life and exercise culture favouring the students form the Department of Early Childhood Education and Care.

Keywords: quality of life, exercise culture

INTRODUCTION

Understanding the issue of "quality of life" is greatly dependent on and conditioned by the multidimensional approach to this notion. The degree of complexity pertaining to this notion is demonstrated by the fact that, today, there are over one hundred definitions of the term quality of life.

The most accurate and comprehensive definition might be the one stating that the quality of life refers to the general welfare determined by objective factors and subjective evaluation of the physical, material, social and emotional well-being, together with personal development and purposeful activity, with everything being assessed through the personal set of values pertaining to an individual (Felce & Perry, 1995). Additionally, the quality of life is a multidimensional construct comprising a combination of objective and subjective indicators (Golubić, 2010).
For many years, the quality of life has evoked great interest of researchers but it can be noted that research was mainly focused on satisfaction with the quality of life in ill people, and only recently can we notice greater interest in this topic with regard to the healthy population. This paper tries to find the relationship between the quality of life and exercise culture in the student population. It has been scientifically proven that physical activity plays an important role in improving

individuals' quality of life (Crnković & Rukavina, 2013). The level of physical activity declines during the period between adolescence and adulthood (Stephens, Jacobs, & White, 1985), with the student population belonging to this age group.

This paper examines the quality of life pertaining to female students from the Faculty of Educational Sciences in Sarajevo through different dimensions of the quality of life and an emphasis on exercise culture, that is, the respondents' relationship towards regular physical activity.

WORK METHOD

For the purpose of this research, the sample of respondents was selected from the population of the University of Sarajevo's Faculty of Educational Sciences. A total of 200 respondents were divided into two subsamples, namely: 100 students from the Department of Education and Rehabilitation and 100 students form the Department of Early Childhood Education and Care. All respondents are female and reside in the Sarajevo metropolitan area. The research used an online survey modelled on the five-point Likert scale of satisfaction, with 21 questions defined for the purpose of this research. The items on the measuring instrument were examined considering their reliability under the presumption that they measure a general construct of satisfaction.

Based upon the 21 items, the value of Cronbach's alpha reliability has been determined to be 0.823 which falls into the category of high reliability.
With the goal to determine the differences in attitudes of female students from the University of Sarajevo's Department of Education and Rehabilitation and the Department of Early Childhood Education and Care, we used the Student's t-test for independent samples (one-sample t-test) and Levene's test for equality of variance, with Cronbach's alpha coefficient for testing the reliability of the measuring items and defining the metric characteristics of the test.

RESULTS

Mean values of the two groups were calculated considering their assessment pertaining to the satisfaction with life and exercise culture, and the differences in the mean values were calculated using a t-test for independent samples. The assumption for using the t-test was examined in terms of the homogeneity of error variance for groups using the Levene's test. It was determined that the Levene's test is not significant for any of the 21 items, and it can be concluded that the criterion of the equality of error variance for the groups was fulfilled, with further analysis being conducted using a t-test.

The results of the analysis in terms of individual items are illustrated in the following Table 1.

By analysing the female students' attitudes, we observe that the survey question "To what extent can you count on your friends when you need them?" has a statistically significant difference ($t = -2.275$ and $p = 0.024$). Statistically significant differences were in favour of the respondents from the Department of Early Childhood Education and Care, who express the attitude that they can count on their friends when they need them to a greater extent that the group of respondents from the Department of Education and Rehabilitation.
The survey question "How would you assess the quality of your life?" has a statistically significant difference in favour of the Early Childhood Education and Care respondents ($t = -2.077$ and $p = 0.039$). The female students from the Department of Early Childhood Education and Care have assessed the quality of their life with a higher degree of satisfaction, compared to the respondents from the Department of Education and Rehabilitation.

When it comes to the survey question "To what extent does your quality of life satisfy your needs?", a statistically significant difference was determined in favour of the female students from the Department of Education and Rehabilitation ($t = 2.209$ and $p = 0.028$). The female students attending Education and Rehabilitation strongly consider that the level of their quality of life satisfies their needs.
The survey question "Do you feel that you have enough energy for fulfilling everyday obligations?" has a statistically significant difference in favour of the Early Childhood Education and Care female students ($t = -2.024$ and $p = 0.044$). Female students from the Department of Early Childhood Education and Care possess the attitude that they have enough energy for fulfilling everyday obligations, compared to the female students from the Department of Education and Rehabilitation.

The results for the question "Do you often feel anxiety, depression or dissatisfaction?" show a statistically significant difference in favour of the female students attending Education and Rehabilitation ($t = 2.993$ and $p = 0.003$). Female students from the Department of Education and Rehabilitation feel more anxiety, depression and dissatisfaction more often than the Early Childhood Education and Care female students.
Concerning the answers to the survey question "To what extent can you relax and enjoy?", a statistically significant difference was determined in favour of the Early Childhood Education and Care female students ($t = -2.091$ and $p = 0.038$). Compared with the results of the female students attending Education and Rehabilitation, the Early Childhood Education and Care female students can relax and enjoy more.

The results of the analysis related to the answers to the question "You cycle or run at least two times a week" also show a statistically significant difference in favour of the Early Childhood Education and Care female students (t = -1.989 and p = 0.048). Early Childhood Education and Care female students are more active when it comes to physical activity, compared to the female students attending Education and Rehabilitation. The survey question "How much are you truly satisfied with your life?" also has a statistically significant difference.

Early Childhood Education and Care female students are satisfied with their life, compared to the group of female students attending Education and Rehabilitation (t = 2.087 and p = 0.038). The results of the survey question "How much meaning do your personal convictions give to your life?" show a statistically significant difference (t = -2.023 and p = 0.044). The difference is in favour of the Early Childhood Education and Care female students. They believe that their personal convictions provide meaning to their life. The remaining questions did not have any statistically significant differences.

Table 1

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	T	df	Sig. (2-tailed)
To what extent can you count on your friends when you need them?	.458	.499	-2.275	198	.024
How would you assess the quality of your life?	.048	.826	-2.077	198	.039
To what extent does your quality of life satisfy your needs?	2.445	.120	2.209	198	.028
Do you feel that you have enough energy for fulfilling everyday obligations?	.096	.758	-2.024	198	.044
Do you often feel anxiety, depression or dissatisfaction?	.005	.944	2.993	198	.003
To what extent can you relax and enjoy?	.736	.392	-2.091	198	.038
How important is it that you do not have any pain?	.559	.455	-.392	198	.695
Physical activity has an essential role in maintaining health?	.008	.930	-.418	198	.677
You cycle or run at least two times a week?	.002	.962	-1.989	198	.048
You engage in sports activities at least two times a week?	.011	.915	-1.966	198	.051
Compared to last year, how much has the level of your activity changed?	.199	.656	.326	198	.745
You feel inactive and dissatisfied if you do not get out of the house all day?	1.203	.274	-.923	198	.357
To what extent do you fear the inability to engage in sports?	.015	.902	-.982	198	.327
Do you consider that exercise culture is an essential part of the Culture of Living?	2.412	.122	-1.220	198	.224
How much are you truly satisfied with your life?	1.212	.272	-2.087	198	.038

How much are you satisfied with your current health?	1.005	.317	-.761	198	.447
How much are you satisfied with your physical appearance?	.232	.631	-1.657	198	.099
How much are you satisfied with your concentration and memory during learning?	.284	.594	-1.160	198	.247
How much meaning do your personal convictions give to your life?	2.108	.148	-2.023	198	.044
Do you feel discriminated against for any reason?	.000	.992	-.284	198	.776
To what extent do you feel that there is meaning in what you do in life?	.209	.648	1.410	198	.160

DISCUSSION

The aim of this research was to examine the differences in the values of certain indicators or aspects of life satisfaction and engagement in physical activity between the students attending Early Childhood Education and Care as well as Education and Rehabilitation. The rationale for this study was seen in the fact that different study programmes place different demands for students regarding time management, study and work methods, available leisure time, and indirectly, the possibility for engaging in physical activity. Consequently, it is expected that there are differences among students in the very satisfaction with certain aspects of life, coping with stress and general lifestyle affecting these variables.

Based upon the results of the conducted analyses, statistically significant differences between the groups were determined in eight out of twenty-one indicators of life satisfaction. On average, the Early Childhood Education and Care students have demonstrated significantly greater satisfaction with social support, general quality of life, work energy when performing everyday activities, relaxation, showing greater involvement in physical and sports activities and higher values of the meaning given by their personal convictions. Additionally, they demonstrate a lesser degree of problems with anxiety and mood swings, compared to Education and Rehabilitation students.

On the other hand, the only indicator in which the Education and Rehabilitation students had greater values is the estimated degree to which their quality of life satisfies their needs. Even though the results seem paradoxical, if we properly take into account the entire context of responses, there is a likelihood of a lesser degree of aspirations for an increase in the standard and quality of life in Education and Rehabilitation students. Intergroup differences in motivation are one of the models for explaining the diverse profile of life satisfaction in these groups.

Since most research has been directed towards analysing the differences among students on life satisfaction considering the demographic characteristics, there is limited availability of the results pertaining to analyses in terms of the study course which would enable proper interpretation and comparison with the results of this work.

Nevertheless, the results presented in this study are consistent and comparable with the findings of other authors in terms of mood and anxiety self-assessment variables. Even though the groups were demographically equal, there is a series of factors which can explain the stated differences, with the study course being only one of them. However, as can be seen from the results themselves, the higher degree of anxiety and mood swings has been detected in Education and Rehabilitation students, together with minor assessments of some life satisfaction indicators. This finding is in accordance with the research results demonstrated by other authors, where a negative relationship between life satisfaction and the level of anxiety has been found (Tsitsas, Nanoupolos, & Paschali, 2019; Serin, Serin, & Özbaş, 2010).
Likewise, some authors find the differences in the level of anxiety and quality of life in students considering certain demographic characteristics such as place of residence. The effect of the residence factor (in terms of urban or rural place of residence) in this research was excluded since all respondents from both groups reside in the Sarajevo metropolitan area. Additionally, no differences were identified in the economic status and gender structure (all respondents were female). Considering the above mentioned, the identified differences can be attributed to different study programme structure for students, where those attending one department are more engaged in sports and physical activities, learning more about the rules of healthy living than the students from the other department.

The fact that the Department of Education and Rehabilitation orients the studies on a large number of pathology-related subjects or deviation in the mental and physical development, can indirectly provide the students with a signal for lowering the criteria when it comes to satisfaction with the quality of their own life.

If we consider the fact that there are no differences among the groups in most attitudes on the benefits of physical activity, and yet the Education and Rehabilitation students are less actively engaged in physical activities, a question remains as to why the Early Childhood Education and Care students are more active and involved in sports activities. The methodical prevalence of the Sports and Physical Education subject is only one of the explanation models for which there is also a strong indication based on these results. Additionally, the higher load of Education and

Rehabilitation students when it comes to the theoretical teaching content impacts the lack of their time available for engaging in sports activities and the increased prevalence of sedentary lifestyle during learning. Generally, the sedentary working style and decreased physical activity have shown to be negatively related with the quality of their own health (e.g., Wu, Han, Zhang, Luo, Hu, & Sun, 2017), and consequently related to the decrease in satisfaction with the remaining aspects of the quality of life such as social relationships and the environment (Çiçek, 2018). Within our research, it was shown that the Early Childhood Education and Care students actually have greater general life and social support satisfaction in addition to greater engagement in physical activities, which is congruent with the findings of the mentioned authors.

Moreover, the imposed work regime can, over a longer period of time, also change the students' psychological profiles, especially those concerning their strategies of coping with difficulties and stress, as well as when it comes to the general level of work energy and willingness for engaging in additional activities.

The research results found in this work indicate a logical relationship between the values for different aspects of satisfaction with the quality of life. It is known that there is a relationship between physical activity, relaxation and anxiety, as well as stress responses. Physical activities reduce the negative effects of stress and anxiety, so the prevalence of physical activity contents should be greater not only at the departments where students are methodically prepared for future work, but also at the departments where future professional orientations do not imply a higher degree of physical activities.

In light of the above, it can be detected that the programme orientation of the studies and the study methods, as well as the general professional orientation and teaching requirement loads not only in the quantitative but also in the substantive sense, can stimulate students of otherwise similar constitutional, psychological and demographic characteristics to engage in physical activities to a certain degree. Consequently, these students have a different degree of satisfaction with their quality of life.

Modifying teaching programmes and contents is necessary to a certain extent since they are not only the instrument of professional development and education, but must have an educational component, even the one related to physical health and development. In order to conduct a more in depth and substantial research on the relationships between the stated programme-oriented variables and inclusion of physical activity, and possibly the moderation effects of some of these variables on life satisfaction self-assessment, analyses could be additionally conducted with a different methodological approach such as regression analysis or modelling. This would be one of the open problems which could be researched in further large-scale studies.

CONCLUSION

The results of the conducted study have shown that there is a significant difference in a series of indicators pertaining to life satisfaction between the Early Childhood Education and Care students and those attending Education and Rehabilitation at the Faculty of Educational Sciences in Sarajevo.

The differences were determined for the variables related to satisfaction with social support, general quality of life, work energy when performing everyday activities, relaxation, as well as involvement in physical and sports activities and higher values of the meaning given by their personal convictions. The higher values of these indicators were found in Early Childhood Education and Care students. Education and Rehabilitation students had greater values only for the variable related to how their quality of life satisfies their needs as well as the anxiety and mood swings variable. No statistically significant differences were determined for the remaining indicators.

The stated differences can be explained by various study programme orientations for students which dictate their learning method, inclusion in physical activities and general lifestyle and activity distribution. Additional analyses are needed to examine the correlation, moderation and mediation relationships between the stated factors. The main practical implication of this research is that there is a need to modify teaching programmes which will enable students to have healthier work methods and activity distribution, and thus, greater satisfaction with the quality of life.

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STAVOVI STUDENATA O ZADOVOLJSTVU KVALITETOM ŽIVOTA I KULTURI VJEŽBANJA

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Ključne riječi: kvaliteta života, kultura vježbanja

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