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DEAR READER,

This issue contains scientific papers from 13 countries and 5 continents that are written by researchers who come from 15 countries and 5 continents.

Continuity in publishing scientific papers from the field of sports that promote new values and results is also maintained in this issue of the magazine, which is indicated by an overview of published papers in the areas of sport psychology, transformation processes, sports management, sports medicine and kinesiological education.

Just as in previous issues, the research conducted by young scientists have been included in this issue, whereby we strive to promote their knowledge and quality through our magazine. We are thankful to our Editorial Board members for their devoted work, promptness and a responsible approach that demands originality and the quality of authored works thereby ensuring the magazine's value and recognition.

Our Editorial board deeply believes that the development of sports disciplines is only possible through the development of scientific achievements and their implementation in practice. The exchange of results, ideas and new scientific findings through our magazine contributes to an advancement of scientific thought, which results in indicators of shifting boundaries and creating new sports systems accompanied by the usage of advanced technology and its implementation in the field of sports.

Changing rules in sports disciplines, implementing and using new equipment, adapting the environment according to different needs of athletes, the appearance of new techniques that keep up with new technologies and many other factors impact the constant need for monitoring, researching and detecting obstacles that stand in the way of accomplishing the best results. Understanding new technologies in sports is no longer a privilege of major sports milieus, but a need without which it is not possible to keep

up with trends in sports and strive towards successful, top results. Promoting the results through papers in our magazine is not only the quickest way to reach our readers, but also an obligation to maintain trust and the quality that will satisfy the readers' needs and expectations. Our wish is to include an even wider auditorium and new authors in the following issues so as to publish more diverse, affluent, interesting and higher quality editions.

We invite you, readers, to become a part of our team and participate in our work so that, together, we could contribute to changes in the world of sports in a creative and innovative way.

Nihad Selimović, MD, MSc
Editor in chief



DRAGI ČITATELJU,

U ovom broju nalaze se naučni radovi iz 13 zemalja sa pet kontinenta, realiziranih od strane istraživača koji dolaze iz 15 zemalja i sa pet kontinenata.

Kontinuitet u objavljivanju naučnih radova iz oblasti sporta koji promovišu nove vrijednosti i rezultate zadržan je i u ovom broju časopisa što pokazuje pregled objavljenih radova iz oblasti sportske psihologije, transformacionih procesa, sportskog menadžmenta, sportske medicine i kineziološke edukacije.

Kao i u prethodnim izdanjima, istraživanja mladih naučnika uključena su i u ovaj broj, čime nastojimo promovisati njihovo znanje i kvalitetu kroz naš časopis. Zahvalni smo članovima recenzentskog odbora na predanom radu, ažurnosti i odgovornom pristupu u kojem se zahtjeva originalnost i kvalitet autorskog djela čime se osigurava vrijednost časopisa i njegova priznatost.

Naš urednički odbor duboko je uvjeren da je razvoj sportskih disciplina jedino moguć kroz razvoj naučnih dostignuća i njihovu implementaciju u praksi. Razmjena rezultata, ideja i novih naučnih saznanja preko našeg časopisa doprinosi unaprjeđenju naučne misli što za rezultat ima pokazatelje o pomjeranju granica i stvaranja novih sportskih sistema uz korištenje napredne tehnologije i njene primjene u oblasti sporta.

Izmjene pravila u sportskim disciplinama, primjena i korištenje nove opreme, prilagođavanje okruženja prema različitim potrebama sportista, pojava novih tehnika koje prate nove tehnologije i mnogo drugih faktora, utiču na stalnu potrebu za praćenjem, istraživanjem i otkrivanjem prepreka koje stoje na putu ostvarivanja najboljih rezultata. Poznavanje novih tehnologija u sportu više nije privilegija velikih sportskih sredina već potreba bez koje nije moguće pratiti sportska kretanja i težiti ka uspješnim, vrhunskim rezultatima.

Promovisanje rezultata preko radova u našem časopisu je nabrazi put do naših čitatelja ali i obaveza da održimo povjerenje i zadržimo kvalitet koji će zadovoljiti potrebe i očekivanja čitatelja. Naša je želja da u narednim izdanjima uključimo još širi auditorij i nove autore, kako bi svako sljedeće izdanje bilo raznoliko, bogatije, kvalitetnije i zanimljivije.

I Vas, čitatelje, pozivamo da budete dio našeg tima i da učestvujete u našem radu kako bi svi zajedno doprinosili promjenama u svijetu sporta na kreativan i inovativan način.

Mr. sci. dr. Nihad Selimović
Glavni urednik

EIGHT WEEKS OF HIGH-INTENSITY INTERVAL TRAINING IMPROVE HAEMATOLOGICAL HEALTH AND DECREASE BLOOD PRESSURE IN SLIGHTLY-HYPERTENSIVE ELDERLY

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ABSTRACT

High-intensity interval training (HIIT) has demonstrated benefits to human health, however, more investigations are needed with regards to its impact on the cardiorespiratory health and the safety of the elderly suggesting urgency. The purpose was to verify the impact of the HIIT on haematological health and blood pressure of slightly-hypertensive older individuals. A semi-experimental study was proposed to evaluate the impact of the HIIT on nineteen elderly individuals, selected conveniently and submitted to the intervention for 60 days. Blood was collected prior to the intervention, four and eight weeks after it. Respiratory capacity, non-invasive cardiac tests, haematological parameters and blood pressure were measured before the beginning of the intervention period and eight weeks after it. ONE-WAY ANOVA with Tukey's post Hoc Test and a significance set up to 5% was performed to determine the differences between the data points. As a result, the HIIT provoked an enhancement in haematological health and decreased the blood pressure in slightly-hypertensive elderly. In conclusion, these results suggest that HIIT is an effective tool for the improvement of haematological health of the elderly, it has the efficacy to decrease blood pressure in slightly-hypertensive older individuals, yet, since it improved the haematological parameters, there were no reports of intercurrents related to the study, suggesting the effectiveness and safety.

Keywords: High-Intensity Interval Training, body composition, physical performance, human health, biochemistry, haematology, innate immunity, cardiovascular health.

INTRODUCTION

Exercise has been implicated with changes in physiology, morphology and several other molecular, cellular, tissue and metabolic alterations in the human body (Freidenreich & Volek, 2012; Gibala, Little, MacDonald, & Hawley, 2012; Swift et al., 2013; Weston, Wisløff, & Coombes, 2014), although several factors may affect the adaptations caused by this practice such as the volume, intensity, frequency, type of exercise and nature of exercise (Gillen et al., 2016). High-intensity intermittent exercise (HIIT) is defined as high-intensity exercises with low-intensity recovery intervals (Gibala et al., 2012), which may vary according to intensity, duration, recovery period, number of intervals, among other possible variations (Hwang, Wu, & Chou, 2011). There is evidence that this exercise approach, i.e., one with an intense and intermittent nature, stimulates physiological parameters as much as continuous exercise of moderate intensity does (Gibala & McGee, 2008); in fact, studies have shown that it may be superior in some aspects (Gillen et al., 2016; MacInnis & Gibala, 2017), a fact that inspires more research on the subject. High-intensity intermittent training programmes still require further research to determine their safety and benefits associated with human health, especially

for elderly adults, since aging brings with it a number of possible limitations to the practice of vigorous physical exercises, which is the main characteristic of the program executed in the present investigation. Continuous or intermittent high-intensity exercises promote increased cardiovascular capacity (R. A. Da Silva, Lunardello, De Oliveira, De Olivera, & Valentim-Silva, 2016; Gillen et al., 2016), muscular hypertrophy (Egan & Zierath, 2013), increased bone density (Guadalupe-Grau, Fuentes, Guerra, & Calbet, 2009; Nikander et al., 2010) and have been described as a viable alternative to traditional continuous and long-lasting training. Biochemical and immunological changes were also observed as a result of the exercise, especially acute reactions to intense exercise. The chronic effects of intense exercise in different populations such as the elderly, however, are not well established, although there is a variety of evidence that intense exercise in healthy adults and athletes provides benefits (Gibala, Gagnon, & Nindl, 2015; Gibala et al., 2012; Gillen et al., 2016). Thus, the present study sought to verify the safety and the impact of HIIT on the cardiac health of slightly-hypertensive older individuals.

METHODS

Volunteers and research ethic

This study was carried out in a Basic Health Unit of the municipal network in the East Zone of the City of Porto Velho, Rondônia, Brazil. As an inclusion factor, the volunteers had to undergo a clinical evaluation by a physician who attested to their physical health and

ability to practice vigorous exercises. Nineteen volunteers of both sexes had a mean age of 72.85 ± 11.32 years, body mass of 69.1 ± 4.01 kg, height of 1.5 ± 0.05 meters and body mass index of 29.34 ± 3.16 kg/m². All volunteers were informed about all procedures, possible discomfort and risks and signed a consent form giving us their consent

for voluntary participation in this research. The method was approved by the ethics and research council under CAAE number: 44907715.2.0000.5653 on 07/27/2015.

Study Type

The present study was of the longitudinal type, since it involved a continuous time scale of exposure to the experimental situation; it was quantitative, since the variables of interest in the study were quantified; and quasi-experimental, since it had a voluntary group and the formation of this group was done in a convenient way (Provdanov & Freitas, 2013).

Design and Procedures

All blood evaluations were performed at three points: prior to the start of the intervention period, four and eight weeks afterwards, all of which coincided with each evaluated individual's routine monthly clinical consultation. Three clinical consultations were performed with the physician who attended to the patients, maintaining their monthly routine. These consultations occurred immediately before the intervention period, four weeks later, and at the end of the intervention. In these consultations, routine clinical investigations such as blood pressure, heart rate, cardiac auscultation, complete anamnesis, orthopaedic investigations and other medical investigations were carried out following the monthly routine of clinical consultations. These consultations served as support for the control of health conditions and for reporting intercurrents and adverse clinical events that might be related to the intervention proposed herein. At each collection, two blood samples were collected before the start of the programme and two months later in EDTA tubes (4 mL vacutainer tube, BD Vacutainer, Franklin Lakes, NJ, USA) and stored in a refrigerated container (4 °C) until measurement, which was performed in all cases within 1 h after venepuncture. To determine their respiratory capacity, the 6-minute walk test (TC6M) was performed outdoors. The subjects walked at their own pace and alone, as far as possible during the six minutes; knowing the possible cardiorespiratory changes that might arise, they were allowed to walk slowly, stop, relax when necessary, and begin walking again when he or she felt apt to resume the exercise. Each individual was encouraged to wear light clothing and not to exercise prior to the test. The following equations determine the level of walking distance predicted for each test performed on the patient:

Men:

Distance TC6M (m) = (7.57 x height cm) - (5.02 x age) - (1.76 x weight Kg) - 309m

Women:

Distance TC6M (m) = (2.11 x height cm) - (2.29 x weight kg) - (5.78 x age) + 667.6

Equation 1: Equation used to calculate maximum Vo2.

It should be emphasized that, in the present study, the anthropometric and performance evaluations were only performed 60 days after the beginning of the intervention, because the literature is categorical in stating that 30 days is insufficient time for anthropometric and performance measurements to have changed sufficiently to show a difference in such a short time, even in sedentary people.

Training Protocol

A high-intensity interval training programme was developed and applied three days a week with an average duration of 40 minutes per meeting. All exercises were performed without equipment, using one's own body weight alone. Each exercise set was done against the clock at a ratio of 1:2, between activity and rest. A standardized 5-minute warm-up with stretching exercises and calisthenics was performed for 5 minutes on a daily basis. After that, the main work out was performed, consisting of 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). Finally, a 5-minute cool down was carried out to promote calmness. Each exercise was performed for 30, 45 or 60 seconds with a recovery always 2x greater than the stimulus time. In addition, all classes had approximately 10 minutes of stimulation. During all the moments of rest between one stimulus and another, the subject was free, yet encouraged to be still and quiet, awaiting the next stimulus in order to characterize a passive rest.

Blood Pressure Determination

Blood pressure was determined following the procedures of the American Heart Association (AHA) and the Brazilian Society of Cardiology (BSC) as previously described in (Catellane et al., 2014). The Mean Arterial Pressure (M.A.P.) and the Double Product (D.P.) were then calculated using the following equations:

$$1 - M.A.P. = \frac{\{S.B.P. + (2 \times D.B.P.)\}}{3} - D.P. = C.F. \times S.B.P.$$

Equation 2:

Equation for calculating the Double Product. 1 = Mean of Arterial Pressure, D.P. = Double Product. D.B.P. = Diastolic Blood Pressure, S.B.P. = Systolic Blood Pressure, C.F. = Cardiac Frequency

Statistical Analysis

In order to verify the normality of the data, the Shapiro-Wilk statistical test was performed to determine the normality. For the comparison of the P1, P2, and P3 data, a ONE-WAY ANOVA was performed with a significance of 5% in the programme Prism Stat 5.0.

RESULTS

HIIT improves the blood pressure, resting heart rate and the double product in elderly individuals. The systolic blood pressure (SBP) and the diastolic blood pressure (DBP) of the volunteers did not decrease, however the mean arterial pressure (MAP) (Table 1) ($p > 0.05$) and the resting heart rate (RHR) (Table 1) ($p = 0.036$) decreased from P3 to P1. Table 2 expresses the values of SBP, DBP, MAP RHR and DP.

Table 1: Table 1: SBP, DBP, MAP, REP and DP values.

Variables	P1	P2	P3
SBP (mm/Hg)	139.52+ 10.3	133.4+ 11.7	127.6+ 11.6*
DBP (mm/Hg)	87.43+ 6.5	86.59+ 6.3	83.87+ 5.9*
MAP (mm/Hg)	104.79+ 14.5	102.19+ 13.3	99.44+ 11.1*
RHR	96.3+ 9.9	89.5+ 11.4	82.9+ 10.9*
DP	13435+ 1167	11939+ 888*	10743+ 765**

Elderly subjects ($n = 16$) underwent sixty days of high-intensity intermittent training before (P1), after four weeks (P2) and after eight weeks (P3) of intervention. Their systolic blood pressure, diastolic blood pressure and heart rate were measured, and then the mean arterial pressure and the Double Product were calculated.

A ONE-WAY ANOVA with a significance of 5% was used to indicate the possible differences between P1, P2 and P3. (SBP = systolic blood pressure), (DBP = Diastolic Blood Pressure), (MAP = Mean Arterial Pressure), (RHR = Resting Heart Rate), (DP = Double Product). (*= $p < 0.05$ vs P1; **= $p < 0.0001$ vs P1).

HIIT improves the haematocrits, haematocrits corpuscular medium, triglycerides and high density lipoprotein. The haemoglobin, mean corpuscular volume, and mean corpuscular haemoglobin showed a difference from P3 to P1 ($p = 0.05$) (Tab. 2), and haematocrits displayed a difference from P3 to P1 ($p = 0.036$) (Tab. 2). A similar effect was noted in the haematocrits which increased in P3 when compared to P1 (Table 2) ($p = 0.036$).

Table 2: values from biochemical, haematological and lipidic investigations

Variables	P1	P2	P3
Haematocrit	4.34+ 0.2	4.37+ 0.1	4.42+ 0.2#
Haemoglobin	12.96+ 0.7	12.97+ 0.9	12.31+ 0.7*
MCV	86.1+ 1.3	87.9+ 1.1	87.2+ 1.2*
MCH	29.8+ 0.7	29.3+ 0.4	27.6+ 0.6*
Platelets	282650+ 22951.8	283760+ 22951.8	283830+ 15325

Elderly individuals ($n=16$) were submitted to sixty days of high-intensity intermittent training before (P1), after four weeks (P2) and after eight weeks of intervention (P3). Blood samples were acquired for the determination of biochemical, haematological factors and to obtain a lipid profile. HDL (High Density Lipoprotein), MCP (Mean Corpuscular Volume), MCH (Mean Corpuscular Haemoglobin). A ONE-WAY ANOVA with a significance of 5% was used to indicate the possible differences between P1, P2 and P3. (*= $p < 0.05$ vs P1); (*= $p < 0.05$ vs P1, **= $p < 0.031$ vs P1); (#= $p < 0.036$ vs P1); (£= $p < 0.04$ vs P1) and (¢ $p < 0.04$ vs P1).

DISCUSSION

Evidence suggests positive evidence between the practice of exercise and sports and health benefits of different populations (Egan & Zierath, 2013; Hoff et al., 2015). Within this context, it has been shown that intermittent and high-intensity exercise has important effects on adult health (Belviranli, Okudan, & Kabak, 2017; Karlsen, Aamot, Haykowsky, & Rognmo, 2017; MacInnis & Gibala, 2017), as well as improving physical performance (Mijwel et al., 2017) in a manner similar to continuous exercise. The present study aimed to investigate the effects of high-intensity intermittent training (HIIT) on the cardiovascular and haematological health of elderly individuals, in fact, it has not been very well explored in the literature, since most of the studies have been done with healthy young adults (Gibala et al., 2012; MacInnis & Gibala, 2017). For this propose, a series of clinical and haematological investigations were carried out. The data demonstrated here show that HIIT can be an effective strategy for the modification of factors related to cardiovascular and respiratory health, as well as the haematological parameters compound a good scenario around the health of the vascular systems.

A number of recent intermittent training studies have demonstrated the efficacy of intermittent and high intensity exercise on human health and performance (Gibala & McGee, 2008; Gillen et al., 2014; MacInnis & Gibala, 2017). It has been demonstrated that HIIT

can improve cardiovascular outcomes, a factor that is fundamentally related to the reduction of the risk of myocardial, neural or peripheral vascular diseases and accidents (R. A. Da Silva et al., 2016; Karlsen et al., 2017), which is therefore one of the most valuable findings of the present study. These results become even more expressive, since high-intensity intermittent training, due to its intense nature, has not been thoroughly investigated in the elderly population. However, it was evident here that the training application did not provoke cardiovascular and orthopaedic interurrences (data not showed), and, in fact, this study suggests that this modality preserves bone, muscle and joint integrity in this population that did not have any diseases or injuries previously identified in their medical appointments and in the physical evaluations performed. Otherwise, the population investigated differs fundamentally in age from other scientific investigations, making the application of a methodology of high-intensity exercises delicate, due mainly to the scarcity of data in the literature, which is why the design of the exercise programme was based on one review, although, a recent review would suggest that HIIT may induce a greater number of cardiovascular events than continuous moderate-intensity exercises when applied to people with coronary or arterial disease (M. A. Wewege, Ahn, Yu, Liou, & Keech, 2018; M. Wewege, van den Berg, Ward, & Keech, 2017). Regarding the cardiovascular system, it was evident that HIIT can improve M.B.P. and R.H.R. Both are related to a decrease in cardiovascular overload and to an increase in the efficiency of this system, which, when presenting a lower number of beats per minutes, expresses a lesser need for vascular overload, since the DP, which is an excellent predictor of the oxygen consumption of the myocardium, also decreased, corroborating this statement. These data agree with different studies demonstrating the positive effects of exercise and HIIT on the cardiovascular system of children, adolescents, adults and the elderly (Elhakeem, Cooper, et al., 2018; Elhakeem, Murray, et al., 2018; Parsons et al., 2018). Altered values of haemoglobin, mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were documented after a prolonged period of sports training. It is suggested that the decrease in MCH and MCHC may be related to the loss of red blood cells or haemoconcentration (Wu et al., 2004). Lower MCHC values indicate greater erythrocyte flexibility, which can be considered an advantage for better blood flow and for oxygen supply capacity during exercise, the effect observed here. It is important to note that the decrease of blood pressure in this population is a very important result found here (Tab. 1). This fact, if viewed in conjunction with the all another modifications observed to the vascular system leads to affirm that this exercise intervention is an effective tool to improve the cardiovascular health in older people. In the present study, haematocrit, mean corpuscular volume (MCV), and mean corpuscular haemoglobin (MCH) demonstrated a significant decrease that may be associated with adaptations to the training proposed here. It should be noted that these adaptations are related to an increase in the efficiency of the cardiovascular system, evidenced by a set of adaptations observed here as a decrease in mean arterial pressure, resting heart rate, double product (Table 1) and maximum $\dot{V}O_2$ (Tab. 1). These results demonstrate the efficacy of this training to improve different factors related to the cardiovascular and respiratory systems, corroborating the vast majority

of literature on the subject (Heikura et al., 2018; Ramos, Dalleck, Tjonna, Beetham, & Coombes, 2015). In particular, resting heart rate and increased maximal $\dot{V}O_2$, if analysed together, demonstrate that the cardiovascular system is under less overload and functioning with greater efficiency, a fact that has been associated with better health and quality of life, and appears to dramatically reduce the risk of vascular accidents, a very important fact to reinforce the notion that HIIT is effective in improving cardiovascular and respiratory system functions, as has been well documented previously by different authors (Gibala et al., 2012; Mora-Rodriguez et al., 2017). Another important result is the modulation of the blood pressure. Other exercise types displayed an important effect on the blood pressure (Callegaro, Ribeiro, Tan, & Taylor, 2011; D. F. Da Silva et al., 2014), when it comes to different populations like adolescents (D. F. Da Silva et al., 2014), adults (D. F. Da Silva et al., 2014), including the HIIT and the short interval training which showed a positive effect on the blood pressure (Dos-Santos & de Mello, 2011; Gillen et al., 2014; Karlsen et al., 2017; Stavrinou, Bogdanis, Giannaki, Terzis, & Hadjicharalambous, 2018; M. Wewege et al., 2017), which in fact agrees with the data exhibited here. This is an important result due the fact that blood plays an important role in the health of the cardiovascular system. The limitations of the present study are related to finding studies that used HIIT in the elderly population to discuss the data found here for the variables of interest. This fact allows us to suggest that this is one of the pioneer studies investigating the effects of HIIT in this population. Previously, we conducted a pilot study with this population ($n=4$) and with adults close to senility ($n=4$), but for a period of 180 days (unpublished data). This pilot previously demonstrated its efficacy and safety, which encouraged the expansion of the sample and the realization of a new study with similar characteristics in the population that is the most vulnerable to cardiovascular and metabolic diseases. So, these results suggested that HIIT is an effective tool for the improvement of cardiorespiratory and haematological health of the elderly, it is efficient in decreasing blood pressure after sixteen days in slightly-hypertensive older individuals. Yet, since it improved cardiovascular, respiratory, and haematological parameters, there were no reports of interurrences related to the study, suggesting the effectiveness and safety of this approach. Finally, it is recommended that this approach is observed for a longer period of time with longer longitudinal interventions in order to assess the safety and efficacy of long-term HIIT for this particular population and to evaluate the effects of different daily and weekly doses in order to obtain ideal benefits to human health.

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Conflict of Interest Statement

All authors claim that this work does not have a conflict of interest of any nature.

Authorship Contributions

All authors contributed equally to the study design, writing, data treatment and final text approval. The JRVs, FEFL, have done the data collection.

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OSAM SEDMICA VISOKO INTENZIVNOG INTERVALNOG TRENINGA POBOLJŠAVA HEMATOLOŠKO ZDRAVSTVENO STANJE I SNIŽAVA KRVNI PRITISAK KOD STARIJIH OSOBA SA BLAGOM HIPERTENZIJOM

Visoko intenzivni intervalni trening (HIIT) je pokazao dobrobiti za zdravlje ljudi. Međutim, potrebno je provesti više studija po pitanju njegovog uticaja na kardiorespiratorno zdravlje i sigurnost starijih osoba. Svrha ove studije je bila provjeravanje uticaja visoko intenzivnog intervalnog treninga na hematološko zdravstveno stanje i krvni pritisak starijih osoba sa blagom hipertenzijom. Polueksperimentalna studija je predložena kako bi se procijenio uticaj visoko intenzivnog intervalnog treninga na devetnaest starijih osoba koje su izabrane metodom prigodnog odabira, te podvrgnute intervenciji u trajanju od 60 dana. Krv je prikupljena prije intervencije, četiri i osam sedmica nakon nje. Testovi za provjeru respiratornog kapaciteta, neinvazivne kardiološke pretrage, hematološki parametri i krvni pritisak su mjereni prije početka perioda intervencije, te osam sedmica nakon njega. Jednosmjerna ANOVA sa Tukey post hoc testom i nivoom značaja postavljenim na 5% su provedeni kako bi se utvrdile razlike između podataka. HIIT je rezultirao poticanjem poboljšanja kada je u pitanju hematološko zdravstveno stanje, te snižavanjem krvnog pritiska kod starijih osoba sa blagom hipertenzijom. Zaključuje se da ovi rezultati ukazuju da je HIIT efektivan alat za poboljšanje hematološkog zdravstvenog stanja starijih osoba, te da je efikasan za snižavanje krvnog pritiska kod starijih osoba sa blagom hipertenzijom. Međutim, budući da je poboljšao hematološke parametre, nije zabilježeno postojanje interkurentnih bolesti u ovoj studiji što ukazuje na njegovu efektivnost i sigurnost.

Ključne riječi: Visoko intenzivni intervalni trening, sastav tijela, fizičke sposobnosti, zdravstveno stanje ljudi, biohemija, hematologija, urođeni imunitet, kardiovaskularno zdravlje.

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DEPENDENCE OF THE SKATING AND RUNNING PERFORMANCE ON THE EXPLOSIVE STRENGTH OF LOWER LIMBS AND DYNAMIC BALANCE OF ICE HOCKEY PLAYERS

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ABSTRACT

This work refers to the dependence of the skating and running performance on the explosive strength of lower limbs and dynamic balance of ice hockey players in the youth category. We suppose that the performance in skating and running tests is limited by some factors such as the explosive strength of lower limbs and dynamic balance and they create a differentiated hierarchy according to the test difficulty. The ice skating tests and running tests were put to the relationship analysis as the dependent variables. Independent variables were formed by tests of maximal muscle strength of lower limbs, vertical jump with and without countermovement, standing long jump, single leg lateral jump from left and right foot and the test of dynamic balance on the right and left foot. In determining the limiting factors of performance in skating and running tests, we have used the multiple correlation and regression analysis. For the reduction of indicators, the stepwise analysis was used. When it comes to the explosive strength of lower limbs, the vertical jump with countermovement, standing long jump and test of lower limbs muscle performance indicators have a decisive contribution to the explanation of skating and running performance. Single leg jump tests had the smallest part in these indicators. Dynamic balance tests have an impact only in the 5-10-5 meters running test. From all skating tests, the highest consistency with lower limbs explosive strength tests is seen in the 5-10-5 test, which was proven statistically ($F = 10.490$; $p < 0.01$), by intercorrelation ($p < 0.05$) and practically ($f^2 = 1.592$). From all running tests, the highest consistency with explosive strength tests is seen in the 10 meters run test, which was proven statistically ($F = 9.181$; $p < 0.01$), by intercorrelation ($p < 0.05$) and practically ($f^2 = 0.706$). In both cases, the partial proportions in individual parameters are in positive relation to the skating and running performance. The assumption about the impact of the lower limbs explosive strength and dynamic balance on the performance in the skating and running tests has been confirmed in the vertical jump, maximal muscle performance and in the standing long jump. The differentiated hierarchy of factors according to the test difficulty and their performance on the ice or on dryland has been proven.

Keywords: ice hockey, skating, running, performance, explosive strength, dynamic balance

INTRODUCTION

Ice hockey is a physically demanding contact sport. As in other collective sports, it is a meeting of players who perform short-term, high-intensity impulses at a maximum performance during a certain time (Bishop, Lawrence, Spencer, 2003). This whole process runs with speed acceleration and with direction-changing movements of players (Buchheit, Lefebvre, Laursen, Ahmaidi, 2011). In order for hockey players to be able to play at the top level, it is important to increase their anaerobic threshold, aerobic endurance, and muscle strength (Wilson, Snyder, Game, Quinney, Bell, 2010). Due to these demanding requirements, the physical tests of players are regularly realized even before the competitive season, and they can continue during the season (Power, Faught, Przysucha, McPherson, Montelpare, 2012). The results of these tests can significantly influence the decision of the coach about the timing of individual play time for the season and also they can be a good predictor of game success (Durocher, Leetun, Carter, 2008). Based on these results, the coach will decide about the playtime of a hockey player on the ice in a certain match, which can strongly influence his career (Burr, Jamnik, Baker, Macpherson, Gledhill, McGuire, 2008). The skating skills play an important role in the player's performance (Price, 2003). The most characteristic feature based on the claims of elite hockey players is the maximal skating speed (Marino, 1983). Endurance, muscle strength as well as coordination are important too (Bracko, Fellingham, 1997). Ice skating training can increase these factors, which are limiting for the skating and running performance (Greer, Serfass, Picconatto, Blatherwick, 1992). It means that some relation exists between the skating performance on ice and the special exercises used to achieve this performance. In regard to this fact, it is necessary to apply the development of lower limbs' dynamic balance and explosive strength as the devices of sports training.

AIM

The aim of this work is to contribute to the hierarchy of factors which determine the performance in the ice hockey skating tests and running tests. According to empirical literature, we consider that the performance in skating tests is limited by factors such as the explosive strength of lower limbs and dynamic balance. We consider that these factors will create a differentiated hierarchy according to the test difficulty.

METHODS

The monitored group consisted of 29 hockey players from HK Dukla Trenčín, in the average age of $M = 16.79$ $SD = 0.71$, who actively play in a youth league in the Slovak Republic. The average body height of the monitored players is

$M = 180.45$ $SD = 5.05$ cm and body weight $M = 73.77$ $SD = 7.94$ kg. The level of physical development, skating tests, lower limbs explosive strength (maximal muscle performance, vertical jump with and without a countermovement, standing long jump, single leg lateral jump from the left and right foot) and dynamic balance on the right and left foot are characterized by the mean (M), standard deviation (SD), minimum (Min), maximum (Max) and by percentiles in Table 1. The ice hockey skating tests were realized according to the methods of the Airdrie Minor Hockey Association (AMHA, 2018). For tests such as the skating and running acceleration speed to 10 meters (both by the same realization), skating and running changes of direction in speed, Weave test is assessed in seconds. All of these tests were conducted without puck carrying. For the evaluation of dynamic balance on the right and left foot, we used the methods of Y-Balance test (Hoch et al., 2017, Shaffer 2013). For the measurement of the vertical jump with and without a countermovement, the jump ergometer, Fitro Jumper (cm), has been used. For the measurement of maximal muscle performance (W) in squat jump with a barbell with 50% of the player's body weight load, the Fitro Dyne Premium (Fitronic, 2017) was used. When determining the limiting factors of the ice hockey skating tests, we evaluated the dependency between all motoric variables. For the reduction of the indicators, we used the step regression analysis with a Backward method. This method is characterized by gradual incorporation of variables from the total set in the regression function. These variables are tested in back-coupling whether they statistically impact the quality of the regression model. Relation (r) and a ratio ($\beta \cdot r$) of individual factors, has been estimated by correlation and regression analysis technique. Besides the multiple correlation coefficient (R), the determinant of multiple correlations (R^2), a standard error of regression (SEE), coefficients of partial regression (b), factor significance (t) and significance of the model (F), have been calculated. The effect size is measured by Cohen's f^2 (Cohen, 1998). Statistical significance is measured in the significance level $p < 0.05$, $p < 0.01$, and the effect size in $0.02 = \text{small}$, $0.15 = \text{medium}$, $0.35 = \text{large effect}$. Empirical data were evaluated in MS Excel and SPSS programmes.

RESULTS

All monitored hockey players already have enough years of training to reach the maximum sports performance which means that players have the optimal age to achieve the top sports performance. A decisive precondition for the hockey specialization are the average values of physical development indicators (Kokinda and Turek, 2015). In this study, we did not use the indicators of physical development to detect the determining factors. For the relation analysis, we inserted only the skating tests, lower limbs explosive strength tests and the dynamic balance tests. The multiple correlations and regression analysis allowed us to optimally reduce the observed factors to the number that would most likely explain the skating performance (Table 2-4) and running performance (Table 5-6). When it comes to the factors of the lower limbs explosive strength, all tests confirmed the affinity to the performance, mostly the squat jump test with a barbell with 50% of the player's body weight load.

The dynamic balance tests - Y-balance tests did not establish themselves between the limiting factors. In the running tests, we confirmed the affinity test of muscle performance in the exercise squat jump with a barbell with 50% of the player's body weight load, vertical jump with countermovement, standing long jump and Y-balance tests of dynamic balance. Single leg lateral jumps did not establish themselves between the limiting factors. The set of factors are differentiated according to the skating tests, running tests and their performance difficulty. The reduced factors explain significantly and with a large effect the reliability of models in skating tests to 10 meters ($R^2 = 0.3140$; $f^2 = 0.4581$; $F = 3.8179$; $p < 0.05$), in skating test to the 5-10-5 meters ($R^2 = 0.6143$; $f^2 = 1.592$; $F = 13.270$; $p < 0.01$) and in Weave test ($R^2 = 0.4466$; $f^2 = 0.8069$; $F = 10.490$; $p < 0.01$). Also in the dryland tests, it is explained in the acceleration run to 10 meters ($R^2 = 0.4139$; $f^2 = 0.7062$; $F = 9.181$; $p < 0.01$) and in 5-10-5 m running test ($R^2 = 0.635$; $f^2 = 1.737$; $F = 14.475$; $p < 0.01$).

Out of the speed-strength factors of lower limbs with the increasing difficulty of skating tests, increasing muscle performance of lower limbs and vertical jump with countermovement most commonly occur. The significant part in the explanation of the performance in skating tests where direction changes were needed (5-10-5 m test and Weave test) is reserved for the vertical jump without countermovement and standing long jump. Out of the speed-strength factors of lower limbs in the 10 meters running test, the increasing muscle performance of lower limbs and vertical jump with countermovement are established. A significant part in the explanation of performance in the running test with changes of directions (5-10-5 m test) is seen in the performance in the dynamic balance Y-Balance test with a left foot as well as in Y-Balance test with the right foot. From all skating tests, the highest consistency with lower limbs explosive power tests is seen in the 10 meters run which was proven statistically ($F = 9.181$; $p < 0.01$), by intercorrelation ($p < 0.05$) and practically ($f^2 = 0.706$).

Table 1: Descriptive statistics of somatic indicators, skating and running tests, speed-strength factors and balance tests on ice hockey players

	M	SD	Min	Max	Percentiles		
					25th	50th	75th
Age	16.79	0.71	15.41	18.00	16.35	16.76	17.21
Body height [cm]	180.45	5.05	170.00	188.00	178.00	181.00	185.00
Body weight [kg]	73.77	7.94	60.40	88.70	68.80	72.40	78.00
Ice 10 m test [s]	1.88	0.09	1.69	2.07	1.81	1.88	1.93
Ice 5-10-5m test [s]	4.69	0.22	4.21	5.08	4.59	4.70	4.82
Ice Weave test [s]	11.27	0.36	10.50	12.05	10.99	11.24	11.48
10 m test [s]	1.80	0.07	1.67	1.94	1.76	1.81	1.85
5-10-5 m test [s]	4.90	0.22	4.50	5.39	4.76	4.90	5.09
Vertical jump without counter-movement [cm]	44.84	5.07	36.40	56.40	41.70	43.40	47.70
Vertical jump with counter-movement [cm]	38.77	4.63	30.90	49.10	35.80	38.30	40.80
Standing long jump [cm]	244.22	13.93	219.30	284.40	239.80	241.40	250.60
Single leg lateral jump – Left leg [cm]	206.16	9.85	177.60	226.30	199.80	206.60	211.80
Single leg lateral jump – Right leg [cm]	207.18	10.50	181.40	225.30	200.60	208.20	215.50
Squat Jump 50% [W]	457.33	62.09	353.80	600.00	411.80	455.70	507.10
Y-balance test Left leg [cm]	105.85	5.73	96.81	119.38	102.04	105.61	109.47
Y-balance test Right leg [cm]	105.95	5.26	91.84	115.97	103.13	105.67	108.42

Table 2: Correlation and regression analysis of selected factors that influence the acceleration speed in 10m skating test

10 m skate test	beta	b	beta*r	r	sig	t	Sig
Squat Jump 50%	-0.398	-0.0006	0.146	-0.367	0.049	-2.293	0.031
Vertical jump with counter-movement	-0.554	-0.0112	0.177	-0.320	0.090	-2.493	0.020
Single leg lateral jump – Right leg	0.468	0.0042	-0.009	-0.019	0.485	2.051	0.051
	R²	0.3142	SEE	0.0819		F	3.8179
	R	0.5605	bo	5.3542		sig	0.0222
	f²	0.4581					

Table 3: Correlation and regression analysis of the selected factors that influence the 5-10-5 m skating test

5-10-5 m skate test	beta	b	beta*r	r	sig	t	sig
Squat Jump 50%	-0.493	-0.0017	0.257	-0.521	0.004	-3.963	0.001
Vertical jump without counter-movement	-0.446	-0.0192	0.257	-0.576	0.001	-3.151	0.004
Single leg lateral jump – Left leg	-0.223	-0.0050	0.101	-0.450	0.014	-1.580	0.127
R²	0.6143		SEE	0.1437		F	13.270
R	0.7837		bo	7.3674		sig	0.001
f²	1.5924						

Table 4: Correlation and regression analysis of selected factors that influence the Weave test

Weave skate test	beta	b	beta*r	r	sig	t	sig
Vertical jump with counter-movement	0.283	0.0222	-0.125	-0.443		1.103	0.280
Standing long jump	-0.882	-0.0229	0.572	-0.649	0.016	-3.432	0.002
R²	0.4466		SEE	0.2798	0.000	F	10.490
R	0.6683		bo	16.0175		sig	0.001
f²	0.8069						

Table 5: Correlation and regression analysis of the selected factors that influence the acceleration speed in 10 m running test

10 m run test	beta	b	beta*r	r	sig	t	sig
Squat Jump 50%	-0.309	-0.0003	0.126	-0.408	0.027	-2.019	0.054
Vertical jump with counter-movement	-0.507	-0.0071	0.288	-0.567	0.001	-3.313	0.003
R²	0.4139		SEE	0.0517		F	9.181
R	0.6434		bo	2.2279		sig	0.001
f²	0.7062						

Table 6: Correlation and regression analysis of the selected factors that influence the 5-10-5m running test

5-10-5 m run test	beta	b	beta*r	r	sig	t	sig
Standing long jump	-0.639	-0.0103	0.430	-0.674	0.000	-5.117	0.000
Y-balance test Left leg	0.865	0.0338	-0.196	-0.226	0.237	2.933	0.007
Y-balance test Right leg	-1.025	-0.0436	0.400	-0.390	0.036	-3.480	0.002
R²	0.6346		SEE	0.1432		F	14.475
R	0.7966		bo	12.9933		sig	0.000
f²	1.7370						

CONCLUSION

In this study, the hierarchy of limiting factors of hockey performance in skating and running tests was created through relation analysis. The assumption about the influence of the lower limbs explosive strength and dynamic balance on the performance in the skating and running tests was confirmed only in maximal muscle performance, vertical jump and standing long jump. The differentiated hierarchy of factors according to the test difficulty and their performance on the ice and on dryland was proven. The lower limbs muscle performance test, vertical jump with countermovement and standing long jump are the indicators of lower limbs explosive strength which have the decisive part in the explanation of skating and running performance. Standing long jump tests from

the left and right foot have the minimum share. Dynamic balance tests on both feet shows as limited only at 5-10-5 meters running test. Out of all skating tests, the 5-10-5m test has the highest consistency with lower limbs explosive strength tests. Out of the running tests, the 10 meters run test has the highest consistency with the lower limbs explosive strength test. In both cases, the partial shares of individual parameters are in positive relation to the skating and running performance. These findings reaffirmed the importance of speed-strength assumptions of lower limbs as the factors limiting the skating and running speed in the sport-structured preparation of hockey players. The differentiated hierarchy of factors is closely related to the difficulty of tests and their performance on the ice and on dryland, reflecting the current level of physical performance in hockey players from the youth category.

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ZAVISNOST IZVEDBE KLIZANJA I TRČANJA OD EKSPLOZIVNE SNAGE DONJIH EKSTREMITETA I DINAMIČKE RAVNOTEŽE IGRAČA HOKEJA NA LEDU

Ovaj rad se odnosi na zavisnost izvedbe klizanja i trčanja od eksplozivne snage donjih ekstremiteta i dinamičke ravnoteže igrača hokeja na ledu u kategoriji omladine. Prepostavljamo da je izvedba testova klizanja i trčanja ograničena nekim faktorima poput eksplozivne snage donjih ekstremiteta i dinamičke ravnoteže, te da oni stvaraju diferenciranu hijerarhiju u skladu sa težinom testa. Testovi klizanja i trčanja su, u analizi odnosa, postavljeni kao zavisne varijable. Nezavisne varijable su kreirane testovima maksimalne mišićne snage donjih ekstremiteta, skoka u vis sa ili bez pripreme, skoka u dalj iz mjesta, bočnog skoka sa lijeve i desne noge, te testa dinamičke ravnoteže na desnom i lijevom stopalu. Za određivanje faktora koji ograničavaju izvedbu testova klizanja i trčanja, koristili smo analizu višestruke korelacije i regresijsku analizu. Za redukciju indikatora, korištena je stepwise analiza. Kada je u pitanju eksplozivna snaga donjih ekstremiteta, indikatori skoka u vis sa pripremom, skoka u dalj iz mjesta i testa mišićne snage donjih ekstremiteta su dali odlučujući doprinos za objašnjavanje izvedbe klizanja i trčanja. Bočni skokovi su imali najmanji udio u ovim indikatorima.

Testovi dinamičke ravnoteže su imali uticaj samo u testovima trčanja na 5-10-5 metara. Od svih testova klizanja, najveća usklađenost sa testovima eksplozivne snage donjih ekstremiteta je ustanovljena za testove trčanja na 5-10-5 metara, što je statistički dokazano ($F = 10,490$; $p < 0,01$), putem međusobne povezanosti ($p < 0,05$) i u praksi ($f_2 = 1,592$). Od svih testova trčanja, najveća usklađenost sa testovima eksplozivne snage je ustanovljena za testove trčanja na 10 metara, što je statistički dokazano ($F = 9,181$; $p < 0,01$), putem međusobne povezanosti ($p < 0,05$) i u praksi ($f_2 = 0,706$). U oba slučaja, djelimične proporcije u pojedinačnim parametrima su pozitivne u odnosu na izvedbu klizanja i trčanja. Pretpostavka o uticaju eksplozivne snage donjih ekstremiteta i dinamičke ravnoteže na izvedbu testova klizanja i trčanja je potvrđena skokom u vis, maksimalnom mišićnom snagom i skokom u dalj iz mjesta. Diferencirana hijerarhija faktora prema težini testova i njihovoj izvedbi na ledu i van njega je dokazana.

Ključne riječi: hokej na ledu, klizanje, trčanje, izvedba, eksplozivna snaga, dinamička ravnoteža.

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PLYOMETRIC EXERCISES AS AN INTEGRAL COMPONENT OF STRENGTH IN SHOT PUT ACHIEVEMENTS

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ABSTRACT

Background: Identify the effect of plyometric exercises to improve muscular ability and digital level in shot put conducted by students (20-22 years old).

Methods: The sample was formed from students belonging in the Physical Education and Sport Institute, University of Mostaganem (Algeria). Thus, the application was made in the form of pre-test and post-test method which was applied to a sample of 46 students attending the third year (males) who were divided into two groups: the first was an experimental group consisting of 22 students and the second was a control group consisting of 22 students. They were tested by using the broad jump test, medicine ball push test and performance in the shot put.

Results: After the treatment of the results by statistical means and through these results, several conclusions have been made, namely, that plyometric exercises are important to develop muscular ability and digital level in shot put effectiveness (statistically significant difference ($p \leq 0.05$)). The advantages of the experimental group compared to the control group rely more on the technical side only in the shot put event.

Conclusions: Plyometric exercises have a positive effect on a digital level in shot put effectiveness. The researchers recommend the use of plyometric exercises proposed in this study. The claims owed to their impact on the development of the athlete's strength, power and speed are combined with the development of motor components related to the characteristics of shot put achievements.

Keywords: throw exercises, jump exercises, muscle power, legs and arms, performance, shot put event.

INTRODUCTION

Shot put is one of the four throwing events in regular track and field competitions, along with the discus throw, hammer throw and javelin. The effectiveness of the chucking part of the activities done on the field is divided into several sports such as discus, javelin, shot put, hammer throw. Various components of fitness and different proportions among them according to the type of competition are needed for this. It has also the effectiveness of the shot put in terms of athletics' reference, which are related to the body movement and the body's ability to deliver a dynamic tool aimed at the push or to throw into the distance. It is the ability of an individual to perform motor movements (Rob Lasorsa, James Peterson, 2008). Reaching out to achieve the best digital achievements in shot put throw event requires access to technical performance. It is as close

to optimal by linking the speed of the approach and put throwing in order to enable the contestant to give the shot put the best speed and power launch during the release stage, through modern techniques and a variety of physical exercises in the practical lesson and training (Mohammed Awad, 2015). The performance in track and field throwing events depends, to a large extent, on muscle power production (Zatziorsky, V. M, 1995). Muscle power is the product of force and velocity, thus, either of these components, or both of them, need to be addressed in a training programme in order to develop muscular power and, therefore, the throwing performance (Judge L.W, 2007). This refers to (Howcar Salar Ahmed) the inability to show muscular strength which affects the athlete

and develops performance skills and lack of access to sports. In addition to the role of flexibility and agility which make it possible for the body to track the correct motor movements from the beginning of the activity to its end, a lack of fitness component which provides aesthetic movement in performance, the development of flexibility, particularly in the spine and shoulders, makes it easy to bind and transition which appears through rhythm-weighted performance of the movement. During the traditional programmes, the muscle strength of a muscle which has not been trained in similar movements for technical performance is increased with functional drills including several muscle groups and joints for both groups, "top and bottom", as well as using alternative options within training assistance which constitute the ways to improve technical performance. Compared to traditional drills, these exercises fit people of all ages and contribute to the improvement of all physical abilities, where they increase and enhance muscle strength endurance, motor balance, agility, leading to full motor joints term (Tiana Weiss, Jerica Kreitinger, Hilary Wilde, Chris Wiora, Michelle Steege Lance Dalleck, Jeffrey Janot, 2010). To use the training and a variety of physical exercises and quality and effective practitioners' needs in throwing performance, the physical preparation corresponds with their potential and abilities. Effectiveness (Nikolaos Zaras, Konstantinos Spengos, Spyridon Methenitis, Constantinos Papadopoulos, Giorgos Karamatsos, Giorgos Georgiadis, Aggeliki Stasinaki, Panagiota Manta, and Gerasimos Terzis., 2013) and requirements take a substantial share of work, and the associated levels indicate the player's weight in numbers that can be recorded in shot put. It is known that the plyometric exercises are training techniques used by athletes in all types of sports to increase strength and explosiveness (D.A, 1998). Plyometric exercises consist of rapid muscle stretching (eccentric action) which is immediately followed by a concentric or shortening action of the same muscle and connective tissue. The stored elastic energy within the muscle is used to produce more force that can be provided by a concentric action alone (Marginson V., 2005). In addition, some experts indicate that the importance of plyometric exercises for the strength and conditioning programme has previously been established, with positive training adaptations reported for force production (Malisoux L, 2006). It is understood that the primary objective in physical education and sports sections is upgrading physical fitness for students. Weakness of our students in the digital level is noted throughout this study. It is suspected that there is a vulnerability of some specific physical capabilities associated with the shot put demands. Researchers claim that, due to the adoption of skills by a lot of teachers, primarily during the teaching process,

and the lack of using appropriate methods of training concerned with the physical aspect have a direct impact on performance, which is shown by many experts in the field of specialization, as well as studies and previous research. So, the researchers considered using some plyometric exercises to see their impact on muscle capacity under discussion, which contribute to improving the digital level in an effective shot of third-year students in the Institute of Physical Education and Sports at the University of Mostaganem-Algeria.

Research objectives

- To prepare plyometric exercises to develop the muscle capacity and digital level in shot put of the third-year males students (20-22 years old)
- To identify the effect of the plyometric exercises on muscular ability and digital level in shot put of the third-year students
- To identify the differences between pre- and post-tests for members of the research samples (experimental and control sample)

METHODS

Participants: the research sample was selected from third-year students of physical education and sports from the Institute of Physical Education and Sports of Mostaganem (Algeria). 44 students ranging between 20 to 22 years of age of the 2015/2016 school year, 46 male students were chosen and divided into two groups as follows: the first group is the experimental one (22 students), and the second group is the control group (22 students), all of them belonging to the third-year of physical education and sports. The sample has been selected in a deliberate way.

The tests that were used are:

- Broad jump test to measure explosive power of legs (m)
- The medicine ball push test in the setting for measuring the capacity of arms (m)
- Achievement shot put test (m)

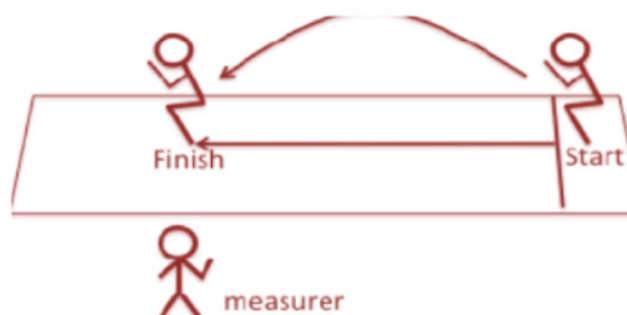


Figure 1: Broad jump test

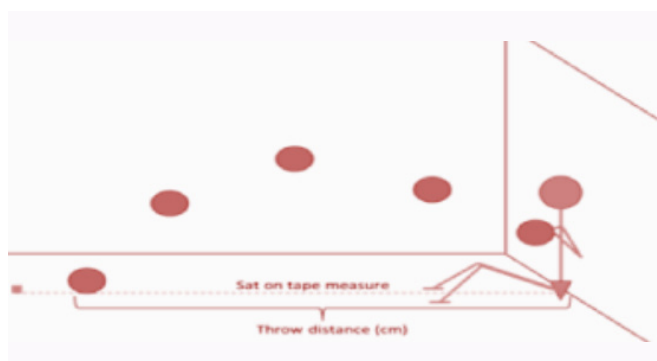


Figure 2: Medicine ball push test



Figure 3: Shot Put – Full Sequence

Programme objectives

The goal of the proposed programme conducted through practical lessons is to develop muscular ability (legs and arms) and a digital level in the effectiveness of the shot put for third-year students (20-22 years old) in the Institute of Physical Education and Sports Mostaganem - Algeria.

The content of the training programme

- The training programme includes a set of physical exercise associated with physical variable (muscular ability of legs and arms) to improve the digital level of effective shot put, plus a warm-up and exercises.
- The first phase was conducted in 2 weeks, and the duration of using the proposed exercises was about 20 minutes, with the intensity of load ranging between 40% and 60%, and the number of repetitions per exercise was from 6 to 10 with 3 to 4 sets, with an estimated 1 to 2 minutes of rest. - The second stage was conducted in 3 weeks, with the training duration set at 20-30 minutes. It was implemented under the load intensity ranging between 60% and 70%. The number of repetitions per exercise was from 4 to 6, with 3 to 4 sets, with an estimated 3 to 4 minutes of rest. However, the control sample was exercising the shot put effectiveness under the supervising teacher.

Experience

- The tests were conducted on the sample of experimental and control groups on 09th December 2015.
- It was suggested that 16 training sessions containing a set of physical exercises proposed for an effective shot put were to be conducted from 06th January 2016 to 29th February 2016.
- The control group examined the effectiveness of the shot put under a supervisor. All remote tests were done in the same conditions and at the same time, using the same methods or tests conducted March 2nd 2016.

RESULTS

As illustrated in Table number (1), all values, T calculated, that come between 02 as the smallest value, and 3.04 as the largest value, are greater than the value of T tabular estimated 1.72 at a degree of freedom 21, with a level of indication 0.05, which are the differences between the averages of any differences resulting between the averages of statistical significance.

Table 1: The results of the experimental sample

Statistical significance	T Tabular	Pre-test		Post-test		Statistical tests
		SD	Means	SD	Means	
Significant	02	0.20	2.28	0.23	2.17	Broad jump
Significant	2.57*	0.69	5.80	0.61	5.31	Medicine ball push
Significant	3.04*	0.89	10.65	0.87	9.86	Achievement test

In Table (02), there are no statistically significant differences in the control sample, in most tests where the calculated T value ranged between 01. They are smaller than the value of the indexed and estimated T 1.72, at an indication of 0.5 and a degree freedom 21, except the medicine ball push test and achievement test. T was calculated from 2.00 to 2.12 and it is larger than the value of the table T.

As illustrated by Table (03) above, all values, T calculated, that come between 1.81 as the smallest value and 2.54 as the largest value are greater than the value of T tabular which reached 1.68, at degree freedom 43, and a level of indication 0.05. Reported as detailed in Figure (01).

Table 2: The results of the control sample

Statistical significance	T Tabular	Pre-test		Post-test		Statistical tests
		SD	Means	SD	Means	
Not Significant	01	0.33	2.23	0.32	2.13	Broad jump
Significant	2.00*	0.81	5.64	0.9	5.16	Medicine ball push
Significant	2.12*	1.01	10.21	1.03	9.53	Achievement test

Table 3: Comparison of post-test results of research samples

Statistical significance	T Tabular	Experimental Sample		Control sample		Statistical tests
		SD	Means	SD	Means	
Significant	2.54*	0.20	2.33	0.33	2.18	Broad jump
Significant	1.92*	0.69	5.83	0.81	5.54	Medicine ball push
Significant	1.81*	0.89	10.65	1.01	10.21	Achievement test

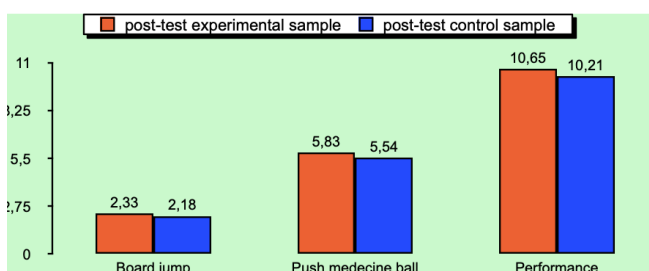


Figure (01) indicates comparisons between experimental and control sample at average performances in the research variables and digital level in shot put. (*P < 0.05)

DISCUSSION

Table (01) shows the lack of differences between measurements in the pre-test and post-test of the experimental sample, with the differences in averages that indicate progress on the level of muscular ability

in legs and arms, and a digital level ineffective shot put with third-year students from the Department of Physical Education and Sports. This is because most of our teachers' option based on athletic competence (shot put) mainly relies on skilful side development. Followed by physical and cognitive side alike, in addition to the use of physical exercises which contribute to the development of special physical qualities for an effective shot put in the preparatory segment only share, increasing to twice the physical level of the students who need intensification of training to improve the physical level. As recommended by some studies, such as the study of Hassan Ibrahim (2001) and Judge L.W (2007), Fatouros et al. (2000) and Benzidane Houcine (2013) on the special attention to elements of physical performance. Especially the power of quick explosiveness and strength through diversification in using muscle strengthening exercises to improve achievement in efficiency (Hassan Ibrahim, 2001), (Judge L.W, 2007), (Fatouros, 2000), (Benzidane houcine, 2013).

This is confirmed by Ahmed Bastawissi (1997) on the importance of the development of physical capacity of digital achievement in the competition, that muscle power is firmly linked to some of the components installed for fitness as the capacity required by the nature of the performance in shot put competitions (Ahmed Bastawissi, 1997). Apart from the experimental sample, there are statistical significance tests and researchers. Due to the physical exercise quality used that contributed to the development of physical performance elements, for example, explosive power and speed force, flexibility through the development of locomotor and nervous system to activate the reflex to working muscles, where this production method and output the maximum power to achieve the best result. Claims by researchers owed to plyometric exercises used for the benefit of the experimental sample. Leading this sample to develop the explosive power through the development of muscle contraction and the development of the relationship between maximum power and explosive strength in the arms and legs to be a clear impact to achieve the feat in the shot put. Indicated by Judge et al. (2000), Kawamori et al. (2004) through muscle power as the product of force and velocity, thus, either of these components, or both of them, need to be addressed in a training programme in order to develop muscular power and, therefore, throwing performance, according to Judge L.W. et al. (2000), Kawamori. N., (2004) and Benzidane Houcine, et al. (2015). Researchers suggest the case of this study in the improvement of shot put achievements among PE students. Due to the use of quality physical exercises that have had a positive impact on it, according to Mehdi Kadhimi Ali (2002). Underlined by Mohammed Awad (2015) via the improvement in digital level and the effectiveness of shot put, mainly owed to the development of physical capacity and by adopting the most appropriate training methods and selection

of physical exercises and special ones associated with the type of effectiveness. Admitted in this study by the significant differences noted in Table (03), between the post-measurements for the experimental and control sample in the level of muscular ability (muscle capacity of legs, muscle capacity of arms) and the digital level in shot put discipline pilot for the experimental sample. Where this result indicates that plyometric exercise was more effective in improving performance applied in the shot put tests compared to the traditional method, which relies on memorization and performance of the model with the control sample. As for digital achievement test in shot put, we claim this superiority is due to the use of plyometric exercises. Mentioned by Tiana Weiss et al. (2010), confirmed by Zatziorsky, V. M (1995) and Samah kamal (2016), owed to explosive strength development of leg muscles to push increase forward speed output extension working muscles resulting from training and adaptation to reduce the time of impeachment during a push forward, which increases the distance shot, according to Kamal S, (2016). From the proof, we agree with the judgements of Michael Young (2009) and Venkatesan, (2012), that to develop explosive force leads to production of capacity and high performance fast activist more than a muscle when a large tide or slow, as a result of retraining by using the plyometric exercises constantly.

This actually confirms the effectiveness of using plyometric exercises while teaching the students led to an improvement in some physical abilities and performance with the experimental research sample. This is approved by Sam J. Allen, (2013) in elite players, affirmed by (Labuber, 1993), optimal training load for the development of muscular power, and Habib Bensikaddour, et al. (2015) to improve physical capacity and athletic performance among students.

DISCUSSION

Our results confirmed the need to integrate

- plyometric exercises used as a positive impact on the development of muscular ability under consideration of an effective shot put
- plyometric exercises as a positive effect on digital levels in shot put
- plyometric exercises in PE lessons as the best training strategy to improve students' strength, power and speed combined with the development of their motor components as characteristics of shot put achievements.

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PLIOMETRIJSKE VJEŽBE KAO SASTAVNA KOMPONENTA SNAGE U BACANJU KUGLE

Osnova: Utvrditi efekat pliometrijskih vježbi na poboljšanje mišićne sposobnosti i izvedbu bacanja kugle od strane studenata (20-22 godine starosti).

Metode: Uzorak je formiran od studenata Instituta za fizičko obrazovanje i sport Univerziteta u Mostaganemu (Alžir). Prema tome, primjena je provedena u obliku metoda pretesta i posttesta koje su upotrijebljene na uzorku od 46 studenata muškog spola koji pohađaju treću godinu studija, te koji su podijeljeni u dvije grupe: prva je bila eksperimentalna grupa koja se sastojala od 22 studenata, a druga je bila kontrolna grupa koja se sastojala od 22 studenata. Testirani su korištenjem testova skoka u dalj, potiska sa medicinskom loptom i izvedbe u bacanju kugle. Rezultati: Nakon obrade rezultata statističkim sredstvima, i putem istih, došlo se do nekoliko zaključaka. Naime, pliometrijske vježbe su važne za razvoj mišićne sposobnosti i efikasne izvedbe bacanja kugle (statističke značajna razlika ($p \leq 0,05$)). Prednosti eksperimentalne grupe u poređenju sa kontrolnom grupom se više oslanjaju na tehničku stranu, samo u bacanju kugle.

Zaključci: Pliometrijske vježbe imaju pozitivan efekat na efikasnu izvedbu bacanja kugle. Istraživači preporučuju korištenje pliometrijskih vježbi predloženih u ovoj studiji. Navodi zasnovani na njihovom uticaju na razvoj snage, sposobnosti i brzine su kombinovani sa razvojem motoričkih komponenti vezanih za karakteristike bacanja kugle.

Ključne riječi: vježbe bacanja, vježbe skakanja, mišićna snaga, noge i ruke, izvedba, bacanje kugle.

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RECOGNITION OF THE MOST SIGNIFICANT COMPONENTS OF WELLNESS AS ONE'S OWN ACTIVITIES IN THE TOURIST OFFER

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ABSTRACT

The main goal of this paper is to determine the role and modality of applying wellness and the resources of sports and recreational activities in modern tourist offers, as well as recognising the most important components of wellness as one's own activities in the tourist offer. In line with the set objective, a survey was carried out to determine the extent to which the respondents recognized the significance of wellness for shaping a healthy lifestyle, as well as which components of wellness, in the opinion of the respondents, were the most significant when it comes to the concept of wellness. We were interested in whether the visitors (tourists) staying in the mentioned hotels consider that all the components of wellness are equally significant and whether they recognize all the components of personal wellness. The sample of respondents consisted of 880 adult visitors of the Kemer tourist destination in Turkey, in the period from 07/06/2013 to 04/09/2013. When it comes to their gender, the sample consisted of 410 males and 470 women aged 18-72. The average age of the sample was 38 years. The results of the survey found that most of the claims have a rating of 3-5, which, in some way, indicates good knowledge of a wide range of personal wellness activities. When asked about their satisfaction with the chosen tourist destination, as far as sports and recreational activities and active holidays are concerned, 835 or 94.88% of respondents expressed their satisfaction with this form of tourist offer. Based on our survey, we can conclude that, based on the wellness offer and the opinions of the respondents, 4 basic components of the concept of wellness are formed, namely, physical wellness, healthy nutrition, emotional and spiritual wellness. Therefore, these are the most important components of wellness perceived by the respondents as possible personal activities in the tourist offer.

Keywords: wellness components, tourist offer, health, survey, respondents.

INTRODUCTION

The time in which we live is called the time of the IT revolution, which is characterized by a great improvement in the field of circulation and information flow, a high degree of industrialisation, technical progress and automation, and it also has the consequence of reducing physical activity, i.e. the volume of daily movement activities. In our daily job and the rush to earn a living, we expose ourselves to excessive nervous and emotional strains. We are increasingly

ignoring the basic needs of our organism: we eat irregularly and often too abundantly, we sleep too much, we do not rest, we smoke a lot, we drink inordinately. We're constantly tense, overloaded and tired. We increasingly have health problems and disturbances. We're not placing sufficient attention to our health. We mostly act as "consumers", do not act enough, and rarely act as "producers" of our own health (Mitic, 2001). In most developed

countries, public-health, social and economic problems dominate chronic non-communicable diseases, where significant etiological risk factors are represented in the lack of movement. These diseases are at the very top of the list not only of illnesses, but also of the mortality of the modern man. The World Health Organization has contributed to the analysis of health statistics, stating the need to develop guidelines for primary and secondary prevention of these diseases, primarily by reducing health risk factors. A significant part of these diseases is a consequence of lifestyle, i.e., daily activities with too little movement and with excessive and qualitatively inappropriate nutrition. They are a remarkable influence of the unhealthy way of life as seen in the illness and mortality of the population in developed countries. However, in developing countries, they increasingly indicate the need for intervention, behavioural change and the implementation of a healthy lifestyle in order to protect and improve health as well as prevent premature mortality. Hypokinesia is a risk factor that can be affected. The fact is that, by regularly practising sports and recreational activities, one can prevent or, at least, postpone the emergence of the most chronic non-communicable diseases (Mikić et al., 2011). To date, the importance of preventing these diseases, in a large number of cases, only stood out in elderly people. However, due to the increase in hypokinesia, the risk of contracting one of the above-mentioned illnesses is increasingly present in young people. Lifestyle has become such that it is increasingly sedentary and people spend more time in their cars, watching TV, sitting in front of computers, etc. It is primarily necessary to prevent physical illnesses and diseases, and then it is very important to pay attention to your good looks. Physical health requires developed motor and functional abilities, and appropriate morphological characteristics. Mental health is at the highest level when we are satisfied with ourselves, with our looks and life, so everyone has to find activities that intellectually enrich and fulfil them. Mental health is closely related to satisfying one's needs. Emotions are a part of our life, which is why emotional health is a significant component of health as a whole. If unpleasant emotions often occur, they occupy and violate our mental and mutual relations. People who are more tolerant of different emotional situations are more resistant to heart attacks than others (Anspaugh and SAR, 2006). Different studies have shown that they have the advantage of healing people who are surrounded by friends and companions, compared to those who do not have these opportunities (Anspaugh and SAR, 2006; Bercic, 2006). The social component plays a significant role in the life of every person. We are spiritually healthy when we have positive thinking. Wellness is a philosophy of living which seeks to establish a good connection between all

components of human life (Mikić, 2005). Wellness integrates a large number of different components that affect the quality of life differently. It is the opposite of disease and we can describe it as a positive component of good health. Many identify wellness with the quality of life because it encompasses the following components (physical, mental, social, emotional, spiritual, working and environmental), (Corbin, 2002; according to Mikić, 2005). The first and the most obvious place belongs to the physical component of wellness which represents the ability to accept all everyday obligations, be physically active, retain adequate body weight and relinquish the consumption of alcohol, cigarettes and other vices. The intellectual component of wellness includes the ability of learning and the use of information. The emotional component of wellness is the ability to control stress and cultivate intimate personal relationships. Optimistic people live longer. The social dimension of personal wellness is the ability of a person to establish intimate relations with others and to show respect and patience to others. From birth, a person is a biological being, and through socialising they become a social being. For most people, spiritual wellness is an identification with faith, God and with reality. But this is not only synonymous with faith. It includes cultural behaviours, norms, values, ethics, morality which present guidelines for the design of a human life. Selflessness, compassion, openness, joy of living, relaxation, understanding the righteousness and unrighteousness. Years of development and attention (Pilcer, 2006) are needed to achieve high levels of the spiritual component of wellness. The employee or working component of wellness represents the satisfaction of the employee at a random place. It is a significant choice of interest that we think we can do with pleasure. As environmental factors affect wellness, they show differences in the incidence of fatalities (accidents with a fatal outcome) and the percentage of patients who are sometimes present. At the beginning of the 20th century, the average life expectancy in America was 47 years. Today, it is 77.8 years (Aspaugh, et al., 2006). Major infections and incurable diseases were present, which were the main cause of death. Their living conditions were poor, and people were not familiar with a healthy lifestyle which significantly affected their lifespan. Our intention is to determine the extent to which the respondents recognize the significance of wellness for shaping healthy lifestyles, as well as which components of wellness, in the opinion of the respondents, are the most important when it comes to the concept of wellness. We were interested in whether the visitors (tourists) staying in the mentioned hotels consider that all the components of wellness are equally significant and whether they recognize all the components of personal wellness. Recently, wellness tourism has increasingly emerged, providing some components of personal wellness (primarily physical and emotional one). That is why people using wellness usually identify with fitness, massages, saunas, swimming pools and Jacuzzi.

WORK METHODS

The sample of respondents

The sample of respondents consisted of 880 adult visitors staying at the tourist destination of Kemer in Turkey. In relation to their gender, the sample was composed of 410 men and 470 women aged 18-72. The average age of the sample was 38 years. The visitors were staying in luxury hotels:

- Limak Limra Resort – Kemer, Antalya
- Kemer Resort – Kemer, Antalya
- Fantasia Deluxe – Kemer, Antalya
- Akka Antendon – Kemer, Antalya
- Porto Bello – Antalya

Sample variables

The sample of variables was made based on a survey containing 20 claims which marked the degree of consent with the role of personal wellness in human life. The questions given to the respondents were constructed with a five-tier scale and claims (1- I completely disagree; 2- I disagree; 3- I partially agree; 4- I agree; 5- I completely agree). The questions provided in the survey were structured so that those indicating the physical component of wellness were placed in the positions (1-4), the intellectual component was placed in the positions (5-7), the emotional component of wellness was placed in the positions (8-11), the social component was placed in the positions (12-14), the spiritual component was placed in the positions (15-17), and the professional or working component was placed in the positions (18-20).

RESULTS AND DISCUSSION

Table 1 illustrates the respondents' answers on the importance of sports and recreational activities in their lives. On the basis of the presented answers, 605 subjects or 68.75% of the total sample are familiar with the concept of wellness. Out of the total number of respondents, 584 or 66.36% engage in sports and recreational activities in their free time, which is quite surprising data in terms of prejudice present among the public indicating that relatively few citizens are engaged in sports and recreational activities. However, in the light of the data which was provided on the choice of the tourist destination for the holiday and the fact that a significant number of respondents expressed the reasons for family vacation, namely 320 or 36.36%, with the second place attributed to sports and recreational activities and active holidays with 270 or 30.68% of respondents, it is obvious that this is the sample of respondents who take care of their preventive-health needs and lifestyle which promotes the quality of life. When asked about their satisfaction with the chosen tourist destination, as far as sports and recreational

activities and active holidays are concerned, 835 or 94.88% of respondents expressed their satisfaction with this form of tourist offer. In (Table 2), we presented the responses in percentages for each claim regarding the degree of consent with the role of personal wellness in the subject's life. Most of the claims have a rating of 3-5, which, in some way, indicates good knowledge of a wide range of personal wellness activities. The fact is that, when it comes to the concept of wellness, the surveyed respondents primarily undertake exercising in the fitness studio and engage in sports and recreational activities (68% totally agree with that), care for their body weight (57% expressed complete consent), practice a healthy diet (41% expressed complete consent), have inner satisfaction and peace (47% indicated a complete consent) and control stress (40% indicated complete consent). From the presented results, it is possible to recognize that the visitors of the Wellness Centre include the first body component under the concept of wellness. Most of them are aware that sports and recreational activities are a necessary need for healthy living which allows them to achieve better physical health. Depending on the desires, motives and goals are often developed and people have different motor and functional abilities, and transform variable morphological characteristics (care for body weight, maintenance of quality muscle mass, reduction of subcutaneous fatty tissue). Moderate physical activity has, on the other side, very significant effects on human health, as demonstrated by many research (Paffenbarger, et al., 1990; Haimer, 1996; Rauramma and Leon, 1996; Pori and Skender, 2009), etc. Active lifestyles and physical activity can diminish the possibility of illness, heart disease and cancer mortality for approximately 50%, which greatly affects the quality of life. A significant component of wellness is a balanced and healthy diet (Murphy and Murphy, 1987; Lamb, 1994; Bercic, 2006; Tuuri et al., 2009; Mikic et al., 2017). Humans have a vital need for a variety of foods to supply themselves with the necessary energy. "Food Wellness" must contain food which is hygienic, nutritious and energetically balanced, distributed in the proper rhythm of feeding, and balanced with the content of nutritious ingredients (vegetables, fruits and cereals), adapted to the socio-cultural environment, human habits and taste. With proper nutrition we preserve and maintain health, prevent ailments and diseases (Berčić, 2006). The surveyed persons have most commonly cited the emotional component under the term wellness. Under this component, they most frequently chose the concepts of stress control (40%) and manifestation of positive emotions (35%). For most people, the demands of today's times are to balance the emotional and physical components. However, the fact is that we often meet with the manifestation of negative emotions and inability to control

stress. It is certain that this imbalance of emotional and physical components leads to psychosomatic difficulties such as headache, high blood pressure, chronic deformity, lack of energy and decreased body resistance (Bokan, 2005; Mikić, 2005). The greatest contradictions are manifested in the social component. The question of socializing with friends has been marked by 38% of respondents with a score of 5, which means that we have to pursue different relationships with other people because we reach social wellness and influence our health. The other two social activities, tours of religious

facilities, discotheque, cinemas and sporting events, and alcohol, smoking and other vices are not attributed to wellness. At the bottom of the ladder, preferably included in the personal wellness, is the intellectual component. We predict that the intellectual component of people is not attracted to wellness, because we associate it with education. It is certain that this component causes growth in the intellectual area and the ability to use information in different life circumstances. Gojčić (2005) notes that, on the basis of the wellness offer, four components were formed, including physical (body) wellness, healthy nutrition, emotional and mental wellness.

Table 1: Overview of responses on the importance of sports and recreational activities

The sample of respondents	880			
The sample of respondents relative to gender	M	%	F	%
	410	46.59	470	53.40
Average age of respondents	38			
I am familiar with the concept of wellness	YES	%	NO	%
	605	68.75	275	31.25
I engage in sports and recreational activities in my free time	YES	%	NO	%
	584	66.36	296	33.63
The choice of the tourist destination for the holiday:	Number		%	
a) families	320		36.36	
b) Companies	30		3.40	
c) Sports and recreational activities and active holidays	270		30.68	
d) Cultural content	30		3.40	
e) Hotel services	170		19.31	
f) Optional visits	35		3.97	
g) Indefinite	25		2.84	
Satisfied with the destination offer	YES	%	NO	%
With regard to sports and recreational activities and active holidays	835	94.88	45	5.11

Table 2: Overview of responses on special values for each claim

		1 %	2 %	3 %	4 %	5 %
1	Exercise in a fitness studio, engaging in sports and recreational activities	2	2	7	21	68
2	Caring for body weight	3	2	15	23	57
3	Practicing healthy diets	8	9	18	24	41
4	Alcohol, smoking, and other vices	40	28	15	10	7
5	Reading books	38	16	30	7	9
6	Learning foreign languages	31	23	16	11	19
7	Additional education	18	26	18	17	21
8	The ability to recognize negative emotions	18	20	24	20	18
9	Manifesting positive emotions (joy, happiness, etc.)	9	14	22	20	35
10	Stress control (anti-stress therapy)	18	11	17	16	40
11	Good friendly relationships	11	16	18	26	29
12	Hanging out with friends	10	12	16	23	39
13	Visits to discos, cinemas, sports facilities, religious objects	29	21	15	16	19
14	Willingness to assist others, respect for others	21	16	20	24	19
15	Self-esteem	10	7	19	28	36
16	Inner pleasure and peace	2	1	20	30	47
17	Expressing positive self-control	5	12	28	16	39
18	Workplace satisfaction	11	17	30	23	19
19	Dealing with workplace stress in a positive way	12	10	22	31	25
20	Manifesting work efficiency	10	6	18	28	38

CONCLUSION

Among the many activities aimed at preserving and improving health in recent decades, wellness has emerged, integrating various programmes and treatments designed for the modern man to improve the quality of life. Wellness in tourism began to be mentioned ten years ago, losing the original meaning of its conception, which mainly concerned the adaptation of the medical treatment model for the purpose of improving health. Modern wellness does not only cover exercise and movement, but it also fills the entire life with certain contents which help him solve numerous problems. Various studies and research in recent years have indicated a significant increase in

the awareness of health, especially physical and mental wellbeing. Wellness is the most modern concept and trend of the tourist offer which has spread to the countries of Europe in the 1990s, especially those that have developed the offer of health and bathing centres, such as Germany, Italy, Austria, France, Switzerland, Hungary, Slovenia, the Czech Republic, Croatia, Serbia, etc. The main goal of this paper is to determine the role and modality of applying wellness and the resources of sports and recreational activities in modern tourist offers, as well as recognising the most important components of wellness as one's own activities in the tourist offer. In line with the set objective, a survey was carried out to determine the extent to which the respondents

recognized the significance of wellness for shaping a healthy lifestyle, as well as which components of wellness, in the opinion of the respondents, were the most significant when it comes to the concept of wellness. We were interested in whether the visitors (tourists) staying in the mentioned hotels consider that all the components of wellness are equally significant and whether they recognize all the components of personal wellness. The results of the survey found that most of the claims have a rating of 3-5, which, in some way, indicates good knowledge of a wide range of personal wellness activities. On the basis of the presented answers, 605 subjects or 68.75% of the total sample are familiar with the concept of wellness. Out of the total number of respondents, 584 or 66.36% engage in sports and recreational activities in their spare time, which is quite surprising data in terms of prejudice present among the public indicating that relatively few citizens are engaged in sports and recreational activities. However, in the light of the data which was provided on the choice of the tourist destination for the holiday and the fact that a significant number of respondents expressed the reasons for family vacation, namely 320 or 36.36%, with the second place attributed to sports and recreational activities and active holidays with 270 or 30.68% of respondents, it is obvious that this is the sample of respondents who take care of their preventive-health needs and lifestyle which promotes the quality of life. When asked about their satisfaction with the chosen tourist destination, as far as sports and recreational activities and active holidays are concerned, 835 or 94.88% of respondents expressed their satisfaction with this form of tourist offer. The fact is that, when it comes to the concept of wellness, the surveyed respondents primarily undertake exercising in the fitness studio and engage in sports and recreational activities (68% totally agree with that), care for their body weight (57% expressed complete consent), have inner satisfaction and peace (47% indicated a complete consent), practice a healthy diet (41% expressed complete consent) and control stress

(40% indicated complete consent). Based on our survey, we can conclude that, based on the wellness offer and the opinions of the respondents, 4 basic components of the concept of wellness are formed, namely, physical wellness, healthy nutrition, emotional and spiritual wellness. Therefore, these are the most important components of wellness perceived by the respondents as possible personal activities in the tourist offer. Due to the humans' primal need for movement, it is necessary to ensure the conditions for the content and active implementation of the tourist offer. Today's society passively conducting the free time created by Foskuli Sun, sect and Sand considered insufficient (Čavlek, 1996). If we go from the fact that wellness is the overall conception of the tourist offer, not only the "additional" service in the hotel, we can find that modern tourism has numerous opportunities and comparative advantages for the development of the modern wellness offer. The wellness offer is a modern conception of the tourist offer, which takes care of the needs of different people. To this end, experts from various fields such as tourism, medicine, kinesiology, economics, architecture and others, who are engaged in improving the quality of human life, have devised wellness programmes that will improve the quality of life for people during their free time, especially on vacation in special health-tourist centres. Therefore, wellness can be viewed from various areas: medicine (healthcare and relaxation), kinesiology (as a form of recreational, sports and kinesiological activities), tourism (improvement of the tourist offer), economics (an increase of economic nutritional effects), nutrition (a healthy diet), etc. On the other hand, respecting human nature, unpredictability, the tendency to discover a new one, and desire for convenience, the wellness offer faces a constant challenge of innovating the offer of reading programmes and activities that will satisfy and make a number of users happy. The results on the use of wellness and recognition of the most important components of wellness as their own activities in the tourist offer may serve as useful information to tourist and sports workers in the sense of creating adequate tourist offers with programmed content that will be attractive and adapted to the customers' wishes.

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PREPOZNAVANJE NAJZNAČAJNIJIH KOMPONENTI WELLNESSA KAO SOPSTVENIH AKTIVNOSTI U TURISTIČKOJ PONUDI

Osnovni cilj ovog rada je utvrđivanje uloge i modaliteta primjene wellnessa i resursa sportsko-rekreacijskih aktivnosti u suvremenoj turističkoj ponudi, kao i prepoznavanje najznačajnijih komponenti wellnessa kao sopstvenih aktivnosti u turističkoj ponudi. U skladu sa postavljenim ciljem provedena je anketa da bi se utvrdilo u kojoj mjeri ispitanici prepoznaju značaj wellnessa za oblikovanje zdravog načina života, kao i koje su komponente wellnessa po mišljenju ispitanika najznačajnije pri pomenu pojma wellness. Zanimalo nas je, da li su posjetiteljima (turistima) navedenih hotela sve komponente wellnessa jednako značajne i da li prepoznaju sve komponente osobnog wellnessa. Uzorak ispitanika je sačinjavalo 880 odraslih posjetilaca turističke destinacije Kemer u Turskoj, u razdoblju od 07.06. do 04.09.2013. godine. U odnosu na pol, uzorak je sačinjavalo 410 muškaraca i 470 žena starosti od 18 do 72 godine. Prosječna starost uzorka je bila 38 godina. Rezultatima istraživanja je utvrđeno da većina tvrdnji ima vrijednosti ocjena od 3 do 5, što na neki način govori o dobrom poznavanju širokog spektra aktivnosti osobnog wellnessa. Na pitanje o zadovoljstvu sa odabranom turističkom destinacijom, što se tiče sportsko-rekreacijskih aktivnosti i aktivnog odmora, 835 ili 94,88% ispitanika je izrazilo svoje zadovoljstvo sa ovim oblikom turističke ponude. Temeljem provedene ankete možemo zaključiti da su se temeljem wellness ponuda i mišljenja ispitanika oblikovale 4 temeljne sastavnice pojma wellnessa i to tjelesni (fizički) wellness, zdrava prehrana emocionalni i duhovni wellness. Dakle ovo su najznačajnije komponente wellnessa koji su ispitanici percipirali kao moguće osobne aktivnosti u turističkoj ponudi.

Ključne riječi: komponente wellnessa, turistička ponuda, zdravlje, anketa, ispitanici.

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BALANCE AND STABILITY STATUS DURING A TEMPORARY ANTERIOR LOAD CARRIAGE

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ABSTRACT

The present study aimed to assess the effect of a temporary anterior load carriage on the overall stability and balance status. Methods: The study recruited twenty volunteers out of college students (ten males and ten females). The participants' balance and stability status was assessed by using the Limits of Stability Test (LOS) provided by Biodex Medical Systems. Three anterior loads provided by medicine balls (10lbs, 20lbs, and 30lbs) were selected and they closely mimic everyday tasks. A 2x3 Between-Groups ANOVA was used to evaluate the effect of the three anterior loads and gender (male, female) on the LOS test scores. Results: the statistical analysis conducted in this study indicated a significant difference between males and females' LOS scores ($p < .001$, $\eta^2 = .68$). Additionally, there was a significant main effect of the load conditions ($p < .001$, $\eta^2 = .758$). The results of this study indicated that, no matter the gender, a temporary load affects the balance and stability status which might raise the risks of falling and injuries. Also, it raises the importance of using alternative moving strategies to maintain balance when carrying external loads.

Keywords: balance and stability, anterior loads, Limits of Stability Index, Biodex Systems

INTRODUCTION

Balance is the integration of the postural control strategies in order to maintain an individual's centre of pressure (COP) within the base of support against static and dynamic perturbation (Karimi, Ebrahimi, Kahrizi, Torkaman, 2008). Thus, the efficacy of postural control is assessed through variations in COP or body sway in static balance tasks (Hong, Guo, Song, Nagurka, Sung, and Yen, 2016).

Since the goal of postural control is to minimize fluctuations in COP displacement by the anticipatory postural adjustments (APA), the provided movement sequence indicates the efficacy of the postural control mechanism (Del Porto, Pechak, Smith and Reed-Jone, 2012; Caballero, Barbado, and Moreno, 2015). Weight is an essential factor which influences balance and postural control. Increasing the weight of the body could challenge the balance control system by increasing the trajectory of the body mass, and thus requiring greater effort to remain balanced (Dounskaia, Peterson, Bruhns,

2018). Whereas, Newton stated in a law: "Force equals mass times acceleration." Therefore, added loads to the body are translated by increased net muscle moments in order to maintain COP within the base of support and prevent falling. Previous research studies stated that the increased net muscle moments, due to extra loads, are associated with increased unbalanced force through the kinetic chain (Costello, Matrangola and Madigan, 2012; Li and Chow, 2018). This leads to greater COP projection, sway speed, and a lack of stability during static tasks (Palmieri, Ingersoll, Stone and Krause, 2002; Cantú, Emery and Côté, 2014). Extra weight challenges both static and dynamic balance which affects the body's strategies used to regain postural control, increasing the risk factor of injuries and falling. Hue and colleagues' study showed that the impact of extra body weight accounted for a significant proportion of changing balance strategies to maintain postural control with both open and closed eyes in static balance assessments (Hue et al., 2007). Whereas, the influence of extra weight on dynamic balance has been found in literature to affect gait mechanics and body sway due to elevated hip and trunk range of motion which increases the risks of falling (Kim and Chai, 2015; Caderby, Dalleau, Leroyer,

Bonazzi, Chane-Teng and Do, 2013). Also, muscle activation and muscle fatigue which are integral in postural control and body sway have been found to be significantly affected by additional weight (Murillo et al., 2012). However, Ledin et al. (2004) and Hue et al. (2007), concluded that body sway is more affected by added weight in comparison with muscle fatigue. Researchers have also addressed the fact that load carriage position differs in exerted postural adjustments to withstand the additional load. Whereas, the anterior load carriage has induced higher motor instability compared with the posterior load carriage as addressed by (Anderson, Meador, McClure, Makrozahopoulos, Brooks, and Mirka, 2007; Lloyd and Cooke, 2011; Wu, Huang and Wang 2017; Lim and D'Souza, 2019). In daily tasks where a temporary anterior load is applied (e.g., marching bands, front bags, carrying a child), movement patterns and posture control are impacted depending on the ability to endure such loads. In a study conducted by Roberts and colleagues (2018), they reported that an added 10% of body mass internal load increased postural sway and gait variability patterns, which increased the risk of falls and related injuries. Also, their results showed that, as the internal carried load increased during walking, the higher the challenges on static and dynamic participants stability (Roberts, Talbot, Kay, Price and Hill, 2018). Previous literature has addressed the fact that the gravitational moment is proportional to the COM height, body mass, and joint range of deviation from the upright posture (Li and Aruin, 2007; Zultowski and Aruin, 2008; Rugelj and Sevs̃ek, 2011; Dounskaia et al., 2017). Many balance assessments have been developed and used in clinical settings, research studies, as well as in the athletic and recreational areas. Balance assessments are considered integral in the evaluation of falls and related injury risks (Dallinga, Benjamins and Lemmik, 2012; Gribble, Hertel and Plisky, 2012; Flanagan, 2012). One of the conventional balance assessment systems is the Biodex Balance System SD that provides a translation of balance and stability tasks to objective evaluation test scores. The system is considered easy to operate and simple to interpret. It also provides a variety of balance and stability test protocols (Aydoğ, Aydoğ, Cakci and Doral, 2006; Salsabili, Bahrpeyma, Forogh, and Rajabali, 2011; Glave, Didier, Weatherwax, et al., 2016). The limits of stability test (LOS) is among the provided testing protocols. In contrast, the overall score has been addressed to be the best indicator of the overall ability of the performers' stability (Didier, Glave, Browning, Fiaud and Weatherwax, 2014). Despite previous research evidence which examined the impact of internal load carriage on balance and stability status of individuals, it is still recommended to conduct studies which examine the effect of temporary external load carriage and closely mimic the activities of the daily loading tasks in healthy individuals' overall balance and stability status. Therefore, the purpose of this study was to assess the effect of three anterior loads (10lbs, 20lbs, and 30lbs) which mimic the daily tasks placed on one's balance and stability. The author hypothesized that the anterior

carriage load would affect the participants' overall stability status, whether they were male or female.

METHODS

Participants:

Twenty healthy participants (10 males, 10 females) were recruited from a convenience sample of college students for this study. The demographic data of the males was: age (22 ± 3) weight (168.5 ± 11.9 lbs) (73.7 ± 5.4 Kg) and body height (176.5 ± 4.2 cm). The females were aged (21 ± 3 years), weighted (146 ± 18.5 lbs) (66.7 ± 8.4 Kg), and had the body height (169.5 ± 4.2 cm). All participants had to answer a Health Screening Questionnaire, including their activity levels, to indicate their eligibility for participating. The participant inclusion criteria for participating in this study were: (a) age between 19 and 28 years old, (b) no pain, injury, or surgery within the last six months, and (c) they felt that they could safely complete the assessments.

Testing Protocol and Equipment:

In this study, three anterior loads were chosen which best represent the common anterior loads such as obesity, pregnancy, and carrying equipment as marching bands. The anterior loads of this study were 10lbs, 20lbs, and 30lbs. To assess balance and stability under the three anterior load tasks of this study, commercially available balance equipment was used (Biodex Medical Systems, Shirley, NY, USA). The Biodex is built as a movable balance platform that provides up to 20° of surface tilt in a 360° range of motion. The platform interfaced with a computer software (Biodex, Version 3.1, Biodex Medical Systems) which translates the balance and stability tasks to objective assessment test scores. The protocol of the Biodex balance and stability assessment involves standing on the platform and leaning the torso (upper body) and hips to follow a virtual dot to line up with targets on the Biodex screen in front of the participants. The virtual dots are arranged in a circle form, in eight directions for every 45 degrees. Testing trials were conducted on a stable platform mode of the Biodex. The participants were asked to complete three practice trials prior to the recorded testing trials. Each practice trial lasted approximately 50-160 seconds, depending on their balance and postural stability. Participants were asked to stand upright and position their feet in the way they reported as stable and comfortable, over the centre of the platform. The coordinates were recorded to maintain foot placement for subsequent trials. At the initial visit, all participants had a brief explanation of

the purpose and procedures of the study. Also, confidentiality and anonymity of the subjects were explained and insured. Participants were then asked to sign an informed consent form that also included the participants' demographic data: age, sex. This study has fulfilled the ethical and safety standards and accomplished the Yarmouk University code of ethics that have been developed, and followed the ethical principles of the Helsinki Declaration of Human Rights. Biodex manufacturer settings of the test were used in each task of the three anterior loads; three trials were recorded for each task, and the average of the three trials was used for analysis. The Biodex balance and stability assessment provides scores for all eight directions as well as an overall score. The more the participant deviates from a straight line to the target, the lower their score. Higher scores indicated better performance and greater control of balance and postural stability. Participants were asked to hold the assigned medicine ball with their hands at the chest level as close as possible to the front of their body and

adopt their desired strategy for hitting the virtual dots on the screen. The waist-level was chosen based on previous research which showed that load placed at the waist level or lower did not affect postural sway (Zultowski and Aruin., 2008; Rugelj and Sevs'ek., 2011). If the participants were unable to complete the task without losing balance or the medicine ball and stepping out of the platform, the trial was marked as unsuccessful, and the trial had to be redone. No more than three trials were allowed for each participant, in each task, in order to eliminate the learning effect and with approximately 2 minutes rest between them.

Statistical Analysis:

A 3×2 ANOVA was conducted to evaluate the effect of the three anterior loads (10lbs, 20lbs, and 30lbs) and gender (male, female) on the LOS test scores. Whenever statically significant results were indicated, follow-up tests were performed to indicate the exact differences. All statistical analyses were performed using SPSS software (version 20.0; SPSS Inc., Chicago, IL, USA), with an alpha level set at $p \leq 0.05$.

Table 1: Means and standard deviation of the LOS scores

		Mean	Standard Deviation
Males	30 lbs	80.5	3.27
	20 lbs	85.1	3.78
	10 lbs	92.8	1.9
Females	30lbs	57.8	6.35
	20lbs	75.5	6.63
	10 lbs	85.1	5.17

The results of the ANOVA indicated a significant main effect for the gender, $F(1.54)=114.286$, $p<.001$, $\eta^2=.68$, a significant main effect for the anterior weight, $F(2.54)=84.45$, $p<.001$, $\eta^2=.758$, and there was a significant interaction between the gender and anterior weight, $F(2.54)=14.294$, $p<.001$, $\eta^2=.346$. Because the interaction between the anterior weight and gender was significant, the researcher chose to ignore the anterior weight main effect and, instead, examined the anterior weight simple main effect, that is, the differences among anterior weight for men and women separately. To control the Type 1 error across the two simple main effects, the researcher set alpha for each at .025. There were significant differences between anterior weight for males, $F(2.54)=16.55$, $p<.001$, $\eta^2=.380$, and there were significant differences between anterior weight for females,

$F(2.54)=82.2$, $p<.001$, $\eta^2=.753$.

A follow-up test was conducted to evaluate the three pairwise differences among the means for women, with the alpha set at .008 (.025/3=.008) to control the type 1 error over the three pairwise comparisons. The third anterior weight (10lbs and 30lbs) produced significantly higher test scores on the balance stability test, and the second-highest statistically significant scores were found between the anterior weights (20lbs and 30 lbs). One final analysis was conducted to address the hypothesis that males would score higher in the heaviest anterior weights than females, and females would score higher than males in the anterior lighter weights. The differences in the means between anterior 10 lbs weight and anterior 30 lbs weight for males and the differences in the means between anterior 10 lbs weight and anterior 30 lbs weight for females was statistically significant, $F(1.54)=24.12$, $p<.001$.

RESULTS

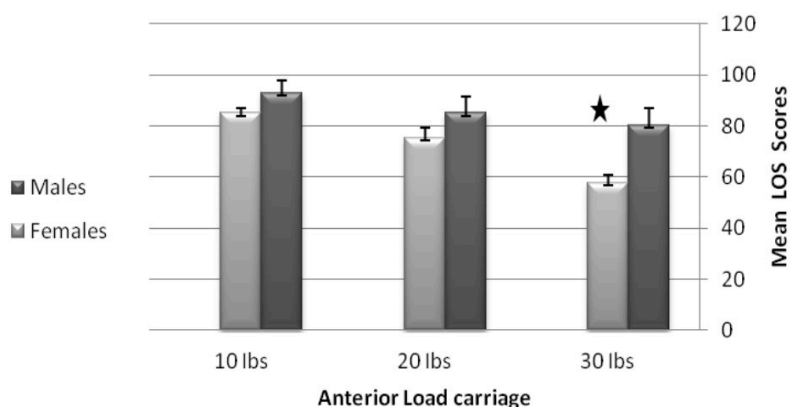
This study aimed to assess the effect of temporary anterior load carriage on the individuals' overall balance and stability test as defined by the BioDex limit of stability test. Load carriage addresses many ramifications on maintaining posture, such as a decrease in dynamic and static balance and stability (dislocation the body's COP to the edge of BOS), and an increase in muscular demands, the risk of falling, and injuries. The results of this study were consistent with previous research studies addressing the effect of anterior load carriage on the individuals' balance and stability status (Castello, Matrangola and Madigan, 2012; Qu and Nussbaum, 2009; Azzeh, Kensara, Helal, and El-Kafy, 2017; Ibrahim et al., 2018). This study has indicated that the higher the load is, the lower the overall stability status is, especially in female participants. Although the carriage loads of this study were not very heavy, the researcher tried to simulate the weights that are usually carried during daily life, including pregnancy. Pregnancy research has shown that the anterior shift of the centre of gravity and the additional body mass contributes to several kinematic and kinetic adjustments during locomotion. Also, it was demonstrated by Foti and colleagues' research study that there was an increase in anterior pelvic tilt along with a decrease in hip extension and single support time during the gait of pregnant women (Foti, Davids, and Bagley, 2000). The biomechanical adjustments that have been addressed by (Foti et al., 2000) study require an increase in muscular demands and strength, which could explain the results of the current research. In contrast, the male participants showed less deviation in the overall test scores when they carried the heaviest anterior load compared with a lighter load than female participants. Load carriage has also been found to spastically increase muscular stiffness in the trunk area, as a result of instability and altered joints range of motion in order to maintain balance and avoid a fall (Birrell and Haslam, 2009; Caron, Wagenaar, Lewis,

Saltzman and Holt., 2013; Wang, Jiang, Liu and Jiao., 2016). During anterior load carriage, the ability to maintain the stability of the trunk can be affected by additional extension, flexion, lateral, and rotational moments that act in shifting the individual's centre of gravity away from the unloaded side. This results in increased demands placed on the musculature and can lead to pain, fatigue, and risks of falling and injury. In the current study, significant differences were found in balance and stability test scores as defined by the BioDex system, whereas female participants showed lower overall test scores in all three load carriage tasks, which could indicate that they had lower muscle strength to withstand the loads (see graph (1)). Similar results have been indicated in a study conducted by Ling and colleagues (2004) where they aimed to evaluate the impact of Modular Lightweight Load-Carrying Equipment (MOLLE) on females' gait on level surfaces by using five load levels (no-load, 20, 30, 40, and 50 pounds). The participants of this study were seven healthy and physical active females. Their results indicated that, with increased loads, women had an increased full limbs support periods, decreased single limb support periods, increased trunk forward flexion and excursion, decreased angle of knee excursion, decreased medial-lateral deviation of the centre of gravity, and increased vertical deviation of the centre of gravity. Hip abductor strength was indicated to be a strong predictor of the centre of vertical gravity excursion (Ling, Houston, Tsai, Chui, and Kirk, 2004). The limitation of this study can be basically addressed in the small number of participants and that only the overall balance and stability test scores were considered as other test directions, and parameters could be measured as anterior/posterior and medial-lateral. Future studies could focus on several areas, primarily determining whether the biomechanical and muscular demands of an altered anterior load shape is more suitable for balance and stability maintenance.

Graph 1: LOS score means and standard deviations of the three anterior load carriages

*Female (N = 10), males (N = 10). M ± SD stands for means and standard deviation.

Denotes significant differences between the means of the indicated means for each direction ($p \leq 0.001$ level).



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PREPOZNAVANJE NAJZNAČAJNIJAH KOMPONENTI WELLNESSA KAO SOPSTVENIH AKTIVNOSTI U TURISTIČKOJ PONUDI

Ova studija je imala za cilj ispitati efekat provođenja privremenog prednjeg opterećenja na sveukupno stanje ravnoteže i stabilnosti. Metode: U studiji je učestvovalo dvadeset dobrovoljaca, studenata (deset muškaraca i deset žena). Stanje ravnoteže i stabilnosti učesnika je utvrđeno koristeći test granice stabilnosti (LOS) kompanije Biodex Medical Systems. Odabrana su tri prednja opterećenja sa korištenjem medicinskih lopti (10lbs, 20lbs i 30lbs), a koja približno oponašaju svakodnevne aktivnosti. Analiza varijanse između grupa - 2x3 ANOVA je korištena za procjenu efekta tri prednja opterećenja i razlike između spolova (muški, ženski) kada su u pitanju rezultati testa granice stabilnosti (LOS). Rezultati: statistička analiza provedena u ovoj studiji je ukazala na značajnu razliku između rezultata testa granice stabilnosti (LOS) muškaraca i žena ($p < .001$, $\beta^2 = .68$). Nadalje, uočen je značajan glavni efekat uslova opterećenja ($p < .001$, $\beta^2 = .758$). Rezultati ove studije ukazuju da, bez obzira na spol, privremeno opterećenje utiče na stanje ravnoteže i stabilnosti, što može povećati rizik od pada i povreda. Također, ona naglašava važnost korištenja alternativnih strategija za kretanje kako bi se održala ravnoteža tokom vanjskih opterećenja.

Ključne riječi: ravnoteža i stabilnost, prednja opterećenja, indeks granice stabilnosti, Biodex Systems

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THE EFFECT OF SACROILIAC JOINT MANIPULATIONS ON THE FUNCTIONAL LEVEL AND PERFORMANCE OF HEALTHY ATHLETES

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ABSTRACT

Background: This study was designed to investigate the effect of chiropractic high-velocity low-amplitude (HVLA) sacroiliac joint manipulations on the functional level and performance of healthy athletes from various sports.

Methods: Functional Movement Screening (FMS) was applied to the athletes in the pre- and post- sacroiliac joint manipulations, and their vertical jump heights were measured through the squat jump test by means of the Optojump system. A total of 40 patients were included in the study, and these individuals were divided into two groups, each having 20 people. A one-time only chiropractic HVLA sacroiliac manipulation was administered to the experimental group, while the control group received a one-time only sham manipulation.

Results: When the groups were evaluated in terms of their total FMS score, no significant difference was observed in the pre- and post-treatment. However, an intra-group comparison showed a statistically significant post-treatment increase in the experimental group ($p=0.001$) and the control group ($p=0.046$).

Conclusions: A significant difference was observed between the groups in terms of squat jump average scores recorded by the Optojump system ($p=0.014$).

Keywords: chiropractic HVLA, FMS, sacroiliac joint manipulation

INTRODUCTION

The sacroiliac joint is the joint between the sacrum and ilium and, since it transfers body weight to the pelvis and lower extremities, it is the key joint in the body. Because it carries a large amount of weight, it is supported by strong ligaments and muscles (1). It makes sliding movements conformable to the flexion and extension of the torso (2). The sacroiliac joint has been shown to play a vital role in the biomechanical and functional movements of athletes (3). Since sacroiliac joint dysfunctions affect lower extremity

kinematics, they also affect the functional capacity and performance of athletes. Reduced mobility in spinal segments causes biomechanical changes to the detriment of the kinematic chain (4). Sacroiliac joint dysfunction is considered to be the primary reason for chronic mechanical lower back pain (5). 13%-25% of injury and pain complaints of athletes result from the sacroiliac joint and lumbar pain for which the sacroiliac joint is responsible. In sacroiliac joint injuries, pain is accompanied by reduced sacroiliac joint mobility and mobility dysfunction (3). Furthermore, Baruah et al.

(2013) found that sacroiliac joint dysfunction has a negative effect on balance and postural stability among athletes (6). The literature reveals that spinal chiropractic manipulations are commonly used to treat sacroiliac joint dysfunction.

It is proven that chiropractic manipulations increase the stimulability of alpha motor neurons in the peripheral nervous system innervating the relevant muscles for 20-60 seconds (8), increase the activity of corticospinal pathways, cerebellum, and sensorimotor areas in the cortex (9), and change motor activity of the sacroiliac joint and the muscles surrounding the joint locally and remotely (5). Furthermore, it is shown that spinal chiropractic manipulations increase the range of motion in the sacroiliac and lumbar region (4), increase the activity of all muscles affecting the vertebra and pelvis such as multifidus, quadratus lumborum, gluteal area muscles, and erector spinae (10), increase the postural stability mechanism in the long-term and positively affect the pain relaxation process (11).

In addition, spinal chiropractic manipulation studies were also performed on athletes with sacroiliac joint dysfunction. Athletes from various sports participated in these studies, which demonstrated that chiropractic manipulation increases the kicking speed performance in soccer players (4), the jump height and running velocity for athletes (7), hip extension range of motion and running velocity for

young female athletes (12), and chiropractic manipulative therapy applied to cervical spine increases the grip strength for elite judo athletes (13). In a systematic review of the literature, Miners et al. (14) found that the number of studies showing the effect of chiropractic manipulation on the functional capacity of athletes is insufficient. At the same time, there is scarcely any study showing that sacroiliac joint chiropractic manipulation is applied to healthy athletes. Therefore, we planned our study on the basis of the hypothesis that chiropractic manipulations applied on the sacroiliac joint will increase the functional capacity and performance of athletes from various sport disciplines. In line with this, Miners et al. elaborate on the anatomy of the sacroiliac joint, its biomechanical and kinematic properties and pathologies that affect this joint, as well as the diagnosis and treatment of these pathologies. A sample group of 40 individuals was divided into two equal sub-groups in the methodology chapter and the hypothesis was tested by means of assessment of both groups accompanied by applications. In the findings chapter of the study, statistical results are put forward and the discussion focuses on a comparison of the findings with other studies regarding this area in the literature. Finally, the conclusion provides general implications deduced in the study. The Ethics Committee approval was obtained prior to the study, and the informed consent and approval of the athletes in the sample group was obtained for assessment and treatments along with the demographic information form which are provided in the annex of this study.

METHODOLOGY

This study was conducted at the Sportomed Physical Therapy and Rehabilitation Centre with the purpose of researching the effect of sacroiliac manipulation on the functional level and performance of athletes. After obtaining the Ethics Committee approval number 22481095-020-334 from Bahçeşehir University, the study was completed between February and April 2018. The sample group consisted of healthy individuals with mechanical problems determined via sacroiliac tests. 44 patients between the ages of 18 and 35 were initially evaluated and 4 of them were excluded from the study due to their failure to match the studying criteria. Written informed consent was obtained from those who agreed to participate in the study. Disc pathologies, cardiac and neurologic problems, history of surgery, nerve root disorders were excluded. In this prospectively planned study, the number of samples was determined as 37 volunteers when the sample size is calculated on the basis of 0.8 power rating in the power analysis made through the Raosoft Software. Assuming that there would be participants leaving the study, 10% more patients were accepted than the required sample size, and the final sample size was determined as 44 people. After the exclusion of 4 individuals, the study was carried out with 40 people. They were divided into two equal groups according to the date of their application to the clinic. First, the demographic characteristics and limb length inequality of both groups were evaluated and Modified Schober, Yeoman's, and Gillet tests were applied to assess sacroiliac joint mobility. The Functional Movement Screen (FMS) was applied to assess the functional level of the patients, and the 'squat jump' test was applied in accordance with Optojump to measure their performance. After the evaluation, a 15-minute rest break was given, followed by an HVLA or sham manipulation application. After the application, another 15-minute rest break was given, and their functional level and performance were re-evaluated.

Chiropractic HVLA manipulation

Many manipulation techniques have been defined for the sacroiliac joint. The literature review shows that a side posture (side-lying position) chiropractic HVLA technique gives the best results. In the side posture technique (the lower leg is freely extended, while the upper leg is attached to the lower leg in knee and hip flexion), hypothenar part of the hand is used to push from the short leg over the PSIS (Posterior superior iliac spine) towards the anterior in order to turn the ilium towards the anterior (Figure 1).

STATISTICAL ANALYSIS

To summarize the data obtained from the study, descriptive statistics were given as mean $\pm$ standard deviation and median (interquartile range) for continuous variables. Numeric variables were checked using the Kolmogorov-Smirnov normality test.

In addition, the Mann Whitney U test was used in comparing the two independent groups. For intra-group comparisons, the Wilcoxon test was applied to compare the two dependent measurements. The McNemar-Bowker Test was used for the dependent categorical variable comparisons. Statistical analyses were conducted by the JASP Team (2018). JASP (Version 0.8.6) [Computer software] was used and the significance level was accepted as 0.05 (p-value).

Table 1: Comparison of Demographic Characteristics

Group			
	Manipulation	Sham	P
Dominant Side			
Right	18(90)	17(85)	² 0.999
Left	2(10)	3(15)	
Manipulated Side			
Right	6(30)	9(45)	¹ 0.327
Left	14(70)	11(55)	
Age			
Aged between 18 and 24	17(85)	16(80)	² 0.999
Aged between 25 and 30	2(10)	2(10)	
Aged between 31 and 35	1(5)	2(10)	
Sex			
Male	20(100)	20(100)	-
Female	0(0)	0(0)	
Marital Status			
Single	20(100)	18(90)	² 0.487
Married	0(0)	2(10)	
Body Mass Index	21.25±2.11	21.88±2.00	0.335*
Branch of Sports			
Basketball	15(75)	16(80)	² 0.487
Volleyball	0(0)	1(5)	
Football	4(20)	1(5)	
Other	1(5)	2(10)	
Year of Sports Training	12.55±2.01	12.45±1.57	0.425**
Smoking			
No	20(100)	20(100)	-
Yes	0(0)	0(0)	
Alcohol Consumption			
No	20(100)	20(100)	-
Yes	0(0)	0(0)	

* Independent Samples T-Test

** Mann-Whitney U

1 Pearson Chi-Square

2 Fisher's Exact Test Among the manipulation group patients in the study, 15 were basketball players, 4 were footballers, and 1 was from another branch of sports, while the sham group included 16 basketball players, 1 volleyball player, 1 soccer player, and 2 athletes from other sports. Accordingly, no statistically significant difference was found between the groups in terms of the sport that the patients played ($p=0.487$).

Table 2: Intra- and inter-group comparison of the final deep squat scores

	Group				Test Statistics	p
	Manipulation		Sham			
Deep Squat Final Score						
Pre-treatment	2.25±0.44	2(2-2.5)	2.35±0.49	2(2-3)	-0.681	0.496
Post-treatment	2.45±0.51	2(2-3)	2.35±0.49	2(2-3)	-0.637	*0.524
Z	-2.000		0.000			
p**	0.046**		0.999**			

* Mann-Whitney U Test

** Wilcoxon test

Table 2 shows the deep squat final scores of the patients participating in the study. No significant statistical difference was observed between the groups in the pre-treatment ($p=0.496$) and post-treatment ($p=0.524$) deep squat final scores. In intra-group comparisons, there was a statistically significant difference ($p=0.046$) between the pre-treatment and post-treatment in the manipulation group, while the sham group did not show any statistically significant difference between the pre-treatment and post-treatment ($p=0.999$). The post-treatment deep squat final score was higher in the manipulation group.

Table 3: Intra- and inter-group comparison of the final inline lunge scores

	Group				Test Statistics	p
	Manipulation		Sham			
Final Inline Lunge Scores						
Pre-treatment	2.3±0.57	2(2-3)	2.3±0.57	2(2-3)	0.000	*0.999
Post-treatment	2.55±0.51	3(2-3)	2.35±0.49	2(2-3)	-1.255	*0.209
Z	-2.236		-1.000			
p**	0.025**		0.317**			

* Mann-Whitney U Test

** Wilcoxon test

Table 3 shows the inline lunge final scores of the patients. Accordingly, no statistically significant difference was observed between the groups in the pre-treatment ($p=0.999$) and post-treatment ($p=0.209$) inline lunge final scores. In intra-group comparisons, there was a statistically significant difference ($p=0.025$) between the pre-treatment and post-treatment in the manipulation group, while the sham group did not show any statistically significant difference between the pre-treatment and post-treatment ($p=0.317$). The post-treatment deep squat final score was higher in the manipulation group.

Table 4: Intra- and inter-group comparison of the hurdle step final raw score

	Group				Test Statistics	p
	Manipulation		Sham			
Hurdle Step Final Raw Score						
Pre-treatment	2.05±0.39	2(2-2)	2±0	2(2-2)	-0.592	*0.554
Post-treatment	2.2±0.41	2(2-2)	2±0	2(2-2)	-2.082	*0.037
Z	-1.732		0.000			
p**	0.083**		0.999**			

* Mann-Whitney U Test

** Wilcoxon test

Table 4 shows the hurdle step final raw scores of the patients evaluated in the study. It was observed that there was no statistically significant difference between the groups in terms of the pre-treatment ($p=0.554$), while a statistically significant difference was observed in the post-treatment ($p=0.037$) hurdle step final raw score. According to this difference, the post-treatment manipulation hurdle step final raw score was higher. As per intra-group comparisons, on the other hand, no statistically significant difference was observed in the manipulation group between the pre-treatment and post-treatment ($p=0.083$). Furthermore, it was observed that there was no statistically significant difference between the pre-treatment and post-treatment in the sham group ($p=0.999$).

Table 5: Intra- and inter-group comparison of the active straight leg raise final raw score

	Group				Test Statistics	p
	Manipulation		Sham			
Active Straight Leg Raise Final Raw Score						
Pre-treatment	2.2±0.52	2(2-2.5)	2.15±0.37	2(2-2)	-0.429	*0.668
Post-treatment	2.5±0.51	2.5(2-3)	2.15±0.37	2(2-2)	-2.333	*0.020
Z	-2.449		0.000			
p**	0.014**		0.999**			

* Mann-Whitney U Test

** Wilcoxon test

Table 5 shows the active straight leg raise final raw scores of the patients. There was no statistically significant difference between the groups in the pre-treatment ($p=0.668$), while there was a statistically significant difference in the post-treatment ($p=0.020$). According to this difference, the post-treatment manipulation active straight leg raise final raw score was higher. With regard to intra-group scores, while a statistically significant difference was observed in the manipulation group between the pre-treatment and post-treatment ($p=0.014$), there was no statistically significant difference between the pre-treatment and post-treatment in the sham group ($p=0.999$). The post-treatment active straight leg raise final score was higher in the manipulation group.

Table 6: Intra- and inter-group comparison of the trunk stability push-up final score

	Group				Test Statistics	p
	Manipulation		Sham			
Trunk Stability Push-Up Final Score						
Pre-treatment	2.2±0.41	2(2-2)	2±0	2(2-2)	-2.082	*0.037
Post-treatment	2.2±0.41	2(2-2)	2±0	2(2-2)	-2.082	*0.037
Z	0.000		0.000			
p**	0.999**		0.999**			

* Mann-Whitney U Test

** Wilcoxon test

Table 6 shows the trunk stability push-up final scores of the patients evaluated in the study. A statistically significant difference was detected between the groups in the pre-treatment ($p=0.037$) and post-treatment ($p=0.037$). Accordingly, the pre-treatment and post-treatment manipulation trunk stability push-up final score was observed to be higher. Intra-group comparisons demonstrated that there was no statistically significant difference in the manipulation group between the pre-treatment and post-treatment ($p=0.999$). Similarly, no statistically significant difference was observed in the sham group between the pre-treatment and post-treatment ($p=0.999$).

Table 7: Intra- and inter-group comparison of the rotary stability final raw score

	Group				Test Statistics	p
	Manipulation		Sham			
Rotary Stability Final Raw Score						
Pre-treatment	2.2±0.52	2(2-2.5)	2.2±0.41	2(2-2)	-0.072	*0.943
Post-treatment	2.35±0.49	2(2-3)	2.2±0.41	2(2-2)	-1.049	*0.294
Z	-1.732		0.000			
p**	0.083**		0.999**			

* Mann-Whitney U Test

** Wilcoxon test

Table 7 shows the rotary stability final raw scores of the patients. No statistically significant difference was observed between the groups in the pre-treatment ($p=0.943$) and post-treatment ($p=0.294$). In intra-group comparisons, there was no statistically significant difference in the manipulation group between the pre-treatment and post-treatment ($p=0.083$). Similarly, no statistically significant difference was observed in the sham group between the pre-treatment and post-treatment ($p=0.999$).

Table 8: Intra- and inter-group comparison of the FMS total score

	Group				Test Statistics	p
	Manipulation		Sham			
FMS Total Score						
Pre-treatment	15.8±1.82	16(14.5-17)	15.85±1.09	16(15-16)	-0.014	*0.989
Post-treatment	17±1.84	17(15-18)	16.05±1.19	16(15-16)	-1.748	*0.080
Z	-3.630		-2.000			
p**	0.001**		0.046**			

* Mann-Whitney U Test

** Wilcoxon test

Table 8 shows the FMS total scores of the patients. No statistically significant difference was observed between the groups in the pre-treatment (p=0.989) and post-treatment (p=0.080). In intra-group comparisons, statistically significant differences were observed between the pre-treatment and post-treatment in the manipulation (p=0.001) and sham (p=0.046) groups. Accordingly, the post-treatment FMS total score was higher in the manipulation and sham groups.

Table 9: Intra- and inter-group comparison of the squat jump average score

	Group				Test Statistics	p
	Manipulation		Sham			
Squat Jump Average Score						
Pre-treatment	33.58±10.21	32(26-37.5)	28.47±6.33	29.5(22.2-33.5)	-1.626	*0.104
Post-treatment	35.4±10.59	35(31-36)	28.67±6	27.5(24-33)	-2.451	*0.014
Z	-2.067		-0.546			
p**	0.039**		0.585**			

* Mann-Whitney U Test

** Wilcoxon test

Table 9 shows the squat jump average scores of the patients participating in the study. There was no statistically significant difference between the groups in the pre-treatment (p=0.104), while there was a statistically significant difference observed in the post-treatment (p=0.014). According to this difference, a statistically significant difference was observed in the manipulation group between the pre-treatment and post-treatment (p=0.039) in intra-group comparisons, while there was no statistically significant difference between the pre-treatment and post-treatment for the sham group (p=0.585). The post-treatment squat jump average score was higher in the manipulation group.

Table 10: Intra- and inter-group comparison of leg size

		Group		
		Manipulation	Sham	p
Leg Size				
Pre-treatment	Sağkisa	6(30)	5(25)	0.723*
	Sol kısa	14(70)	15(75)	
Post-treatment	Sağkisa	0(0)	5(25)	<0.001**
	Sol kısa	0(0)	15(75)	
	Eşit	20(100)	0(0)	
***p		-	-	

* Pearson Chi-Square

** Fisher's Exact Test

*** McNemar-Bowker Test

Table 10 shows the leg size of the patients in the study. While there was no statistically significant difference between the groups in the pre-treatment ($p=0.723$), a statistically significant difference was observed in the post-treatment ($p<0.001$). According to this difference, the right short and left short rates were higher in the sham group than in the manipulation group. Similarly, the leg size equal rate in the post-treatment manipulation group was higher than the sham group. In the intra-group comparisons, on the other hand, statistical calculation was not possible in the manipulation and sham groups since the number of observations for the pre-treatment and post-treatment was limited.

DISCUSSION

The sacroiliac joint is the main joint connecting the trunk, upper and lower extremities and forming the pelvis. Since it is the key joint in the body, its dysfunction leads to pain and other dysfunctions. Those most affected by sacroiliac joint dysfunction are athletes. Indeed, sacroiliac joint dysfunction affects the performance of athletes since it disturbs the function of both the lower extremity and the spine. In a study conducted by Deutschmann et al., the effect of spinal manipulation on kicking speed performance in asymptomatic soccer players was measured (4). The authors formed a 40-person sample group aged between 18 and 35. While soccer players who had sacroiliac joint dysfunction but were asymptomatic and able to hit the ball were included in the study, others who contraindicated spinal manipulation were excluded from the study. Before the assessment, each patient was given standard warm-up exercises. It was proven that kicking speed performance increased in the manipulation group compared to the sham manipulation group. Similarly, this study was conducted with a sample group of 40 people aged between 18 and 35. While healthy athletes aged between 16 and 40, who are capable of competing and have not received chiropractic treatment in the last 3 months, were included in the study, those diagnosed

with disc pathology, nerve compression, cardiac or neurological disorders were excluded from the study. We gave the athletes warm-up exercises before the assessment tests. Similar to the above study, the present study also finds that the HVLA manipulation group had a positive impact on performance and functional capacity compared with the sham group. Kim et al. applied the Modified Schober test to assess the mobility of the lumbar region. As this test is among the most common tests used in assessing the lumbar region mobility (15), it was also used in the present study to assess lumbar region mobility. Stump et al. evaluated the role and effect of chiropractic manipulations in sports (16). They formed the sample group by selecting 36 people from the male national football team. The footballers in this sample group had at least 17 years of sports experience. Among the 40 people composing the sample group of the present study, 31 are basketball players, 5 are footballers, 1 is a volleyball player, and 3 come from other branches of sports. These athletes also have, on average, 17 years of experience in sports. The systematic review conducted by Miners et al. investigated whether chiropractic

manipulation has an effect on the performance of athletes (14). They found no evidence to support the claim that it does. However, our study proves that the FMS total score showed a statistically significant increase in the HVLA manipulation group of athletes from various branches in the comparison of the pre-treatment and post-treatment values. Farazdaghi et al. investigated the effect of sacroiliac joint manipulation on postural stability (5). Their sample group consisted of 32 athletes. They used the Yeoman's Test, Gaenslen's Test, Faber Test, Compression Test, and Hip Thrust Test in their assessments. Since we designed our study with a 40-person sample group, our number of participants is higher than theirs. Shrier et al. examined the effect of manipulations on jump height and running velocity (7). Following a 15-minute warm-up period, the jump height and running velocity of the patients was evaluated. After this evaluation, the HVLA manipulation was applied. The patients rested for an hour after the manipulation and then another 15-minute warm-up exercise was completed. After the warm-up period, the patients were re-evaluated. They used the vertical jump test to assess the jump height of the patients and they measured the test results via the Vertec Jump System. They concluded that the HVLA manipulation had no significant effect on jump height and running velocity. We designed the present study with 15-minute rests between the first evaluation – manipulation and the final evaluation. We also used the squat jump test in our study and the Optojump system for the evaluation of the test, as the literature confirms that the Optojump is superior to the Vertec Jump System (17). Furthermore, a significant increase in squat jump movement was observed in the HVLA manipulation group compared to the sham manipulation group in our study. Sandell et al. investigated the effect of chiropractic application on the hip extension range of motion and running velocity of young female athletes (12). They formed a sample group of 17 female athletes aged between 17 and 20 years. They divided this group randomly into two, one treatment and one control group, with 8 and 9 people, respectively. First, the participants in both groups had a warm-up run between 30 and 45 minutes. Later, they measured the running velocity in the 30 meter sprint and the hip extension range. They applied the HVLA manipulation on the sacroiliac joint in the treatment group. After this stage, they re-evaluated both groups. They found that the hip extension capacity of the athletes in the treatment group showed an increase compared to the control group. In the present study, in contrast to Sandell et al., all of the participants were male, and it was found that there was a significant difference between the groups after the treatment in the active straight leg raise test where hip flexion was assessed.

Botelho et al. investigated the effect of chiropractic manipulative therapy applied on the cervical spine as it affects grip strength (13). The sample group of 18 people was divided into two: the cervical manipulation group and sham manipulation group. A chiropractor with at least 3 years of clinical experience performed the manipulation in both groups. The researchers claimed that cervical chiropractic manipulation significantly increased the grip strength in elite judo athletes. Based on this research, we also divided our sample group into two: the sacroiliac manipulation group and the sham manipulation group. In our study as well, manipulation was applied to both groups by a chiropractor with 3 years of clinical experience. We also found that functional capacity and performance increased in the manipulation group. Finally, Soleimanifar et al. showed in their study that the Gillet Test has 93% specificity in the assessment of sacroiliac joint mobility (18). We used the Gillet Test in our study to assess sacroiliac joint mobility.

CONCLUSION

40 healthy athletes participating in the study were divided into two groups: the chiropractic HVLA manipulation (experimental group) and the sham manipulation (control group). The effect of sacroiliac joint manipulations on functional level and performance was evaluated. The following results were obtained: demographic characteristics of the athletes such as age, body mass index, years of experience in sports and dominant side, their branch of sports and smoking-alcohol consumption were similar before the treatment. In the intra- and inter-group comparisons, there was no statistically significant difference between the pre-treatment and post-treatment in the Modified Schober, Gillet and Yeoman's tests. With regard to FMS, while a statistically significant difference was found between the pre-treatment and post-treatment in Deep Squat, Inline Lunge and Active Straight-Leg Raise tests in intra-group comparisons of the manipulation group, there was no significant difference in the sham manipulation group. Post-treatment comparison between HVLA and sham manipulation groups showed statistically significant difference in the Hurdle Step, Active Straight-Leg Raise, and Trunk Stability Push-Up tests of FMS. In the Shoulder Mobility and Rotary Stability tests among the FMS tests, no statistically significant difference was found between the pre-treatment and post-treatment comparisons of the HVLA and sham manipulation groups. We believe that this is due to the fact that these tests are evaluating the upper extremity. A comparison of the HVLA and sham manipulation groups in terms of the pre-treatment and post-treatment FMS total score revealed a statistically significant increase in the HVLA manipulation group. In the Squat Jump test examined through the Optojump system for performance evaluation of the groups, there was no significant difference between the groups. On the other hand, post-

treatment comparisons showed a significant increase in the HVLA manipulation group. In addition, the HVLA manipulation group showed a significant post-treatment increase in the intra-group pre- and post-treatment comparison. There was no statistically significant difference between the athletes participating in the study in terms of leg size inequality. However, leg size inequality was found to be significantly higher in the sham manipulation group than in the HVLA manipulation group. In conclusion, it is presented in this study that the chiropractic HVLA manipulation technique, which is used as a treatment modality in sacroiliac joint pathologies, can be applied to healthy athletes wishing to increase

their functional level and performance. It should be noted that the present study has two limitations. First, we conducted our study with athletes from various branches of sports with mixed experimental and control groups. Yet, we managed to determine a sufficient number of samples and grouped these individuals according to their branches to compare and determine the branch of sports with the highest increase in the functional level and performance after HVLA manipulation. The other limitation was that the manipulations could have been applied not only on the sacroiliac joint, but also the lumbosacral joint which works in coordination with it.

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EFEKAT MANIPULACIJE ZGLOBA IZMEĐU KRIŽNE I BOČNE KOSTI NA FUNKCIONALNI NIVO I UČINAK ZDRAVIH SPORTISTA

Osnova: Ova studija je osmišljena da ispita efekat kiropraktičkih brzih i kratkih (engl. High Velocity Low Amplitude - HVLA) manipulacija zgloba između križne i bočne kosti na funkcionalni nivo i učinak zdravih sportista koji se bave različitim sportovima.

Metode: Funkcionalna procjena pokreta (engl. Functional Movement Screening - FMS) je primjenjena na sportiste prije i poslije manipulacija zgloba između križne i bočne kosti, a visine skoka u vis su mjerene putem testa skoka u vis iz čučnja korištenjem Optojump sistema. Ukupno 40 ispitanika je uključeno u studiju, te su ovi pojedinci podijeljeni u dvije grupe koje su imale po 20 učesnika. Jednokratna kiropraktička HVLA manipulacija zgloba između križne i bočne kosti je primjenjena na eksperimentalnu grupu, dok je jednokratna lažna manipulacija primjenjena na kontrolnu grupu.

Rezultati: Kada su grupe vrednovane na osnovu njihovog ukupnog FMS rezultata, nisu uočene značajne razlike prije i poslije tretmana. Međutim, poređenje između grupa je pokazalo statistički značajno povećanje poslije tretmana u eksperimentalnoj ($p=0,001$) i kontrolnoj grupi ($p=0,046$).

Zaključci: Značajna razlika je ustanovljena između grupa kada su u pitanju prosječni rezultati skoka u vis iz čučnja koji su zabilježeni putem Optojump sistema ($p=0,014$).

Ključne riječi: kiropraktička HVLA, FMS, manipulacija zgloba između križne i bočne kosti

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THE EFFECTS OF PRE-EXERCISE MASSAGE ON MUSCLE ACTIVITY DURING SUSTAINED CONTRACTION

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ABSTRACT

Massage is widely used in sports in order to increase performance and decrease fatigue. However, the effect of massage on the changes in electromyographic (EMG) activity has been inconsistent. The purpose of this study is to examine the effect of pre-exercise massage on calf raise muscle activation during sustained contractions of plantar flexion. Ten healthy and volunteer males were investigated on two occasions with an interval of one week, once without (control, CTL) and once with a 10-minute massage of the non-dominant leg. The exhausting contraction involved a two-minute isometric plantar flexion. Power spectra of EMG analysis was done by calculating the mean power frequency (MPF) and average amplitude of surface electromyographic signals (aEMG), which was recorded from the non-dominant lateral and medial gastrocnemius. Alternate muscle activity between two muscles was assessed by a repeated measure ANOVA analysis on the basis of the LG/MG rate of integrated EMG (iEMG). In addition, Pearson correlation coefficients were computed between iEMG values recorded from MG and LG to investigate between-synergist substitution. There were no significant differences in the raw and normalized slope of MPF and aEMG between two conditions during the first, second and third 20s of EMG signal in the medial and lateral gastrocnemius. Furthermore, no significant differences were found in the normalized slope of MPF and aEMG between the two conditions. Therefore, there was no evidence to conclude that massage influenced the localized muscle fatigue, which is associated with myoelectric changes.

Keywords: pre-exercise massage, electromyographic activity, sustained contraction, gastrocnemius muscles.

INTRODUCTION

Muscle fatigue can be induced by sustained muscular contractions and it is related to factors like the external signs as the inability to maintain a desired force, tremor, and pain (Tanaka, Leisman, Mori, and Nishijo, 2002). While the decline in force production is evidently harmful in many situations, fatigue has also been shown to impair postural stability, decrease velocity and accuracy of motor responses, alter movement control, and delay reaction time (Slobounov, 2008). Neuromuscular alterations that occur during fatigue might as well increase the risk of injury. It is believed that fatigue reduces the shock absorbing capacity for the muscle and the coordination of the locomotor system, potentially resulting in greater stress on passive structures. Thus, it is important to postpone fatigue during activity. Many athletes and coaches

believed that pre-exercise interventions such as massage improve performance, prevent injuries and postpone fatigue (Ogai, Yamane, Matsumoto, and Kosaka, 2008). Although massage is widely used by athletes, its effectiveness is not reliable. Theoretically, it is claimed that massage can improve performance. For example, by decreasing neuromuscular excitability, muscle spasms (Sullivan, Williams, Seaborne, and Morelli, 1991), and pain (Preyde, 2000), massage may influence the subsequent force-generating capacity. Only a few studies have specifically considered the effects of pre-exercise massage. Hunter et al. used a massage protocol similar to that in our study, and reported a significant reduction in isometric strength after the massage.

Nevertheless, this decline was not associated with any changes in the electromyographic signal (Hunter, Watt, Watt, and Galloway, 2006). Furthermore, there is evidence that massage reduces motor unit activity. However, these studies used the H-reflex before and after the massage. Although this method is a valid measure for motor unit activation, it is different from the electromyography (EMG) during a voluntary contraction (Field, 2016). Goodwin et al. found that a fifteen-minute lower limb massage had no significant effect on sprint performance (Goodwin, Glaister, Howatson, Lockey, and McInnes, 2007).

Harmer studied the effects of the 30-minute full-body Swedish massage pre-exercise in sprinters and showed that the massage had no effects on physiological responses during submaximal treadmill running (Harmer, 1991). In summary, none of these studies reported a decline in motor unit activation to show any alteration in neuromuscular characteristics of the massaged muscle. It should be noted that these studies assessed force generation capacity by measuring maximal voluntary contraction which is affected by personal factors such as motivation.

Thus, more reliable measures are required to assess the possible effects of massage on muscle fatigue (Kankaanpää, Taimela, Airaksinen, and Hanninen, 1999; Rinder and Sutherland, 1995). An analysis of the electromyographic power spectrum can be considered as an index of motor unit recruitment and neuromuscular fatigue of a muscle. When a muscle is fatigued, EMG frequency shifts towards a lower frequency band and EMG amplitude increases following both static and dynamic contractions (De Luca, 1979). It has been reported that the increase of motor unit recruitment, synchronization of motor unit activation, change in conduction velocity and firing rate, and motor unit action potential deformations are the main reasons behind these changes (Basmajian and De Luca, 1985).

Athletes commonly utilize more than 100 different types of massage (Eisenberg et al., 1993). Thus, a lack of details on massage such as massage type, severity, duration of the strokes and full-body or local massage is the major limitation of previous studies. In addition, because of the weak methodology, unstable levels of control, lack of placebo conditions, and number of subjects, the result of these studies is not reliable (Robertson, Watt, and Galloway, 2004). Therefore, the purpose of this study is to examine the effects of pre-exercise massage on the neuromuscular fatigue of the medial and lateral gastrocnemius muscle during weight bearing contraction.

METHODS

Participants

Ten healthy males were recruited as volunteer subjects (body mass 72.1 ± 7.6 kg, height 173.9 ± 4.5 cm, age 20.6 ± 1.8 years, means $\pm$ SD). The subjects were carefully informed about the design of the study with special information on possible discomfort and benefits that might result, and subsequently signed an informed consent form before the study. Throughout the experiment, they were all in a good physical condition and none of them had a history of neuromuscular disorders and surgery in lower limbs, and had no pain and discomfort. All subjects maintained normal daily activities and were asked to avoid strenuous exercises 48 h prior to the testing procedure. Before the first test, limb dominance was determined. We implemented the protocol on the subdominant leg. In a crossover design, the subjects visited a laboratory on two separate occasions one week apart and at the same time of day. All tests and measurements were done in two sessions after the warm-up and after the massage.

Massage protocol

Participants lay prone on the bed. The same qualified massager with five years' experience carried out all massage interventions on the calf muscles with the massage sequence steps:

- Stage 1) four centripetal strokes conducted by very light contact with two hands in different directions to affect superficial vessels and give a sedative effect.
- Stage 2) three effleurage strokes with different pressure to influence the onward flow of superficial and deep vessels. This technique was completely performed by using two hands, with the pressure exerted centripetally and centrifugally.
- Stage 3) two petrissage strokes (picking up, whole hand, two-handed V-shaped, centripetal and centrifugal) in two grades: grade I (sufficient to influence superficial vessels on underlying structures and compress the superficial soft tissue), and grade II (sufficient to compress the deep tissue on underlying structures and affect deeper tissue drainage).
- Stage 4) one wringing (grade I) done centripetally and centrifugally in different directions completely performed by using two hands.
- Stage 5) one grade II muscle rolling done centripetally for lifting muscle tissue and affecting deeper structures. All petrissage was interspersed with effleurage grade II in a centripetal direction. The whole process of massage would take about 7 to 8 minutes (Hunter et al., 2006).

Control Intervention

In this study, a general warm-up protocol was used as a control intervention. At first, the subjects ran five minutes with fifty percent of the HR max. Then, they performed static stretching for five minutes. Finally, the subjects repeated five repetitions of 36 meters sprinting with a one-minute rest between each run (Gelen, 2010).

EMG Measurements

Surface EMG signals of the gastrocnemius were collected using a bipolar differential collection system during the test by using surface bipolar electrodes (ME3000P8; Mega Electronics Ltd, Finland). The skin surface was cleaned with alcohol and rubbed with sand paper.

For fixing skin impedance state, 5 minutes was spent. The room temperature was fixed at 27°C. Surface bipolar electrodes Ag-AgCl, with the 6-mm contact diameter and 2-cm interelectrode space were placed at the gastrocnemius medial and lateral heads ~7 cm below the caput fibulae. Electrode placement was visually verified by inspecting the signal during an isometric contraction. Bony landmarks and careful palpation were used to place electrodes in the same location.

Both skin marking and measurement techniques enhanced the repeatability of electrode placement. In order to avoid the cable movement artefacts and minimize the risk of separating the electrodes from skin, the cable, pre-amplifier and electrodes were fixed on the skin by regular tape and net bandages. In order to cooperate between the test and EMG measurement, we used an alarm of the EMG device. The EMG signals were sampled at 1000 Hz (band-pass filtered between 20 Hz and 500 Hz) and were amplified differentially with an AC amplifier (gain 1000, common mode rejection ratio 130 dB, noise 1 μ V). They were sent to a personal computer via an analogue to a digital (A/D) board with sensitivity of 3 mV and resolution of 2.95 mV (12-bit, 8 channels, Mega Electronic, Finland).

Signal Processing

All signals were visually inspected during the real-time collection of EMG to ensure optimal signal quality. EMG power spectral frequency analysis was performed with the Megawin 2.4 software (Mega Electronic Ltd, Finland) to evaluate the localized muscle fatigue. The median frequency (MF), mean power frequency (MPF) and average amplitude of the EMG signal (aEMG) were derived from raw EMG signals and plotted against time using a Fast Fourier Transformation (FFT) algorithm and a Hamming window function. A spectral estimate was calculated using a 1024-point moving window over the time. The MF, MPF (Δ Hz/s) and aEMG (Δ μ V/s) slope

per unit time over the first, second and third 20s periods of one-minute signal were calculated using the least squares linear regression analysis. The initial MF, MPF (Hz) and aEMG (μ V) were computed as the intercept of slope for the whole contraction time. These slopes represent the rate of change for the EMG frequency (MF and MPF slopes) and average amplitude of the EMG (aEMG slope) over time, which reflect the fatigue rate of the muscles. The normalized slope ($\Delta\%$ /s) was calculated as the (slope/initial frequency) $\times 100$.

Procedures

Since the weight bearing isometric contraction is a normal activity and is suitable to assess fatigue, this static method was applied in this study. For this purpose, the subjects stand upright on the edge of a concrete structure, 20 cm high, and we used an upright standing position (180° of knee angle), since the previous studies confirmed that the role of the gastrocnemius versus soleus muscle is more dominant in the standing position than in the sitting position (90° of knee angle). For maintaining and preventing artefact movements, subjects maintained the arms and fingers fully extended (90° shoulder flexion), kept the two hands parallel in front of their body, and attached to the anchor.

The subjects had no advantage to transfer their weight to anchor in this position. The subjects were instructed to keep balance in this position and keep the weight of the bar equally distributed across both feet. After establishing the correct position, the subjects performed 50 repetitions of plantar flexion in the full range of motion for 1 minute. After the last repetition of calf raise, the subjects sustained weight bearing isometric plantar flexion at the ending range of motion for 60 seconds with the command of the researcher and device alarm. The subjects were given standardized verbal encouragement during the effort.

Statistical Analysis

The data is presented as the mean (SD), which was computed by standard methods. Distributions of the measurements were assessed by a one-sample Kolmogorov – Smirnov test. The changes to each variable during the experimental periods (massage and warm-up) were analysed using a two-way analysis of variance with repeated measurements (2 $\times$ 3, two conditions, three periods) for each 20s of trial. The adjustment to the degrees of freedom of the F-test statistics was the Huynh-Feldt epsilon. Statistical significance was set at the $P < 0.05$ level. These analyses were performed with SPSSwin software (SPSS 16.0, SPSS).

RESULTS

A Kolmogorov – Smirnov test of normality showed that the MF, MPF and aEMG measures were acceptably and normally distributed. The changes in raw aEMG, MPF and MF values obtained from the medial and lateral part of the gastrocnemius after both pre-warm-up and pre-massage conditions are shown in Table 1 and Table 2. In the lateral part of gastrocnemius, there were no significant differences observed in initial MF, MPF and aEMG (Table 1) for three periods of contraction and between the massage and warm-up conditions.

Furthermore, the result of a two-way analysis of variance test (2×3 , intervention $\times$ time) showed no significant interaction in the slopes of MF, MPF and aEMG. No significant two-way interaction was found in normalized slopes of MF, MPF and aEMG ($p > 0.05$). At the medial gastrocnemius, there were no significant differences in initial fatigue indices between the massage and warm-up. Furthermore, no significant differences were found in the slope and normalized slopes of MF, MPF and aEMG in the medial gastrocnemius between the massage and warm-up conditions (Table 2).

Table 1: Summary of Changes in EMG – Measurements in the Lateral Gastrocnemius After Warm-Up and Massage

variable	indices	Intervention	Time			Two-way ANOVA		
			0-20	20-40s	40-60s	F	df	Sig.
MF	Initial value (Hz)	Warm-up	135.3 $\pm$ 44.9	128.1 $\pm$ 45.1	139.1 $\pm$ 51.7	0.560	1.847	0.568
		massage	125.6 $\pm$ 56.2	125.8 $\pm$ 59.5	124.6 $\pm$ 54.8			
	slope (Δ Hz/s)	Warm-up	29.4 $\pm$ 71.2	39.5 $\pm$ 70.5	4.0 $\pm$ 38.8	2.128	2	0.148
		massage	16.3 $\pm$ 102.3	-7.5 $\pm$ 53.3	53.5 $\pm$ 83.5			
	Normalized slope ($\Delta\%$ /s)	Warm-up	34.2 $\pm$ 76.3	34.1 $\pm$ 61.8	8.7 $\pm$ 39.1	2.139	2	0.147
		massage	16.9 $\pm$ 98.9	-4.1 $\pm$ 38.3	62.5 $\pm$ 90.0			
MPF	Initial value (Hz)	Warm-up	43.3 $\pm$ 155.6	41.6 $\pm$ 149.6	46.6 $\pm$ 159.1	0.257	1.491	0.713
		massage	48.2 $\pm$ 146.7	54.2 $\pm$ 146.7	42.5 $\pm$ 154.5			
	slope (Δ Hz/s)	Warm-up	81.4 $\pm$ 25.2	56.7 $\pm$ 14.9	28.8 $\pm$ 3.8	1.221	1.771	0.316
		massage	81.0 $\pm$ -.2	41.1 $\pm$ -0.2	65.8 $\pm$ 38.1			
	Normalized slope ($\Delta\%$ /s)	Warm-up	70.0 $\pm$ 24.0	39.7 $\pm$ 13.3	20.0 $\pm$ 4.5	1.439	1.679	0.265
		massage	61.6 $\pm$ 0.9	27.5 $\pm$ 2.4	62.1 $\pm$ 35.4			
aEMG	Initial value (μ V)	Warm-up	72.5 $\pm$ 53.0	68.5 $\pm$ 55.3	60.5 $\pm$ 51.7	0.373	1.787	0.671
		massage	65.7 $\pm$ 53.2	65.1 $\pm$ 43.1	65.7 $\pm$ 54.7			
	slope ($\Delta\mu$ V/s)	Warm-up	-38.8 $\pm$ 124.8	-2.6 $\pm$ 101.1	-6.8 $\pm$ 65.6	0.088	1.154	0.807
		massage	-59.5 $\pm$ 132.6	-6.0 $\pm$ 99.2	-38 $\pm$ 70.2			
	Normalized slope ($\Delta\%$ /s)	Warm-up	-54.2 $\pm$ 151.3	32.8 $\pm$ 138.1	32.1 $\pm$ 136.7	1.798	1.494	0.205
		massage	3.2 $\pm$ 223.4	19.9 $\pm$ 158.9	-48.2 $\pm$ 130.6			

Abbreviations: MF=Median Frequency, MPF=mean power frequency, aEMG= average amplitude of electromyographic signals

Table 2: Summary of Changes in EMG – Measurements in the Medial Gastrocnemius After Warm-Up and Massage

variable	indices	Intervention	Time			Two-way ANOVA		
			0-20	20-40s	40-60s	F	df	Sig.
MF	Initial value (Hz)	Warm-up	107.3±39.1	123.4±43.7	116.0±40.7	0.361	1.707	0.670
		massage	142.8±55.1	147.1±51.7	142.7±52.7			
	slope (ΔHz/s)	Warm-up	-18.6±95.7	-15.8±63.1	-40.9±91.9	1.067	1.604	0.355
		massage	18.5±76.6	-15.8±42.2	15.4±37.9			
MPF	Normalized slope (Δ%/s)	Warm-up	10.7±83.4	-11.3±39.6	-18.9±56.2	0.828	1.607	0.432
		massage	28.0±62.9	-18.4±35.8	13.6±27.7			
	Initial value (Hz)	Warm-up	130.9±45.8	143.3±40.2	140.3±35.7	0.390	1.578	0.636
		massage	158.9±49.2	160.7±44.1	160.1±47.7			
aEMG	slope (ΔHz/s)	Warm-up	-0.5±91.4	-14.5±51.8	-33.7±79.3	0.950	1.318	0.376
		massage	21.5±78.5	-20.9±43.3	15.7±40.9			
	Normalized slope (Δ%/s)	Warm-up	23.8±83.0	-8.8±27.8	-15.2±38.4	0.536	1.216	0.514
		massage	27.2±67.6	-19.1±36.9	11.4±27.4			
	Initial value (μV)	Warm-up	75.2±82.6	84.5±68.7	64.8±61.3	3.235	1.299	0.091
		massage	34.5±50.1	22.3±44.6	71.4±71.8			
	slope (ΔμV/s)	Warm-up	93.3±56.9	92.9±25.0	97.3±28.4	0.941	1.156	0.369
		massage	99.2±51.2	167.5±60.4	68.2±14.3			
	Normalized slope (Δ%/s)	Warm-up	89.7±51.6	66.4±19.7	126.9±46.9	0.914	1.780	0.410
		massage	208.8±47.6	246±101.7	94.1±9.3			

Abbreviations: MF=Median Frequency, MPF=mean power frequency, aEMG= average amplitude of electromyographic signals

DISCUSSION

The major finding of this study is that massage does not have an advantage over warm-up to delay the localized gastrocnemius fatigue during weight bearing isometric plantar flexion. Some researchers compared the effect of active and passive warm-up on sport performance (Hemmings, Smith, Graydon, and Dyson, 2000; Ng et al., 2007). However, it does not seem to be a common agreement on which type of warm-up is more beneficial in delaying the fatigue. Some researchers reported that an intensive warm-up improved performance more than a low level of warm-up and no warm-up at all. However, others did not report any difference between the high level, low level and no warm-up in performance. Ng et al. compared the effect of active warm-up and massage and reported that massage prior to exercise could lengthen exercise time before subjects reach a high

level of perceived exertion in cycling (Ng et al., 2007). Therefore, further research is required on selecting the best pre-exercise interventions. The results showed that initial MF, MPF and aEMG values of both the medial and lateral parts of the gastrocnemius (after fifty repetitions of calf raise) after the massage and warm-up were similar. It means that massage is as effective in decreasing fatigue as the warm-up after a set of isotonic contractions. Furthermore, aEMG at the start of isometric contraction was almost similar to that present after the massage and warm-up. This means that the number of motor units recruited after two interventions are equal. Therefore, we could note that this theory that motor units recruitment and firing rate has changed by applying massage will be rejected, because this study used the same level of loading in both conditions.

Moreover, neither the load intensity, nor the number of motor units had changed, and these factors did not have many effects on the MF and MPF. Applying a seven-minute massage similar to the present study protocol, Tanaka et al. found that this type of massage had no effect on the neuromuscular fatigue parameters of the low back muscles, but it reduced psychological indicators of fatigue (Tanaka et al., 2002). In the present study, there are no significant differences in the slope and normalized slope of MF, MPF and aEMG neither in the lateral gastrocnemius, nor in the medial gastrocnemius between the massage and warm-up conditions. MF and MPF, are both associated with motor unit recruitment, conduction velocity, tissues filtering characteristic and muscle temperature. Furthermore, MF and MPF are slightly affected by the motor unit firing rate, because they represent only a small percentage of the total EMG signals frequency spectrum. MF and MPF in the remainder of the spectrum are most affected by the shape of the motor unit impulse. Motor unit shape is influenced by conduction velocity and tissue filtering properties (Hunter et al., 2006). It is assumed that any change in force production would coincide with a similar rate of changes in motor unit recruitment and firing rate. For example, this would be a direct result of the number of motor units being recruited, displaying a different aEMG (Hunter et al., 2006). A lack of difference in the parameters of the two conditions indicates that motor units recruitment and firing rate may not be different. Alternatively, it can be suggested that there should have been an increase in neural recruitment to compensate for the impaired force-generating capacity after the massage. However, when additional motor units are recruited (for example, during the submaximal fatigue) this would depend on afferent receptors signalling the central nervous system to increase the force (Hunter et al., 2006). Therefore, it can be concluded that the effects of massage and warm-up on firing rate, conduction velocity and tissue filtering properties are similar. Massage, like warm-up, may increase internal muscle temperature and the content of muscle blood flow. It is probable that muscle temperature influences the MF and MPF through increased nerve conduction velocity or a changed tissue filtering effect. Also, limitations in blood flow cause insufficient oxygen transfer and decreased metabolic products discharge. Although Durkin et al. had reported a significant increase in skin temperature, blood flow and muscle oxidation with the application of massage and a device while driving, they had not reported an increase in MPF and aEMG (Durkin, Harvey, Hughson, and Callaghan, 2006). We used effleurage, petrissage, ringing and rolling techniques for applying the massage. These techniques could increase blood

flow by producing a centralized force for discharging capillaries and veins with a compensatory response (Callaghan, 1993). However, the blood flow probably increases much more during warm-up exercises. Another reason for the slight effect of massage in delaying fatigue is that massage can reduce excitability of a-motor neurons. Some researchers believe that a local point massage may lead to a general response in muscle. In other words, muscle tensions caused by decreased activities of spinal neurons are not only controlled by muscle spindle impulses, but also affected by the brain commands to the motor neurons. However, massage-related changes on muscle tension are modified by changes in other muscles. Therefore, massage will have little impact on any muscle (Kassolik et al., 2009). Despite the results of the present study, the generalization of these findings must be done with caution. This study has several limitations. Negative correlation between muscle fatigue and its slow-twitch fibre content is one of the limitations of this study. The one-minute isometric contraction used in the current study, which was recommended by Yang and colleagues, may not be enough due to a high level of slow-twitch fibre and resistance to fatigue in the gastrocnemius muscle (Young, Gutnik, Moran, and Thomson, 2005). Furthermore, we used a weight bearing sustained contraction to achieve local fatigue in gastrocnemius. Some researchers found that the frequency spectrum had no relationship with the intensity of contraction in healthy subjects. Basmajian and DeLuca contend that, although the rate of change in MPF is affected by the intensity of contraction, it is doubted whether this is a major factor in EMG spectral shifts during constant contractions (Basmajian and De Luca, 1985). Others, like Hagberg and Ericson found that the MPF increased with contraction strength for low-level contractions, while at higher levels in excess of 25% MVC, the MPF becomes independent of the contraction level (Hagberg and Ericson, 1982). Moritani and Muro, however, reported that the initial MPF increased significantly from 0% to 80% MVC (Moritani and Muro, 1987). Individual differences in fatigability could also have an influence on the results of the study. Another problem was controlling the subjects' nutrition and their levels of physical activity which becomes more important when gastrocnemius muscle used in everyday activities is evaluated. These factors may influence muscle glycogen and lactate levels which are the main factors affecting fatigue (Robertson et al., 2004). Another limitation of this study was the short duration of the performed massage. According to previous studies of Japanese researchers, seven-minutes is sufficient for physiological reactions of the surrounding local tissue (Otsuka T, 1999). These studies showed a significant increase in muscle blood flow after the five-minute massage using mechanical instruments. On the other hand, if the protocol of the massage is already determined, this restriction may influence the freedom of the massager's movements which is an important principle in the effectiveness

of massage. Another limitation of this study was the fatigue evaluation through EMG signal. Fatigue could be influenced by factors such as tolerance levels, motivation and synergist compliances which were not reflected in the EMG signal. A lack of strong relationship between the reduced normalized signal amplitude by MVC and the decreased power output are other limitations of fatigue evaluation through the EMG data. Particularly, during the maximum motor units' recruitment, the EMG signal amplitude decreases. However, peripheral fatigue could not cease exercise, because some of the motor units are inactive during submaximal contractions. EMG signal amplitude change depends on the number of recruited motor units and motor units firing rate. Action potential changes during fatigue which could participate in the inability of the EMG signal to achieve maximum amounts

after exhaustive contraction, independent of any reduction in the muscle activation capacity. Another limitation of our study was that the results were not applicable to dynamic movement. Fatigue influences muscle contraction with various velocities through a different manner. Reduction in motor units recruitment and firing rate can occur due to reflexive effects in the spinal cord. On the other hand, according to previous findings, during the exhaustive contraction in this study, fatigue does not seem to occur due to the central mechanism in CNS (Weir, Beck, Cramer, and Housh, 2006). Finally, although the purpose of the present study was to compare the two modalities before an activity, the presence of a control group was not necessary, however, we recommend using this in future studies.

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EFEKTI MASAŽE KOJA PRETHODI IZVOĐENJU VJEŽBI NA RAD MIŠIĆA TOKOM NJIHOVE KONTINUIRANE KONTRAKCIJE

Masaža je općeprihvaćena u sportu, te služi za povećanje učinka i smanjenje umora. Međutim, efekat masaže na promjene elektromiografske (EMG) aktivnosti se pokazao nedosljednim. Svrha ove studije je ispitati efekat masaže na aktiviranje mišića lista tokom vježbi kontinuirane kontrakcije plantarne fleksije. Deset zdravih muškaraca, dobrovoljaca, je ispitano dva puta u razdoblju od jedne sedmice, i to: jednom bez (kontrolna grupa, CTL) i jednom sa desetominutnom masažom nedominantne noge. Neprekidna kontrakcija je uključivala dvominutnu izometričku plantarnu fleksiju. Spektar snage EMG analize je dobiven izračunavanjem srednje frekvencije snage i prosječne amplitude površine elektromiografskih signala (aEMG), što je zabilježeno za nedominantni lateralni i medijalni gastrocnemius. Naizmjenična mišićna aktivnost između dva mišića je ispitana korištenjem analize ANOVA za ponovljena mjerenja na osnovu LG/MG odnosa integrisanog EMG-a (iEMG). Nadalje, Pearsonovi koeficijenti korelacije su izračunati između iEMG vrijednosti koje su zabilježene iz MG i LG, a sve u svrhu ispitivanja sinergijske supstitucije između mišića. Nisu pronađene značajne razlike u izvornom i normaliziranom nagibu MPF-a i aEMG-a između dva stanja tokom mjerenja prvih, drugih i trećih 20s EMG signala u medijalnom i lateralnom gastrocnemiusu. Osim toga, nisu pronađene značajne razlike u normaliziranom nagibu MPF-a i aEMG-a između dva stanja. Prema tome, nisu pronađeni dokazi koji ukazuju da je masaža uticala na umor lokaliziranog mišića, a što je povezano sa mioelektričnim promjenama.

Ključne riječi: masaža koja prethodi izvođenju vježbi, elektromiografska aktivnost, kontinuirana kontrakcija, gastrocnemius mišići.

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COMPARATIVE FACTOR ANALYSIS OF THE REFEREEING APPROACH IN BASKETBALL

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ABSTRACT

This research has been conducted on the basis of forty referees. As shown in this paper, the subjects are referees from FIBA, Basketball Champions League referees, basketball referees from BiH and beginner referees from BiH Championship. The results have shown that there are certain differences in the refereeing approach. It is mainly because we have used senior referees as well as beginner referees as subjects. So, it comes as no surprise that the results show different values. Based on this data, a solid foundation can be made for further specific segments of refereeing when it comes to the conduct as well as other parameters of refereeing.

Keywords: basketball, refereeing, difference

INTRODUCTION

The ability of a referee to estimate the consequences of one or more situations directs him/her to become progressive in his/her career in order to reach high levels of basketball refereeing in the world. There always has to be a balance in judging what constitutes an obvious, illegal contact, which can put an opponent team in an unfavourable position, and a balance of making the right decision not to whistle and interrupt a game for minor things for the sake of the match itself. Basketball as a sports game has developed into a game of speed and strength, and thus a referee's approach in the game has to be both serious and important because he is a developing factor of basketball. Illegal contacts and misconducts of a player or a coach have to be cautioned and thus improve a referee's career. Nowadays, referees, scouts, players and coaches can use available video materials and different software to improve themselves in their respective fields. On the other hand, a referee is the one who needs to be able to read a game and he must know why he stops an attack. It is not a rare occasion that a referee tries to predict what happened on the court, which is wrong, and thus influences the outcome of the match. Referees don't have the authority to change the rules or the interpretation of certain situations. Players and coaches are the ones who have to end the game, and only in that way, a match is considered to be regular. Not a single illegal action or misconduct can be ignored, otherwise it

affects the development of basketball. Big mistakes cannot be justified because they will happen all the time, all over again. It is unacceptable for a referee to inform a player or a coach that he will not caution him for his illegal action, even if it is not his responsibility, and despite the fact that he himself saw the situation on the court. Avoiding responsibility is a matter of an approach and the preparation of a referee and his team in one game, which is unpopular for basketball whatsoever. There are many situations during the game or in the dying seconds of a match when officials prove their values, and they are a matter of an approach to the game on any level of competition. Many decisions came on the go as a reasonable call, but whatever the call it is, it has to be understandable for everybody on the pitch. Moreover, a referee has to be ready for any further possibilities to come and to be able to deal with it through his own approach. The most important approach in a game is that you do not influence the outcome of a match with your calls. Coaches and players would try to put you under pressure verbally or by any other method, but if a referee has his/her own firm stance, it will not force him/her to make some reaction that is not logical. On the other hand, referees sometimes do not understand basketball terminology and the game spirit, even if they have been present in

basketball for years. A professional conduct of coaches, players and officials is the key of success in basketball but, if a referee wants to achieve that, he or she has to improve and put his approach before his emotions. Also, he has to educate himself through that relationship on the court all the time.

Certain mutual workshops of referees, coaches and players show their striving for tolerance and wish for advancement and improvement. In every game, referees have to have a right approach for the conduct of players and coaches. Cooperation has to be mutual with the elements of complete respect and normal conduct. Referees are often under pressure during a match, and yet they have deal with the approach to emotions and players' or coaches' misbehaviour. For each situation, the most important category is the approach and preparation which represent the effect of improvement for somebody to become a professional and top-notch referee. The science and technology breakthroughs have led to the fact that a man needs less time to develop his mind and body. The path we walk on today is shorter than it used to be.

Basketball complements its development through the change of rules. There used to be two half-times, now we have four periods of game play. That fact has led to various changes like the attack time decreased from 30 to 24 seconds and additional fourteen-seconds attack after a rebound. With different alterations of rules, we have come to some promising results. Nowadays, it is almost impossible to imagine a training session without a good preparation and backup conducted by sports and kinesiology experts and psychophysical preparations of athletes.

Today, when we are looking into the future, there is a separation of all segments to the simplest factors for which we have educated people who use technology, measurement, and various testing and preparation through micro and mesocycles. In that way, they create complete athletes, not just basketball players. A big group of players in one place gives us the right to talk about the need for a referee. If we have said that basketball represents complex multidimensional acyclic movements, we can conclude the complexity of the decision making process conducted by the officials.

It represents a process that is stored in the head of each official and which is a synergy of more activities within the thinking process and rapid response, where attention focus, concentration and readiness come to the fore. The most important segment is emotions, rage or stress. In one match, a referee makes about 600-800 decisions,

including situations where we do not make a call at all if the contact does not violate the match criteria. They are popularly called NO CALL situations which are of great importance for basketball.

Recently, we have witnessed referees moving in a pattern of three, where:

- **LEAD REFEREE – L**
- **CENTRAL REFEREE – C**
- **TRAIL REFEREE – T**

The very large number of responsibilities required by referees are the result of their studious work through the games they have been refereeing, as well as the educational seminars that they have attended, where each segment of the above mentioned pattern is analysed, their primary responsibility and elaboration of problems related to secondary responsibility which can happen due to a poor positioning in the court, leading to a failure in making the right decisions. The use of contemporary methods of learning through this segment is within various guidelines which manifest through a large number of educational contents such as video projections and observation. In order to understand the management concept, we primarily have to grasp the concept of organization.

An organization represents a group of people whose collective work leads to an achievement of a common cause, a cause which cannot be achieved by an individual. Management represents the coordination of all resources which are essential for an organization to achieve its cause and goals. (Covell, D., Walker, Sh., Siciliano, J., Hess, P.W. (2007)). Planning is the most basic of all managerial functions. It represents missions, goals and actions for their achievements. By planning, we can overcome a gap between what an organization is now and what it strives to be in the future. Planning, as a managerial function, is closely related to other managerial functions, especially to the control function. To put it in a nutshell, the control without planning is impossible. (Bubble, M. (2006)). Strategic planning is achieved by operational planning. It puts into practice the ways and actions which an organization will use in order to achieve its agreed upon goals.

The aim of operational planning is to produce a series of specific budget plans which will help us to prepare for probable anticipated future arrangements. (Biberović, A., Ahmić D. 2009). Leading is the only true management function. The rest, despite the fact that they play a role in a manager's job, depending on the size of an organization, are conducted and carried out within the related organizational units. In fact, leading implies a preparation of people to do what their managers want them to truly achieve. It also represents a series of activities which are related to the interaction between managers and their associates. (Sikavica, P., Bahtijarević-Šiber, F., Pološki Vokić, N. (2008)).

WORK METHODS

The basic method used in this research the bibliographic - descriptive method.

- a) Sample of respondents
- Euroleague basketball referees,
 - FIBA Champions League referees,
 - Basketball referees from BiH,
 - Beginner referees from BiH,

The battery of tests used in this study are questionnaires containing questions about basketball referees' in-game approach.

- b) Research variables by questionnaire in form of a survey

- Basketball referees' in-game approach survey

Data processing methods:

The data processing has been conducted via SPSS software. Descriptive and comparative statistics have been employed to get the results of the survey. The analysis has been conducted in order to determine the differences between the better and worse clubs according to the table position.

The Median test has been used to determine average values. The Kruskal-Wallis test has been employed to determine the differences between groups where the sample respondents have been classified into more groups in accordance with certain criteria.

RESEARCH RESULTS

Charts 1. and 2. show the difference in the eight applied variables presented through factors that define the officiating approach in basketball.

The results show that there are statistically significant differences in one variable "TACTICAL-TECHNICAL PREPARATION IS THE MOST IMPORTANT SEGMENT OF MY PART OF THE OBSERVATION". For variables that have shown statistical significance, the mean rank is for the first group (BiH-referees).

The reason for this result lies in the fact that BiH referees are at a turning point to make a breakthrough in basketball officiating, and therefore they give a special overview of this approach factor.

Chart 1

	1. OFFICIATING APPROACH OF A BASKETBALL GAME OF ANY LEVEL OF THE COMPETITION ALWAYS REPRESENTS THE SAME PREPARATION FOR ME AS A REFEREE	2. I ALWAYS APPROACH THE GAME ACCORDING TO THE FIXED SCHEDULE (THE WAY OF PREPARATION) IF NOMINATED	3. I DISTRIBUTE THE APPROACH SEGMENTS ACCORDING TO LEVEL OF IMPORTANCE IF NOMINATED FOR THE NEXT GAME	4. THE PREPARATION FOR AN INTERNATIONAL MATCH (EUROLEAGUE, FIBA CHAMPIONS LEAGUE, QUALIFIERS...) REPRESENTS A SPECIFIC CASE FOR ME	5. A MENTAL PART OF THE PREPARATION IS BASED ON THE VISUALIZATION OF THE GAME ITSELF AND ITS DETAILS	6. TACTICAL-TECHNICAL PREPARATION IS THE MOST IMPORTANT SEGMENT OF MY PART OF THE OBSERVATION	7. I NEVER GO TO A GAME WITHOUT HAVING PREPARED BEFORE	8. I GET PREPARED FOR THE GAME ACCORDING TO THE REFEREES WHO ARE IN MY TEAM
Chi-Square	3,854	5,445	7,096	1,893	2,519	12,237	1,408	8,458
Df	3	3	3	3	3	3	3	3
Asymp. Sig.	0,278	0,142	0,069	0,595	0,472	0,007	0,704	0,037

Chart 2

1. Officiating approach of a basketball game of any level of the competition always represents the same preparation for me as a referee	1	10	16.40
	2	10	20.20
	3	10	24.60
	4	10	20.80
	Total	40	
2. I always approach the game according to the fixed schedule (the way of preparation) if nominated	1	10	14.90
	2	10	21.35
	3	10	25.15
	4	10	20.60
	Total	40	
3. I distribute approach on segments according to a level of game's importance if nominated for the next game	1	10	25.85
	2	10	14.50
	3	10	22.45
	4	10	19.20
	Total	40	
4. The preparation for an international match (Euroleague, FIBA Champions League, Qualifiers...) represents a specific case for me	1	10	23.55
	2	10	18.95
	3	10	21.55
	4	10	19.95
	Total	40	
5. A mental part of the preparation is based on the visualization of the game itself and its details	1	10	21.70
	2	10	16.40
	3	10	23.80
	4	10	20.10
	Total	40	
6. Tactical-technical preparation is the most important segment of my part of the observation	1	10	29.40
	2	10	11.50
	3	10	24.95
	4	10	19.15
	Total	40	
7. I never go to a game without having prepared before	1	10	18.40
	2	10	18.70
	3	10	23.40
	4	10	21.50
	Total	40	
8. I get prepared for the game according to the referees who are in my team	1	10	23.65
	2	10	12.30
	3	10	24.95
	4	10	21.10
	Total	40	

Chart 3

	1. OFFICIATING APPROACH OF A BASKETBALL GAME OF ANY LEVEL OF THE COMPETITION ALWAYS REPRESENTS THE SAME PREPARATION FOR ME AS A REFEREE	2. I ALWAYS APPROACH THE GAME ACCORDING TO THE FIXED SCHEDULE (THE WAY OF PREPARATION) IF NOMINATED	3. I DISTRIBUTE THE APPROACH SEGMENTS ACCORDING TO LEVEL OF IMPORTANCE IF NOMINATED FOR THE NEXT GAME	4. THE PREPARATION FOR AN INTERNATIONAL MATCH (EUROLEAGUE, FIBA CHAMPIONS LEAGUE, QUALIFIERS...) REPRESENTS A SPECIFIC CASE FOR ME	5. A MENTAL PART OF THE PREPARATION IS BASED ON THE VISUALIZATION OF THE GAME ITSELF AND ITS DETAILS	6. TACTICAL-TECHNICAL PREPARATION IS THE MOST IMPORTANT SEGMENT OF MY PART OF THE OBSERVATION	7. I NEVER GO TO A GAME WITHOUT HAVING PREPARED BEFORE	8. I GET PREPARED FOR THE GAME ACCORDING TO THE REFEREES WHO ARE IN MY TEAM
Chi-Square	3,854	5,445	7,096	1,893	2,519	12,237	1,408	8,458
Df	3	3	3	3	3	3	3	3
Asymp. Sig.	0,278	0,142	0,069	0,595	0,472	0,007	0,704	0,037

Charts 3. and 4. show the difference in the eight applied variables presented through factors that define the officiating approach in basketball. The results show that there are no statistically significant differences in any of the given variables. It can be said that no factor is singled out because all the referees are equally concentrated on these parameters, regardless of the level of the competition.

Charts 5. and 6. show the difference in the eight applied variables presented through factors that define the officiating approach in basketball. The results show that there are statistically significant differences in three variables, including "DURING THE HALF-TIME BREAK, I ANALYZE THE FIRST HALF AND POINT OUT THE THINGS THAT ARE NOT RIGHT", "AFTER THE GAME, FIRST I ANALYZE THE PERFORMANCE DONE WITHIN A TEAM, AND

THEN MY INDIVIDUAL CONTRIBUTION" and "I USE THE NATIONAL CHAMPIONSHIP MATCHES APPROACH AS A TRAINING FOR THE FORTHCOMING GAMES". For variables that have shown statistical significance, the mean rank is in variables "DURING THE HALF-TIME BREAK, I ANALYZE THE FIRST HALF AND POINT OUT THE THINGS THAT ARE NOT RIGHT" for the third group of respondents (FIBA referees).

For the variable "AFTER THE GAME, FIRST I ANALYZE THE PERFORMANCE DONE WITHIN A TEAM, AND THEN MY INDIVIDUAL CONTRIBUTION", the mean rank is for the third group of respondents (FIBA referees) as well. Finally, for the variable "I USE THE NATIONAL CHAMPIONSHIP MATCHES APPROACH AS A TRAINING FOR THE FORTHCOMING GAMES", it is for the first group of respondents – beginner referees. According to these results, we can see that the mean rank is shown in two factors which correspond with FIBA referees.

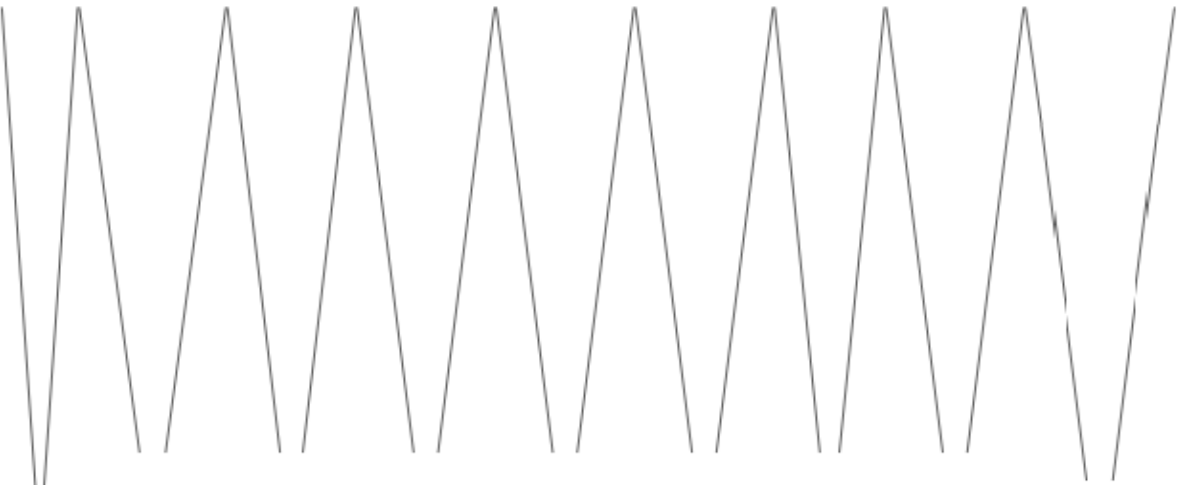
It comes as no surprise because their level of officiating confirms this when these factors are taken into consideration and that is the fact which makes him/her a top-notch referee as he or she strives for a higher level of officiating and analyses his/her work during the

half-time. For one factor, the mean rank is found in beginner referees which indicates the issues related to the national championship games. That is why the result of this questionnaire makes perfect sense.

Chart 4

Group		N	Mean rank
9. The preparation for a derby/an important game is chronologically always the same	1	10	21.25
	2	10	16.55
	3	10	24.05
	4	10	20.15
	Total	40	
12. The preparation contains a large part of the game and I always find it useful	1	10	20.45
	2	10	21.85
	3	10	22.80
	4	10	16.90
	Total	40	
13. The preparation contains a large part of the game and I always find it useful	1	10	18.70
	2	10	20.95
	3	10	24.70
	4	10	17.65
	Total	40	
14. I pay big attention to the atmosphere around the game (the hall, supporters, coaches...)	1	10	23.55
	2	10	17.95
	3	10	19.00
	4	10	21.50
	Total	40	
15. I pay specific attention to the stars of a game where I prepare myself for their reactions	1	10	25.80
	2	10	17.40
	3	10	19.15
	4	10	19.65
	Total	40	
16. I always prepare with no prejudice for the team I am going to officiate to	1	10	19.80
	2	10	23.60
	3	10	17.90
	4	10	20.70
	Total	40	
17. I specifically prepare myself according to the team of referees I am going to work with	1	10	18.90
	2	10	16.05
	3	10	22.60
	4	10	24.45
	Total	40	

Chart 5



	18. DURING THE HALF-TIME, I ANALYZE THE FIRST HALF WORK AND POINT OUT THE THING THAT ARE NOT GOOD	19. MY PREPARATION ENDS WHEN THE GAME IS OVER	20. AFTER THE GAME, FIRST I ANALYZE THE PERFORMANCE DONE WITHIN A TEAM, AND THEN MY INDIVIDUAL CONTRIBUTION	21. I PREPARE IN THE SAME WAY FOR THE NATIONAL CHAMPIONSHIP MATCHES	22. I HAVE A STUDIOUS ANALYSIS APPROACH AS I CONSIDER IT TO BE THE MOST IMPORTANT SEGMENT FOR EDUCATION OF FURTHER POSITIVE IN-GAME APPROACH	23. I SEE A GAME AS THE FIRST CRUCIAL STEP IN A REFEREE'S CAREER	24. I USE THE NATIONAL CHAMPIONSHIP MATCHES AS A TRAINING FOR THE FORTHCOMING GAMES	25. I USE NEW SCIENTIFIC TECHNOLOGIES TO IMPROVE MY CAREER AS A REFEREE (OBSERVATION, PSYCHOLOGICAL TRIGGERS, ETC. TO SHOW TOP FORM)
Chi-Square	13,624	5,531	14,359	5,059	2,027	2,835	7,98	3,633
df	3	3	3	3	3	3	3	3
Asymp. Sig.	0,003	0,137	0,002	0,168	0,567	0,418	0,046	0,304

Chart 6

Group		N	Mean rank
18. During the half-time, I analyze the first half work and point out the things that are not good	1	10	13.00
	2	10	19.08
	3	10	29.00
	4	10	21.00
Total		40	
19. My preparation ends when the game is over	1	10	23.00
	2	10	14.30
	3	10	24.85
	4	10	19.85
Total		40	
20. After the game, first I analyze the performance done within a team and then my individual contribution	1	10	15.80
	2	10	14.00
	3	10	27.90
	4	10	24.30
Total		40	
21. I prepare in the same way for the national championship match	1	10	21.20
	2	10	15.00
	3	10	22.85
	4	10	22.95
Total		40	
22. I have a studious analysis approach as I consider it to be the most important segment for education of further positive in-game approach	1	10	18.45
	2	10	21.60
	3	10	23.50
	4	10	18.45
Total		40	
23. I see a game approach as the first crucial step in a referee's career	1	10	19.30
	2	10	17.40
	3	10	21.70
	4	10	23.60
Total		40	
24. I use the national championship matches approach as a training for the forthcoming games	1	10	26.00
	2	10	22.00
	3	10	21.60
	4	10	12.40
Total		40	
25. I use new scientific technologies to improve my career as a referee (observation, psychological triggers, IRS system, visualization) to show top form	1	10	25.20
	2	10	20.20
	3	10	18.30
	4	10	18.30
Total		40	

According to these results, we can conclude that, within certain factors, there are differences in the officiating approach segments. The reason for this can be a personal relation which manifests through the level of pleasure and personal satisfaction of a basketball referee.

CONCLUSION

This research has been conducted on the basis of forty referees. As shown in this paper, the subjects are referees from FIBA, Basketball Champions League referees, basketball referees from BiH and beginner referees from BiH Championship. All these tell us about the value of results which gave us a chance to consider a bigger picture as well. This can represent a

parameter for further development of officiating in basketball. The results have shown that there are statistically significant differences in certain factors within different levels of refereeing. In this case, we have got the results that show various in-game approach levels. The results have also shown that there are differences in conduct related to the approach by using senior referees as subjects in this survey and their beginner colleagues. Based on this data, a solid foundation can be made for further specific segments of refereeing when it comes to the conduct and other parameters of refereeing as well. The refereeing conduct is closely related to the process of development of a referee, as well as applying those segments on the pitch. All of the above mentioned factors, which have been used as a course for this research, need and have to be used for different further analysis. The ultimate goal in the end would be to make a refereeing development programme based on the relevant results.

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KOMPARATIVNA ANALIZA FAKTORA PRISTUPA SUĐENJA U KOŠARCI

Istraživanje je urađeno na populaciji od 40 sudija. Kao što je u radu naznačeno, populaciju su činili FIBA sudije, Basketball Champions League sudije, košarkaške sudije iz Bosne i Hercegovine i početnici sudije Prvenstva BIH. Rezultati su pokazali da postoje razlike u odnosu na pristup suđenja, samim tim što imamo visoko rangirane sudije kao ispitivačku populaciju a također i niže rangirane sudije, što je shvatljivo kada su sami rezultati istraživanja u pitanju, koje pokazuju nejednakost.

Na osnovu ovih podataka, može se napraviti oslonac za dalje posebne segmente suđenja kada je u pitanju prije svega odnos a i drugi parametri suđenja. Odnos prema suđenju je usko vezan i za sami tok usavršavanja suđenja a tako i primjenu tih segmenata na terenu.

Ključne riječi: košarka, suđenje, sudija, razlika.

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THE EFFECT OF AEROBIC TRAINING IN DECREASING BODY FAT AND INCREASING FREE FATTY ACIDS FOR OVERWEIGHT FEMALES

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ABSTRACT

The purpose of this study was to compare the effect of a continuous aerobic training with low and moderate intensity in decreasing body fat and increasing free fatty acids for overweight females. Methods: this study was conducted on a sample of 30 overweight females with a mean age of 19.3 and Body Mass Index (BMI) between 25 and 30 kg/m². The subjects were divided into 2 groups and given continuous aerobic training with low intensity (Group 1/CATLI) and moderate intensity (Group 2/CATMI) four times a week during the period of 5 weeks. Group 1 exercised for 30 minutes and performed a continuous aerobic training using the ergo cycle with 60% - 70% of maximum heart rate, while Group 2 performed the exercise with 70% - 80% of maximum heart rate. During exercising, heart rate was monitored by using the Polar Heart Rate Monitor. Body fat and free fatty acids were measured before and after exercising. Data was analysed using a paired T-test. Results: there was a significant effect of CATLI and CATMI in increasing free fatty acids, with $p < 0.05$. However, there was no significant effect of CATLI and CATMI in decreasing body fat, with $p > 0.05$. Conclusion: continuous aerobic training with low and moderate intensity can be used to decrease body fat and increase free fatty acids for overweight females.

Keywords: continuous aerobic training, low intensity, moderate intensity, body fat, free fatty acids, overweight.

INTRODUCTION

Overweight represents a nutrient imbalance and lack of exercise as well as the accumulation of fat so that the calories spent are not comparable. According to WHO, the overweight category is characterised by BMI amounting to 25 kg/m² up to 30 kg/m². Overweight causes many health risks, including cardiovascular disorders, diabetes, and some types of cancer [1]. Fat is a very large energy reserve in the human body and a complex chemical chain, due to the long carbon chain. Fat breakdown occurs because triglycerides are hydrolysed which will cause the breakdown into free fatty acids which are then sent to active tissue for oxidation [2]. Fat can change when stimulated by doing aerobic exercise or exercise with a long duration without any rest breaks [3]. One of the solutions can be seen

through stimulation of hormones in the body (cortisol, catecholamines, growth hormones, and many other hormones that can dissolve fat) [4]. Research on fat has been conducted by many researchers. A study on fat using two types of training, namely, High Intensity Interval Training (HIIT) and Continuous Moderate Intensity Training resulted in a decrease in body fat [5]. In addition, aerobic high impact reduces fat thickness [6]. The same study used Low Intensity Exercise Training (LIET) and High Intensity Exercise Training (HIET), with the results of changes in body composition using HIET exercises [7]. Furthermore, there was a change and reduction in FM and fat mass through the training procedures conducted during a 12-week aerobic training [8]. Contradictions occur in another study which examined fat and compared Low Intensity (LI) and High Intensity (HI) exercises, with the results indicating a significant decrease in LI [9]. Some researchers mentioned above are still debating about the reduction of fat with various

training methods, obtaining contradictory results. Therefore, the purpose of this study is to compare the effect of a continuous aerobic training with low intensity and moderate intensity in decreasing body fat and increasing free fatty acids for overweight female.

MATERIALS AND METHODS

Subjects

This study was conducted on a sample of 30 overweight females with a mean age of 19.3 (ranging from 19 to 23 years old), and BMI between 25 and 30 kg/m². The subjects voluntarily participated in this study and were able to conduct an aerobic training programme during the treatment.

Study Design

The design of this study was experimental with the use of a pretest and posttest control group design. Technical sampling used simple random sampling. The subjects were divided into 2 groups (15 subjects per each group) and Group 1 was given CATLI, while Group 2 was given CATMI.

Methods

The aerobic training was conducted four times a week during the period of 5 weeks with 10 minutes of warming up and cooling down. Group 1 exercised for 30 minutes and performed a CATLI using the ergo cycle with 60% - 70% of maximum heart rate, while Group 2 performed CATMI with 70% - 80% of maximum heart rate. During exercising, heart rate was monitored by using the Polar Heart Rate Monitor H10. Body fat was measured using a Bioimpedance Analyser (BIA) and free fatty acids was measured using Human Free Fatty Acids ELISA KIT. Pretest data was taken before exercising, blood was collected after overnight fasting and taken in the morning. Posttest data was taken after exercising, blood was taken one day after exercising and overnight fasting.

Statistical Analysis

Data was analysed using SPSS software 25.0. All data was presented in the form of mean, standard deviation and range. A Saphiro-Wilk test was used to analyse the variables' normality data. A paired T-test and independent T-test were used to analyse the homogeneity and differences of each group.

RESULTS AND DISCUSSION

The result of this study found that mean body fat decreased from 37.14 ± 1.66 (pretest), with a range of 33.55 - 39.52, to 32.7 ± 1.7 (posttest), with a range of

30.22-36.02. On the other hand, the mean of the free fatty acids increased from 827.27 ± 48.78 (pretest), with a range of 710.06 - 897.13, to 925.39 ± 54.37 (posttest), with a range of 823.01 - 993.33. The data obtained for the pretest and posttest of body fat and free fatty acids is presented in Diagram 1 and Diagram 2.

Diagram 1: Pretest and posttest data for body fat

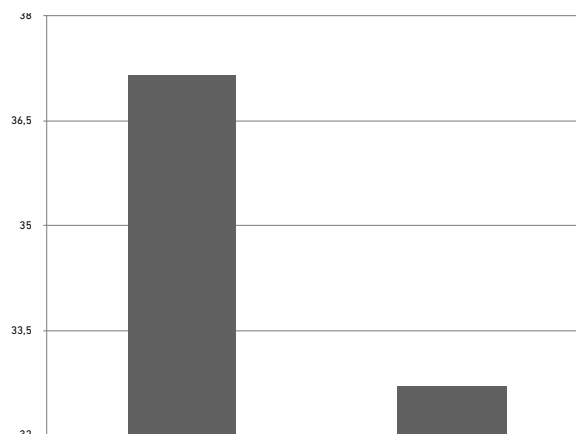
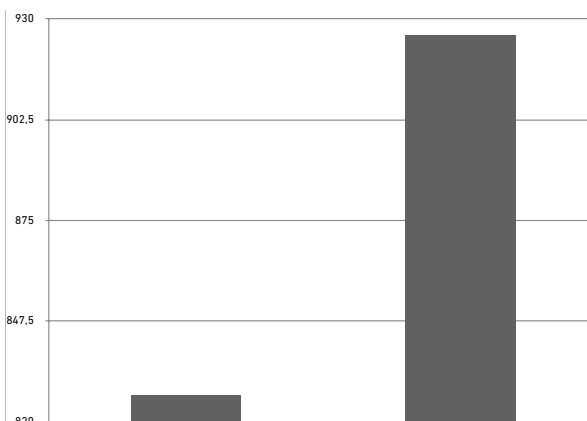


Diagram 2: Pretest and posttest data for free fatty acids



As clearly shown in Diagram 1, the mean body fat decreased approximately 4.44, while the mean free fatty acids improved 98.27. It is indicated that aerobic training could be used to reduce body fat and increase free fatty acids.

Table 1 shows that the pretest and posttest data for body fat and free fatty acids from CATLI and CATMI groups was normal with $p > 0.05$.

Table 2 indicates that there was a significant effect of CATLI and CATMI on body fat and free fatty acids with $p < 0.05$, and body fat pretest and posttest ($p = 0.000$) as well as free fatty acids pretest and posttest ($p = 0.0000$).

Table 1: Analysis Test of Data Normality

	Groups	Sig.
Body Fat Pretest	CATLI	.450
	CATMI	.899
Body Fat Posttest	CATLI	.289
	CATMI	.358
Free Fatty Acids Pretest	CATLI	.702
	CATMI	.851
Free Fatty Acids Posttest	CATLI	.140
	CATMI	.115

Table 2: Paired Samples Test Results

		M±SD	Sig. (2 tailed)
P1	Body Fat Pretest - Body Fat Posttest	4.408±1.2270 3	.000
P2	Free Fatty Acids Pretest - Free Fatty Acids Posttest	98.116±39.27 0	.000

Table 3: Independent T-test Results

	Sig. (2-tailed)
Body Fat Pretest	.102
Body Fat Posttest	.355
Free Fatty Acids Pretest	.000
Free Fatty Acids Posttest	.000

Table 3 shows that the result of the independent T-test, which compared CATLI and CATMI, indicates that there was a significant difference between CATLI and CATMI in increasing free fatty acids with $p < 0.05$.

On the other hand, there was no significant difference between CATLI and CATMI in reducing body fat with $p > 0.05$.

Moderate intensity exercise also causes the acceleration of the human body's respiration to dissolve fat, when TG is split, free fatty acids cannot be directly used, but will join hands with carnitine to carry free fatty acids out of the mitochondrial membrane to form acyl-carnitine. The process occurs due to the exercises with low intensity and moderate intensity [10].

The results of this study are similar to that of Wolinsky and Driskell which revealed that low intensity training will increase fat metabolism so that it breaks down into glycerol and free fatty acids, resulting from increased hormone production, and establishes a lipolysis of triglycerides through HSL (Hormone-Sensitive Lipase) assistance [2]. In addition, it was revealed that low intensity exercise (60%) would stimulate the endocrine system to release epinephrine hormones as much as 2-3 times which could establish a lipolysis of fat more than the rest [11]. Increased epinephrine will stimulate HSL to be produced more for the lipolysis of TG (triglycerides) into free fatty acids and glycerol [12].

The above results support the results of the study which explains that, when doing aerobic exercise, fat oxidation will occur resulting from the body's adaptation response. Exercises with a duration of 30 minutes increase fat lipolysis which is to meet the needs of the use of free fatty acids as energy [13]. In addition, another study also found the same results and stated that there are no significant differences in body fat in the group performing moderate intensity exercises [14].

CONCLUSION

It can be concluded that CATLI and CATMI can be used to increase free fatty acids. However, there was no significant difference between CATLI and CATMI in reducing body fat. It is suggested that overweight females can use training with low intensity in order to reduce injury during exercising because of having a high BMI.

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Disclosure statement

The authors claim that there is no potential conflict of interest.

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EFEKAT AEROBNOG TRENINGA NA SMANJENJE MASNOG TKIVA I POVEĆANJE NIVOA SLOBODNIH MASNIH KISELINA KOD PRETILIH ŽENA

Svrha ove studije je uporediti efekat neprekidnog aerobnog treninga niskog i umjerenog intenziteta na smanjenje masnog tkiva i povećanje nivoa slobodnih masnih kiselina kod pretilih žena. Metode: ova studija je provedena na uzorku od 30 pretilih žena prosječne dobi 19,3 godine starosti i indeksa tjelesne mase (BMI) između 25 i 30 kg/m². Ispitanici su podijeljeni u dvije grupe, te podvrgnuti neprekidnom aerobnom treningu niskog intenziteta (Grupa 1/CATLI) i umjerenog intenziteta (Grupa 2/CATMI) četiri puta sedmično tokom perioda od 5 sedmica. Grupa 1 je vježbala 30 minuta i izvodila neprekidni aerobni trening koristeći ergo bicikl sa rasponom od 60% - 70% maksimalne srčane frekvencije, dok je Grupa 2 izvodila vježbe sa rasponom od 70% - 80% maksimalne srčane frekvencije. Tokom vježbanja, srčana frekvencija je praćena koristeći Polar Heart Rate Monitor (monitor srčane frekvencije). Mjerenje masnog tkiva i slobodnih masnih kiselina je provedeno prije i poslije vježbanja. Podaci su analizirani koristeći T-test za parne uzorke. Rezultati: otkriven je značajan efekat CATLI i CATMI vježbi na povećanje nivoa slobodnih masnih kiselina sa $p < 0,05$. Međutim, nije otkriven značajan efekat CATLI i CATMI vježbi na smanjenje masnog tkiva sa $p > 0,05$. Zaključak: neprekidni aerobni trening niskog i umjerenog intenziteta se može koristiti za smanjenje masnog tkiva i povećanje nivoa slobodnih masnih kiselina kod pretilih žena.

Ključne riječi: neprekidni aerobni trening, niski intenzitet, umjereni intenzitet, masno tkivo, slobodne masne kiseline, pretilost.

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THE EFFECT OF USING COMPETITIVE AND COOPERATIVE TEACHING STYLES IN LEARNING SOME TRACK AND FIELD EVENTS

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ABSTRACT

This study aimed to identify the effect of using two teaching styles (competitive and cooperative) on learning the hammer throw and discus throw events, for the track and field course. The study sample consisted of (50) students, who were divided in two equal experimental groups. The first group was taught by the competitive style and the second by the cooperative style. The researchers calculated the means, standard deviations and T-test to find out the differences between the groups. The results showed statistically significant differences at ($P \leq 0.05$) level between the pre- and post-measurements of the two experimental groups in favour of the post-measurements. The results further showed statistically significant differences at ($P \leq 0.05$) level between the post-measurements of the two experimental groups on the skill and digital performance of the hammer throw and discus throw events, which was in favour of the competitive teaching style. They recommended the use of the competitive and cooperative styles in learning track and field events, and applying modern teaching styles on different events.

Keywords: teaching styles, learning, track and field events.

INTRODUCTION

Physical education is an integrated part of general education, as it is no longer a mere physical or sport training practiced to move parts of the body and activate its systems. Rather, it is an important part of the individual's bringing-up and education conducted through purposeful physical activity under the supervision of the physical education teacher. Utilizing the information and abilities of this teacher basically depends on his teaching method and manner. The applied styles in teaching physical education are among the fundamental indicators of the educational process. It helps in achieving the physical education objectives, and contributes to the student's proper preparation from all psychological, mental, social and physical aspects (Al-Samerai and Al-Yaseri, 1986). The teaching process consists of many components (teacher, student, curriculum, and

educational environment). It is further a continuous series of relations that arise between the teacher and the student, and a link between the tendencies and needs of the students. (Oudat, 2012). Success of the physical education lesson depends on the way, the method or the strategy applied in teaching, through which the students gain motor skills (Goudas et al., 2006). Therefore, physical education methods should be reconsidered, since the teacher is no longer a supreme power representative who decides everything, nor is the student a representative of the negative aspect in the learning process. Good teaching creates learning situations in which every student can achieve the physical education objectives. It is no longer accepted to look at the students as repetitive patterns, but each one must be seen as an individual case, which has its interests, abilities, attitudes and problems (Yasin,

2012). Physical education (PE) methods became more diversified, which led the PE teachers to use more than one method to transmit the information to the students, to face the individual differences in a better way, which, in turn, would help the students achieve more aims (Abed AL Baqi et al., 2011). The teaching style drew a lot of attention in the studies and research works. In this concern, Mosston and Ashworth (2008) studied many teaching methods' concepts, and described learning as a series of decisions taken in the PE lesson.

The effect the teacher's method leaves in his students is represented in their learning degree. Because successful teaching includes a useful scientific material for the students, so that students will interact with and make good use of it. Both the competitive and cooperative teaching styles are among the important teaching methods in teaching physical education. In the competitive teaching style, the teacher explains the skill and provides a model in front of the students, then he makes a contest between them. Here the teacher follows-up the students' performance, corrects the errors, and provides feedback on the students' performance (Jasim and Abed Al Rahman, 2010). And in the cooperative teaching style, the students cooperate in applying the performance and exchange the roles, the errors are corrected during the lesson application stage, (Mahmoud and Oudat, 2007). PE teaching methods depend on the practical experience gained during the PE lesson, and on other scientific advancements and applications in the sports area (Sa'ad and Fahem, 2004). Therefore, it is necessary to increase the teaching activity through reconsidering the PE teaching methods. As stated earlier, the teacher is no longer the supreme power who decides everything, and the student is no longer the negative aspect of the learning process whose mere role is to "follow and carry out orders." It is inescapable to increase the student's confidence and ability to accept responsibility in the learning-teaching process. Good teaching is the one that works towards creating learning situations, where every student achieves the PE objectives. It is unacceptable to look at the students as repetitive patterns, but everyone should be dealt with as an independent case with its own interests, abilities, attitudes and problems (Doudin, 1994). The significance of this study is seen in highlighting the strengths and weaknesses of the long since commonly used traditional teaching method. It also provides scientific proof on the effectiveness of two other styles of PE teaching methods, and their success in the educational field, as well as their impact on the track and field events (hammer throw, discus throw). Discus and hammer throw events are among the rotational events in which they share an approximate technical performance of motions. They share the motions of entering the circle, standby situation, moving, throwing, equilibrium inside the throwing circle, and exiting outside it. They differ in catching and holding the tool and the physical and motor requirements for practicing each (Khuwaileh, 2013).

STUDY PROBLEM

The teacher's knowledge of more than one teaching style increases his ability and cognitions of how to deal with the students. The researchers, through their work in the teaching field, noticed that the PE dominant teaching style did not match the basic foundation upon which the new curricula depended. They also found that the time allocated for applying the skills is insufficient to learn them; that the students' application level of track and field events is low, as compared with other sports activities; and, that the traditional style does not grant the student a chance to express himself freely, or take part in the educational process decisions (Singer, 1982). The researchers saw that the use of untraditional teaching styles (competitive and cooperative) to teach track and field events (hammer throw and discus throw) for the students of track and field course may be able to raise the competition and collaboration levels among them. The student becomes able to compete with others or with himself, and cooperate with his colleague to develop his performance, and subsequently achieve the teaching educational objectives.

Objectives

This study aims to identify the level of differences between the experimental groups' skilful and digital performances of the hammer throw and discus throw events.

Questions

1. Are there statistically significant differences at ($P \leq 0.05$) level between the pre- and post-measurements in the skill performance of the two experimental groups?
2. Are there statistically significant differences at ($P \leq 0.05$) level between the pre- and post-measurements in the digital performance of the two experimental groups?
3. Are there statistically significant differences at ($P \leq 0.05$) level between the post-measurements in the skill and digital performance of the two experimental groups?

Procedure

The researchers applied the experimental method as it is fitting for this study. The sample consisted of (50) male students attending the track and field course. They were distributed over two equal groups, and the first were taught through the competitive style, while the second were taught through the cooperative style.

INSTRUMENTS

- Skill performance of the hammer throw and discus throw in track and field events. The researchers took the degree indicating the skill performance level of the event. Three (3) attempts were given for every student, and the mean was taken.
- Digital tests of the hammer throw and discus throw in track and field events, by measuring the attempt distance in the two events. Three (3) attempts were given for every student, and the mean was taken.
- The teaching programme: the researchers use the previous studies (Jasim and Abed Al Rahman, 2010; Shihateh, 2010) to implement the educational programme. They used both the competitive and cooperative styles through introducing thrill, fun, enthusiasm and motivating them through competition among themselves.

DATA ANALYSIS

Group parity was verified in the skill and digital performances of both the hammer and discus throws events for the experimental groups.

Means (M's), standard deviations (SD's) and T-test were obtained for the skill and digital performances of both the hammer and discus throws events. The values were not statistically significant at ($P \leq 0.05$) level, which indicates that there are no differences between the experimental groups.

On the other hand, the study reliability coefficient was calculated using the test-retest method, and the reliability coefficient value amounted to (0.90). The study instrument validity was also calculated using the content validity, through presenting it to five specialists in track and field teaching in Jordan, which was adopted after carrying out the proposed amendments on it.

Table 1: T Results Between Pre- and Post-Measurements in the Skill Performance

Events	Group (1)				T	P	Group (2)				T	P
	Pre-Measure		Post-Measure				Pre-Measure		Post-Measure			
	M	SD	M	SD			M	SD	M	SD		
Hammer Throw	12.39	1.98	19.35	1.51	7.73	0.000	12.21	1.30	16.25	1.14	6.21	0.000
Discus Throw	12.63	1.88	17.83	1.03	7.01	0.001	12.16	1.17	14.40	0.88	5.01	0.001

RESULTS AND DISCUSSION

Results Obtained for the First Question:

Are there statistically significant differences at ($P \leq 0.05$) level between the pre- and post-measurements in the skill performance of the two experimental groups?

For answering this question, T-test results were obtained to identify the differences of the skill performance in the hammer throw and discus throw among the experimental groups, as illustrated in Table (1). Table (1) shows statistically significant differences at ($P \leq 0.05$) level between the pre- and post-measurements in the skill performance of the two experimental groups, in favour of the post-measurement.

The researchers ascribe this result to the advantages of the modern teaching styles such as providing feedback, control of the event, and cooperation among the students, to enable them to perform the events successfully.

This result is in agreement with the study of Oudat (2010) in that the performance of the model in front of the students and continuous feedback lead to raising the students' skill performance. In this concern, the competitive and cooperative teaching styles are among the important methods that contribute to the student's approaching a mastering stage through the repetitive practices (Schilling and Mary, 2000).

Results Obtained for the Second Question:

Are there statistically significant differences at ($P \leq 0.05$) level between the pre- and post-measurements in the digital performance of the two experimental groups?

For answering this question, T-test results were obtained to identify the differences of the digital performance in the hammer throw and discus throw among the experimental groups, as illustrated in Table (2).

Table 2: T Results Between Pre- and Post-Measurements in the Digital Performance

Events	Group (1)				T	P	Group (2)				T	P
	Pre-Measure		Post-Measure				Pre-Measure		Post-Measure			
	M	SD	M	SD			M	SD	M	SD		
Hammer Throw	13.62	2.09	19.96	0.92	7.62	0.00	15.22	3.15	17.26	2.09	6.72	0.000
Discus Throw	11.50	2.50	17.78	5.31	5.56	0.000	11.80	2.22	15.19	2.27	5.73	0.000

Table (2) shows statistically significant differences at ($P \leq 0.05$) level between the pre- and post-measurements in the digital performance of the two experimental groups, in favour of the post-measurement. These results are in line with those of Oudat (2015) who asserted that the teaching style offers the student sufficient chance to exchange experiences with the teacher, individually, about the skill he applies. It further offers the teacher sufficient time to provide students with feedback during the practical application, which, in turn, leads to upgrading the students' performance level.

The researchers see that both the competitive and cooperative teaching styles contribute to the exchange of experience with the teacher and taking many application-related decisions. Through increasing the application time and correcting the errors, the teacher remains always ready to provide the students with timely explanations.

Results Obtained for the Third Question:

Are there statistically significant differences at ($P \leq 0.05$) level between the post-measurements in the skill and digital performance of the two experimental groups? For answering this question, T-test results were obtained to identify the differences of the skill and digital performance in the hammer throw and discus throw among the experimental groups, as illustrated in Table (3).

Table (3) shows statistically significant differences at ($P \leq 0.05$) level between the post-measurements in the skill and digital performance of the hammer and discus throws between the experimental groups, in favour of the competitive styles. The researchers attribute this result to the fact that the competitive style provides the student with more time during application than the cooperative style. This result is in line with that of Khasawneh et al. (2011), in that the use of the competitive style leads to better use of the best application time; as compared with those of the cooperative style.

Table 3: T Results Between Post-Measurements in the Skill and Digital Performance

Events	Skill Performance				T	P	Digital Performance				T	P
	Group (1)		Group (2)				Group (1)		Group (2)			
	M	SD	M	SD			M	SD	M	SD		
Hammer Throw	19.35	1.151	16.25	1.14	5.20	0.000	19.96	0.92	17.26	2.09	5.72	0.000
Discus Throw	17.63	1.03	14.40	0.88	4.59	0.001	17.78	5.31	15.19	2.27	5.56	0.001

CONCLUSION

Although fully aware of the limitations of our study in terms of sampling, we believe that the results obtained show the importance of using competitive styles in teaching the hammer throw and discus throw.

RECOMMENDATIONS

The researchers recommend using the competitive and cooperative teaching styles in teaching track and field events, and using these styles on larger samples and different events.

LIMITATION

Due to the nature of the study design, the study has several limitations: a) the findings are generalizable

only to the target students and to the same setting; b) the extraneous nature of some variables (such as training and participation of the students in activities inside and outside the university) cannot be completely controlled.

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EFEKAT KORIŠTENJA TAKMIČARSKIH I SARADNIČKIH STILOVA PODUČAVANJA PRILIKOM UČENJA NEKIH ATLETSKIH DISCIPLINA

Cilj ove studije je bio utvrđivanje efekta korištenja dva stila podučavanja (takmičarski i saradnički) na učenje disciplina bacanja kladiva i bacanja diska tokom časova atletike. Uzorak ispitanika se sastojao od 50 učenika koji su bili podijeljeni u dvije jednake eksperimentalne grupe. Prva grupa je podučavana koristeći takmičarski stil, a druga koristeći saradnički stil učenja. Istraživači su izračunali srednje vrijednosti, standardnu devijaciju i T-test kako bi pronašli razlike između grupa. Rezultati su pokazali statistički značajne razlike na nivou $P \leq 0,05$ između mjerenja prije i poslije provođenja podučavanja za dvije eksperimentalne grupe, a koji su išli u prilog rezultatima izmjerenim poslije provođenja podučavanja. Nadalje, rezultati su pokazali statistički značajne razlike na nivou $P \leq 0,05$ između mjerenja poslije provođenja podučavanja za dvije eksperimentalne grupe kada su u pitanju vještine i izvedba bacanja kladiva i diska, a koji su išli u prilog takmičarskog stila podučavanja.

Oni predlažu korištenje takmičarskih i saradničkih stilova prilikom učenja atletskih disciplina, te primjenu modernih stilova podučavanja različitih disciplina.

Ključne riječi: stilovi podučavanja, učenje, atletske discipline.

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DIFFERENCES IN SOME MOTOR SKILLS BETWEEN THE STUDENTS ATTENDING THE FACULTY OF PHYSICAL EDUCATION AND SPORTS OF THE UNIVERSITY OF PRISHTINA AND AAB COLLEGE

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ABSTRACT

The main purpose of this research is to ascertain whether there are significant differences in some motor skills between the two selected University Institutions, between Public and Private Institutions of the same profile, namely, the branch of Physical Education and Sports of the University of Prishtina and AAB College. This research has included 221 male students with an average age of 19.49. Out of them, 150 students come from the University of Prishtina, and 71 students are from the AAB College, from the Faculty of Physical Education and Sport. The research was conducted by means of a discriminative analysis, namely, T-test for independent groups which has led to the following conclusion: discriminative analysis, namely, T-test for independent groups for the use of motor skills provides us with data that there were statistically significant differences in all motor tests applied in favour of students attending the University of Prishtina with a significance of $\text{sig.}=.000$.

Keywords: students, motor skills, differences, T – test, results

INTRODUCTION

A high level of physical activity is an indicator of a healthy future. An important challenge for physical education is the promotion of regular and permanent exercise for a healthy lifestyle. Regular participation in physical activity is accompanied by significant short- and long-term health benefits for students in physical, cognitive, emotional and social fields (Sallis, Prochaska and Taylor, 2000; Yang, Telama, Viikari and Raitakari, 2006, Mikić, et.al., 2008). Motor skills and anthropological characteristics play an important role in the success of students' sports performance. Monitoring and diagnosis of students' anthropometric characteristics and motor skills is the foundation from which the procedures for determining the situation, goals and tasks, as well as the planning and programming

process of the exercise derive (Samson et al. 2000; Maaroos, Landor, 2001; Rousanoglou et al., 2008). Anthropometric characteristics and motor skills undoubtedly have a significant influence on determining the psychosomatic human status. The level of development related to anthropometric characteristics and motor skills plays an important and unique role in the process of human growth and development (Kondrić, Mišigoj-Duraković, Metikoš, 2002). The main purpose of this research is to ascertain whether there are significant differences in some anthropometric characteristics and motor skills between the two selected University Institutions, between Public and Private Institutions of the same profile, namely, the branch of Physical Education and Sports of the University of Prishtina and AAB College.

METHODS

Participants

Subject - The data sample has included 221 male subjects, divided into two sub-samples/groups. The first group included (No.=150) male students with an average age of 19.49, students from the University of Prishtina, while the second group included (No. = 75) male students with an average age of 19.49, students from the Faculty of Physical Education and Sports in AAB College. While five motor variables were tested in the motor variables, namely: foot plate tapping, arm plate tapping, standing broad jump, bent arm hang, and pull-up test.

Statistical methods

Descriptive statistics are used for calculating the results for both groups of subjects; arithmetic average, minimum and maximum score, standard deviation, skewness, kurtosis, and the Kolmogorov-Smirnov test was used for distribution

normality for each variable using the software package SPSS 20.0. Additionally, in order to differentiate the motor skills between the students of Physical Education of the University of Prishtina and the AAB College, the T-test method analysis was used to determine the differences between the two groups of students.

RESULTS

Table 1 shows the results of the descriptive statistics related to motor skills at AAB College and the Physical Culture and Sports course. We tested the sample of 221 students, out of whom 150 were from FEFS and 71 from AAB College.

T-test

Table 3 shows the results of the T-test for motor skills between the students of FEFS and AAB College, and the Physical Culture and Sports course. Through the T-test analysis, we tested the sample of 221 students, out of whom 150 were from FEFS and 71 from AAB College.

Table 1: Descriptive statistic of motor skills - AAB

INSTITUTE AAB	N	MIN	MAX	Mean	SD	SKEW	KURT
Foot plate tapping	67	20	33	26.81	3.47	0.007	-0.802
Hand plate tapping	67	22	48	37.34	5.11	-.326	.549
Long jump	67	160	270	213.27	23.693	-0.16	-0.296
Standing broad jump	67	15	75	36.6109	13.8397 6	1.055	0.648
Pull-up	67	4	20	9.85	3.354	0.792	0.955
Valid N (listwise)	67						

Table 2: Descriptive statistic of motor skills - FEFS

INSTITUTE FEFS	N	MIN	MAX	Mean	SD	SKEW	KURT
Foot plate tapping	150	19	36	29.02	2.927	-0.228	0.379
Hand plate tapping	150	18	47	34.92	4.687	-0.332	1.083
Long jump	150	200	280	237.57	16.897	0.085	-0.094
Standing broad jump	150	11.03	106	53.5003	18.5441 7	0.158	0.236
Pull-up	150	3	35	12.61	5.052	1.679	4.657
Valid N (listwise)	150						

In Table 3, statistical data show that the group of students from the University of Prishtina had better results compared to AAB college students, but not with a valid statistical significance 001. The foot plate tapping variable had a difference, but with not a valid statistical significance, the average being 29.02 for FEFS students

and 26.81 for AAB College students. While AAB College students showed a better result in hand plate tapping test, with an average of 37.34 and a frequency of 15 seconds, compared to the students of the University of Prishtina who had an average of 34.92.

Table 3: T-Test for independent groups - Motor skills FEFS and AAB

Variables	ID	N	Mean	Std. Dev.	t	df	Sig.	Mean Diff.
Foot plate tapping	FEFS	150	29.02	2.927	4.854	215	.000	2.214
	AAB	67	26.81	3.47	4.550	109.735	.000	2.214
Hand plate tapping	FEFS	150	34.92	4.687	-3.421	215	.001	-2.423
	AAB	67	37.34	5.110	-3.310	117.574	.001	-2.423
Long jump	FEFS	150	237.57	16.897	8.594	215	.000	24.298
	AAB	67	213.27	23.693	7.578	97.172	.000	24.298
Standing broad jump	FEFS	150	53.50	18.544	6.668	215	.000	16.889
	AAB	67	36.61	13.839	7.441	166.789	.000	16.889
Pull-up	FEFS	150	12.61	5.052	4.089	215	.000	2.763
	AAB	67	9.85	3.354	4.751	183.903	.000	2.763

FEFS - Faculty of Physical Education and Sports, AAB - AAB College – Physical Education

In Table 3, statistical data show that the group of students from the University of Prishtina had better results compared to AAB college students, but not with a valid statistical significance 001. The foot plate tapping variable had a difference, but with not a valid statistical significance, the average being 29.02 for FEFS students and 26.81 for AAB College students.

While AAB College students showed a better result in hand plate tapping test, with an average of 37.34 and a frequency of 15 seconds, compared to the students of the University of Prishtina who had an average of 34.92.

Discussion

In relation to the obtained results, we have ascertained that there are differences between the two University Institutions, FEFS-AAB and FEFS-UP, in motor skills. Whereas, concerning motor variables, valid statistical

results have been obtained in some variables in favour of AAB College students.

It was the variable hand plate tapping with an average (37.34), compared with FEFS -UP with a score (34.92), while other motor tests were in favour of FEFS-UP. Similar results have also been shown by some other research, (Srna Jenko Miholić, Ivan Prskalo, Vatroslav Horvat, 2008).

The motor results presented in favour of FEFS-UP are justified by the fact that the FEFS-UP students, other than the curriculum they attend, are more active outside of the curriculum, oriented in different sports, which has impacted the higher physical preparation of FEFS-UP students. Intensive after-learning programmes can yield significant and sustained improvements in students' motor skills. (Matvienko and Ahrabi-Fard, 2010).

CONCLUSION

Considering the purpose of the research and the objective of this paper, which was the confirmation of the differences between the students of both institutions of Physical Education from AAB College and UP, we can stylistically conclude that the obtained results have shown that there are differences in anthropometric characteristics, but not with a valid significance. Based on the summary of the results, we have

come to the conclusion that the data results of the motor skills were influenced by the selection of students, since the two groups of students were in the first year of their studies, the selection means that students in FEFS are subject to the admission examination where the best are selected, i.e., students are previously prepared for the practical part, whereas the students in AAB are not subject to the admission examination, i.e., there is no student selection, the desire to enrol is attainable for everyone without any criteria.

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RAZLIKE U NEKIM MOTORIČKIM VJEŠTINAMA IZMEĐU STUDENATA KOJI POHAĐAJU FAKULTET ZA FIZIČKO OBRAZOVANJE I SPORT UNIVERZITETA U PRIŠTINI I AAB UNIVERZITET

Glavna svrha ovog istraživanja jeste istražiti da li postoje značajne razlike u nekim motoričkim vještinama između dva odabrana univerziteta, između javnih i privatnih institucija istog profila, tj. odsjeka Fizičkog obrazovanja i sporta Univerziteta u Prištini i AAB Univerziteta. Ovo istraživanje je obuhvatilo 221 studenta muškog spola sa prosječnim brojem godina u iznosu od 19,49. Od njih, 150 studenata pohađa Univerzitet u Prištini, a 71 student pohađa AAB Univerzitet, Fakultet za fizičko obrazovanje i sport. Istraživanje je provedeno korištenjem diskriminativne analize, tj. T-testa za nezavisne uzorke putem kojeg smo došli do sljedećeg zaključka: diskriminativna analiza, tj. T-test za nezavisne uzorke koji je korišten za upotrebu motoričkih vještina je dao podatke koji su ukazali na postojanje statistički značajnih razlika u svim testovima motoričkih sposobnosti koji su primjenjeni, a u korist studenata koji pohađaju Univerzitet u Prištini, sa nivoom značajnosti u iznosu od sig.=,000.

Ključne riječi: studenti, motoričke vještine, razlike, T-test, rezultati.

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INVESTIGATING THE EFFECTS OF MARKETING MIX FACTORS ON THE PERFORMANCE OF SPORTS MARKETING IN THE VOLLEYBALL PREMIER LEAGUE OF THE ISLAMIC REPUBLIC OF IRAN

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ABSTRACT

The purpose of this study was to investigate the effects of marketing mix factors on sports marketing in the Volleyball Premier League of the Islamic Republic of Iran. The method of the study was descriptive-monitoring. The population of the study was all the official staff from the Ministry of Youth Affairs and Sports, Volleyball Federation officials, league organization authorities, executive managers, supervisors, coaches, volleyball commissions and experts and professors of sports management in all universities of Iran. The population size was 162 individuals and a questionnaire was sent to all of them. Among the 162 questionnaires, 129 of them were used for analysis purposes. Spearman correlation test was used to analyse the data. In all analyses, the significance level was considered to be 0.05. The results showed that promotion and product variables were effective in sports marketing performance of the Volleyball Premier League of Iran. Generally, it is recommended to the Volleyball Federation and the universities to take some measures in order to train and educate professional and experienced marketers to develop the marketing culture.

Keywords: Marketing Mix, Volleyball Federation, Professional Sports.

INTRODUCTION

Economic growth and development of a society requires the development of all active industries inside that society and the way to achieve this goal is to pay special attention to all of the generating industries in the society. In this regard, sports can also be introduced as a profitable industry because great parts of any society somehow deal with sports. A study in America revealed that 70 percent of the population in America watches, reads or discusses a sports issue at least once a day (Sekendiz, 2009; quoted by Soltan Hossseini, 2012). This is why sports have turned into a market. In developed countries, the sports market is one of the greatest and profitable markets that help

the economic development of the country. Thus, marketing is a necessity in this industry. The new marketing is not limited to any geographical border or any specific group of customer anymore. The new trend in marketing is summarized in the short slogan "think globally, act locally". Globalization of the market pushes away the borders in economy and trade. However, globalization requires a wide vision, goal-oriented moves, systematic attitude, development of abilities and promotion of rules and regulation. In this dynamic environment, marketing is a comprehensive commercial philosophy for creating a link between an organization and the developed market. Many of the non-commercial organizations, particularly sports organizations, consider marketing as a tool for communicating

and interacting with people. In fact, marketing is now one of the most complex duties of sports organizations. If the marketing is implemented well, it has many advantages. It can help the sports of the country to flourish at the national and international level. It can also increase participation in collective and athletic sports. It also lessens the dependability of sports to governmental budgets (Latifian, 2014). Obviously, any organization would need financial resources to achieve its goals and sports organizations, particularly, need very rich supplies, one of which can be the financial support of organizations or companies (Greenwell et al., 2007; quoted by Jamshidian, 2010). On the other side, due to economic inflammation and popularity of sports, they compete with each other in supporting the sports teams (Ehsani et al., 2012). Today, sports managers are looking for promotion of financial resources. However, the creation and attraction of financial resources needs skill, knowledge, a good awareness of cultural, political, economic and religious situation, and the use of efficient management strategies suitable to the needs of the society. Nevertheless, when participating in the sports marketing competition, in which professional principles and regulations are observed, marketers cannot be successful without sufficient skills, techniques, knowledge and new marketing tools. Otherwise, the marketers will lose many opportunities and resources (Clausson and Miller, 2001). Thus, the purpose of this study was to investigate the effects of marketing mix factors on the performance of sports marketing in the Volleyball Premier League of the Islamic Republic of Iran.

MATERIALS AND METHODS

The method of the study was descriptive-monitoring. The population of the study was all the official staff from the Ministry of Youth Affairs and Sports, Volleyball Federation officials, league organization authorities, executive managers, supervisors, coaches, volleyball commissions and experts and professors of sports management in all universities of Iran. Because the size of the total population was limited, a consensus method was used for data collection. That is, a questionnaire was sent to all of the individuals. Among the 162 questionnaires, 129 of them could be used for analysis purposes. The individuals were instructed how to fill in the questionnaire and were assured that the data would only be used for research purposes. The questionnaire used in this study was designed by the author. It consisted of 142 questions. The questionnaire had two sides. On one side, the questions were related to the current situation, and on the other side, the desired conditions were investigated.

The questionnaire was divided into 3 parts, namely, the definition of terms, personal information and the main questions. The questions were divided into 6 parts. The first part evaluated the marketing performance of league organization. The second, third, fourth, fifth and sixth part evaluated management, environment, strategy, goal market and positioning and marketing mixes, respectively. Regarding the purpose of the study, the sixth part was investigated, including the product, price, promotion, place, public relations, individuals and physical evidence. The validity of the questionnaire was approved by experts and professors. To investigate the reliability of the questionnaire, Cronbach's alpha was used. For doing so, the questionnaire was distributed among 30 individuals and reliability and subscales of the questionnaire were approved. Alpha coefficients of the questionnaire and subscales were presented in Table 1.

Table 1: Cronbach's alpha coefficients of the questionnaire and its subscales

Variables	Number of questions	Cronbach's alpha
Efficiency	10	0.734
Effectiveness	2	0.718
Adjustability	3	0.707
Marketing management evaluation	26	0.821
Marketing environment evaluation	40	0.738
Marketing strategy evaluation	13	0.813
Evaluation of the goal market and positioning	6	0.803
Marketing mix evaluation	42	0.759
Total		0.872

Binomial test and Spearman correlation test were used to analyse the data. The significance level was considered $p < 0.05$ in all analyses.

RESULTS AND DISCUSSION

Due to the non-normal distribution of the data, a Spearman correlation test was used. The results revealed that there was a significant relationship between promotion and the efficiency aspect. The results also revealed that there was a significant relationship between products and adjustability variables. The relationships between other variables and aspects were insignificant. Thus, it could be concluded that the effective marketing mixes on the performance of sports marketing in the Volleyball Premier League of Iran were product and promotion.

Table 2: The effects of marketing mix factors on marketing performance

Variables	Efficiency	Effectiveness	Adjustability
Product	0.161	-0.041	0.212*
Price	0.113	0.066	0.040
Promotion	0.205**	-0.015	0.128
Place	0.138	-0.016	0.042
Public relations	0.060	0.123	0.041
Individuals	-0.005	0.063	0.018
Physical evidences	0.078	0.043	0.030

*Correlation is significant in 0.01

** Correlation is significant in 0.05

CONCLUSION

The purpose of this study was to investigate the effects of marketing mix factors on the performance of sports marketing in the Volleyball Premier League of the Islamic Republic of Iran. The results revealed that the marketing mixes product and promotion can affect the marketing performance in the Volleyball Premier League of Iran. The findings of this study are in line with Ross et al., (2006) and Clausson and Miller (2001). Chalip et al., (2003) also considered advertisement goals (one of the elements of promotion marketing mix) as an effective element in marketing.

Regarding the effects of marketing mix elements on feasibility management and the related activities, Chalip et al. found that there should be a strong relationship between political authorities and sports managers. Westerbeek and Shilbury (2003) found that there is a direct relationship between marketing mix elements, particularly promotion and the attention of fans.

Cousens and Slack (1996) stated that a combination of financial support, advertisement and verification is the best method for encouraging the fans to follow the matches. In recent decades, the firms have become aware of the great importance of advertisement as an element of marketing mix and managed to affect people's image and beliefs of the goods or services using appropriate advertisement techniques and getting consultations from marketing experts. All in all, it is recommended to the Volleyball Federation of the Islamic Republic of Iran and the universities to take some measures in order to train and educate professional and experienced marketers to develop the marketing culture.

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ISTRAŽIVANJE EFEKATA FAKTORA MARKETING MIKSA NA PROVOĐENJE MARKETINGA U SPORTU ODOJKAŠKE PREMIJER LIGE ISLAMSKRE REPUBLIKE IRAN

Svrha ove studije je bila istražiti efekte faktora marketing miksa na provođenje marketinga u sportu odbojkaške Premijer lige Islamske Republike Iran. Metoda korištena u studiji je bila deskriptivna monitoring metoda. Ispitanici u studiji su bili svo oficijelno osoblje Ministarstva za pitanja mladih i sporta, službenici Odbojkaškog saveza, tijela Lige, izvršni menadžeri, supervizori, treneri, odbojkaške komisije, stručnjaci i profesori sportskog menadžmenta sa svih univerziteta u Iranu. Broj ispitanika je iznosio 162 pojedinca, a upitnik ja dostavljen svima. Od 162 upitnika, 129 je korišteno u svrhu analize. Spearmanov test korelacije je korišten za analizu podataka. U svim analizama, nivo značaja je bio 0,05. Rezultati su pokazali da su varijable promocije i proizvoda bile efektivne u provođenju marketinga u sportu odbojkaške Premijer lige Irana. Odbojkaškom savezu i univerzitetima se općenito preporučuje poduzimanje nekih mjera kako bi obučili i obrazovali profesionalce i iskusne trgovce za razvoj kulture marketinga.

Ključne riječi: marketing miks, Odbojkaški savez, profesionalni sport.

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INDICATORS OF THE MOTIVATION LEVEL FOR AVOIDING FAILURE IN FEMALE BOXERS WITH MASCULINE AND ANDROGYNOUS PSYCHOLOGICAL GENDER TRAITS

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ABSTRACT

The study of gender-specific features for women's motivation to train masculine sports is an actual problem of sports psychology. The purpose of the study is to identify the motivation level for avoiding failure among young elite female athletes practicing boxing and having different psychological genders. Young women (18-24 years old) (n=34) practicing boxing have taken part in the research. Diagnosis methods of psychological gender of S. Bem and assessment of the motivation level aimed at avoiding failure of T. Ehlers were used for the study on the psychological characteristics of female athletes. The female athletes have been distributed between the androgynous (n=26) and masculine (n=8) psychological gender. The average motivation level for avoiding failure prevails in the group of androgynous psychological gender and low motivation level is present in the group of masculine psychological gender. A significant difference ($P < 0.01$) has been found between the data of the low motivation level for avoiding failure among athletes of androgynous (7.58) and masculine (6.24) psychological gender.

Keywords: female boxing, elite athletes, androgyny, masculinity, motivation.

INTRODUCTION

Experts point out that there are two main types of motivation: avoiding failure and achieving success in sports. It has been found that failure avoidance as the main motivation is significantly higher among male athletes than among female athletes (Bester, 2014). The scientists point out that male athletes showed higher rates of psychological characteristics, in particular, the control of stress conditions, than female athletes (Medrano, and Espada-Mateos, 2018). The problem of psychological gender specificity of sports qualities in athletes practicing various sports deserves close attention since the composition of these psychological

qualities may vary significantly depending on the type of sports activity (Damadaeva, 2011). Unfortunately, experts note a lack of research devoted to women practicing different types of martial arts (Osipov, et al., 2017). Initially, these sports are perceived as "male" and the assessment of the psychological qualities of athletes is based on male characteristics (Follo, 2012). It should be mentioned that research is needed to highlight the topics of the gender specific characteristics of martial arts' athletes for the most complete understanding of all significant aspects of the gender creation of sports practice (Carlsson, 2017). The scientists point to a lack of research in the field of sports psychology among girls and women who

are professionally involved in sports (Iedynak, et al., 2017) including practicing boxing (Kovalev, Osipov, Sadyrin, et al., 2019; Simpson and Wrisberg, 2013). It should be noted that amateur women's boxing is quite a young sport which has been recently included in the programme of the Olympic Games.

Experts note a high level of interest in boxing among modern young girls and women (Taymazov, Ashkinazi, and Obvintsev, 2016). The training methods of female boxers are significantly different from the training methods of male boxers, including the field of sports psychology. In particular, the actual problem of sports psychology is the problem of studying women's motivation to engage in initially masculine sports: martial arts, weightlifting, etc.

An analysis of the model related to the participation of men and women in sports activities shows that most men and women's sports choice conforms to traditional notions about men's and women's sports (Alvariñas-Villaverde, López-Villar, Fernández-Villarino, and Alvarez-Esteban, 2017). It should be noted that gender aspects of women's motivation engaging in "male" sports activities had been studied insufficiently, although the attempts in identifying specific motives for women boxing were made by the scientists (McGannon, Schinke, Ge, and Blodgett, 2018).

It is believed that martial arts, including boxing, are performed by women who have masculine (inherent for men) character traits and a low level of emotionality (Burdzicka-Wolowik, and Goral-Radziszewska, 2014).

An analysis related to the psychological profile of female boxers will provide detailed information about the specifics of female boxing and improve the sports training programmes for female boxers into competitive activities. The importance of studying the psychological gender that determines the social behaviour and emotional intelligence of women who are professionally involved in sports is emphasized by specialists (Rutkowska, and Bergier, 2015).

It is believed that a detailed study of such aspects will allow us to answer a number of important practical questions related to determining the specificity of the female boxers' sports motivation and the influence of specific motives of athletic performance. The purpose of the research is the determination of the psychological gender in young elite female boxing athletes and an assessment of the motivation level aimed at avoiding failure of these female athletes in sports practice.

RESEARCH METHODS

Participants: Young women (n=34) practicing boxing (elite athletes). The age of the studied female athletes is 18-24 years old. All female athletes gave voluntary informed consent to participate in the research. The studies were approved by the local Ethics Expert Committee of the Institute of Physical Culture, Sports and Tourism (Siberian Federal University). **Organization and research methods:** The method of diagnosing the psychological gender developed by Sandra L. Bem was used in determining the characteristic psychological traits of female athletes. The athletes were asked to answer "yes" or "no" to 60 questions assessing the presence or absence of certain personality traits. The athletes included in this study were also evaluated by people who knew these women well (in our studies, one of the athletes' parents has conducted the assessment) to increase the level of reliability. The evaluation of the athletes' motivational characteristics aimed at avoiding failures in sports activities was carried out according to the method of T. Ehlers. Statistical analysis data of the research: SPSS20 programme was used for statistical processing and analysis of the research results. Mann-Whitney U-test was used to verify the validity of the results.

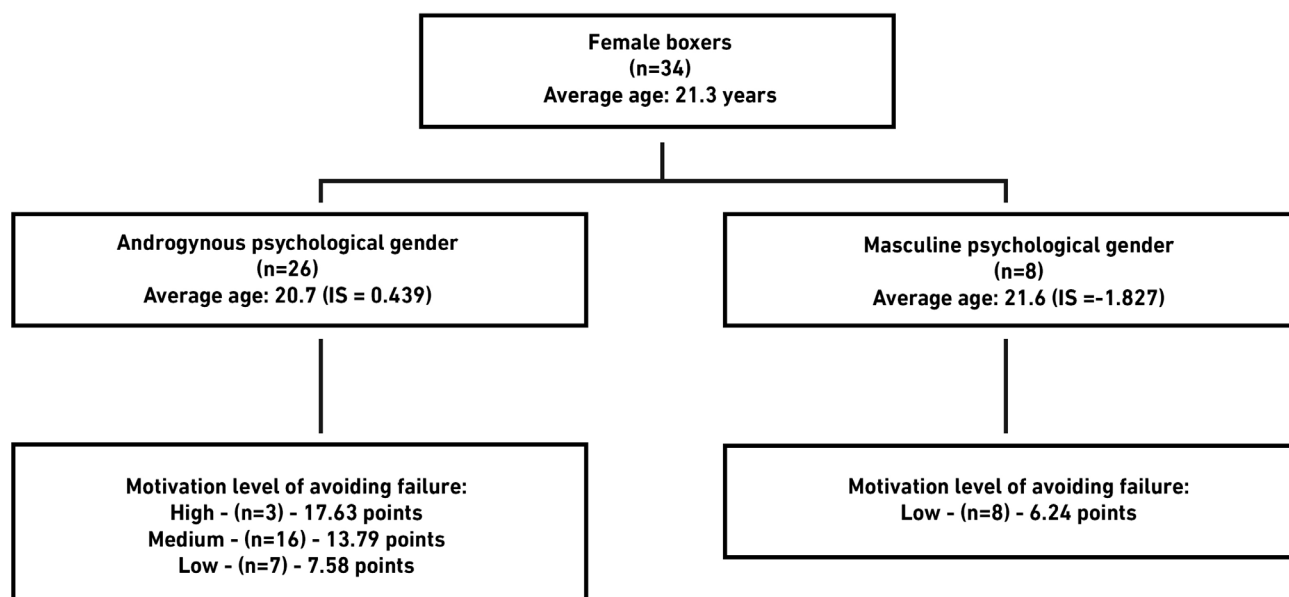
RESULTS AND DISCUSSION

The study has revealed that 26 female boxers have the features of the androgynous psychological gender ($IS=0.439$). The predominance of masculine psychological gender ($IS=-1.827$) has been found among 8 female athletes. Individuals with the feminine type have not been identified among the athletes. It was found that the majority of the studied women (n=16) has shown an average motivation level for avoiding failures (13.79) in the group of female athletes with a predominance of androgynous personality traits.

Thus, a low motivation level for avoiding failures (7.58) has been found among 7 female boxers and a high level (17.63) has been found only among 3 female athletes of the androgynous psychological gender group. All female athletes (n=8) of the group with the predominance of masculine personality traits have revealed a low motivation level for avoiding failure (6.24).

At the same time, there was a significant ($P < 0.01$) difference between the data of the low motivation level for avoiding failure present in the athletes belonging to the androgynous and masculine psychological gender. Female boxers with an androgynous psychological gender have shown higher scores of the motivation assessment level for avoiding failure than female athletes with distinct psychological masculinity. Data on the psychological characteristics of the studied female athletes are presented in Figure 1.

Figure 1: Study data on the psychological characteristics of female athletes practicing boxing



The achievement of sports success in martial arts depends on a number of psychological factors: confidence in their abilities, sufficient motivation, mental stamina and resistance to stress (Slimani, et al., 2017). It was revealed that the majority of women practicing martial arts identify themselves with the androgynous psychological gender (Cardoso, et al., 2016). In our studies, the majority (76%) of female athletes also identified with the androgynous psychological gender. At the same time, there is not enough data on the correlation between the psychological gender of women practicing martial arts (androgynous, feminine or masculine) and the female athletes' level of athletic achievements (Burdzicka-Wolowik, 2012). The influence of psychological gender on the formation of sports identity related to women practicing martial arts has been recognized by experts (Dogan, and Graham, 2019). The data on the study of gender-role orientations of women practicing "male" sports show that the orientation towards masculinity has a positive effect on the athletes' level competence in contrast to the orientation towards femininity (Guillet, Sarrazin, Fontayne, and Brustad, 2006). In our studies, the prevalence of medium and high motivation level has been found for avoiding failure in female boxers. These data somewhat differ from the statements that the higher rates of motivation for avoiding failure are characteristic for male athletes in sports activities (Bester, 2014). Literature presents evidence that women practicing martial arts have mainly been inclined towards psychological masculinity (Burdzicka-Wolowik, and Goral-Radziszewska, 2014). In our studies, the features of androgynous psychological gender have been revealed among the majority of female athletes practicing boxing.

Scientists argue that women who have a high fear of negative assessment regarding their sports activities (a high motivation level to avoid failure in sports) practice "male" sports less than women who have a lower fear of negative assessment for their activities (Yi-Hsiu, and Chen-Yueh, 2013). In our studies, high and medium motivation levels for avoiding failure have been revealed among the majority (n=19) of female athletes. A low level of this motivation was revealed among a smaller (n=15) number of female boxers. There is data on the dependence of the level of psycho-emotional anxiety for competitive results on the level of sports practice and the achievements of athletes in the literature. In particular, for women practicing martial arts where female athletes of a higher level of athletic performance demonstrate lower levels of anxiety than female athletes of lower qualifications (Fernandez, et al., 2019). In our studies, the majority (n=19) of the elite female boxers are dominated by indicators of medium and high motivation level for avoiding failure.

CONCLUSION

The analysis of the theory and practice of sports activities shows that it is necessary to study the links between the individual characteristics of the motivation for avoiding failure and the psychological gender of female athletes practicing boxing. It is revealed that the manifestation of the motive for avoiding failure in athletes of different psychological gender has a different size.

Female boxers with masculine personality traits are characterized by a low level of this motivation. Most female boxers with androgynous personality traits revealed an average motivation level for avoiding failure. The studies of the individual

psychological characteristics of female athletes practicing martial arts are necessary since the level of female athletes' motivation has a significant impact on combat styles and the competitive results of female athletes.

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INDIKATORI NIVOA MOTIVACIJE ZA IZBJEGAVANJE NEUSPJEHA KOD BOKSAČICA SA MUŠKIM I ANDROGINSKIM OSOBINAMA PSIHOLOŠKOG RODA

Proučavanje uticaja rodno specifičnih osobina žena na motivaciju za treniranje muških sportova predstavlja stvarni problem sportske psihologije. Svrha ove studije je identifikovati nivo motivacije za izbjegavanje neuspjeha kod mladih elitnih sportašica koje se bave boksom, te imaju različite psihološke rodove. U istraživanju su učestvovala mlade žene (18-24 godine starosti) (n=34) koje se bave boksom. Metode za dijagnozu psihološkog roda razvijene od strane S. Bem, te metode procjene nivoa motivacije za izbjegavanje neuspjeha razvijene od strane T. Ehlers su korištene za istraživanje psiholoških karakteristika sportašica. Sportašice su podijeljene na androgini (n=26) i muški (n=8) psihološki rod. Prosječni nivo motivacije za izbjegavanje neuspjeha prevladava u grupi androginskog psihološkog roda, a nizak nivo motivacije je prisutan u grupi muškog psihološkog roda. Značajna razlika ($P < 0,01$) je pronađena između podataka o niskom nivou motivacije za izbjegavanje neuspjeha kod sportašica androginskog (7,58) i muškog (6,24) psihološkog roda.

Ključne riječi: ženski boks, elitne sportašice, androginitet, muževnost, motivacija.

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PSYCHOLOGICAL READINESS OF HANDBALL PLAYERS FOR THE COMPETITION

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ABSTRACT

The athletes' readiness for competitions is characterized by a certain set of features (functional, mental, physical, technical and tactical, etc.) that manifest in their unity. Aim: determine the readiness of handball players for competing with rivals of a different class. Materials and methods: the research was conducted on the basis of the Kherson High School of Physical Culture. A female handball team of the Super League "Dniproanka" was involved in the research and included 15 handball players aged 19 to 32. Sports Masters of Ukraine were a contingent of the team. The research lasted for 3 years (2015-2017), took place in three stages, and was conducted in the form of observation, psychological testing and questionnaires. Results: the research on the handball team "Dniproanka's" psychological readiness for competitions was conducted during games with the Super League teams of Ukraine, different in terms of athletic skill and experience. Consequently, 35.7% of handball players had an average level of mental readiness, 50% were above the average, and 14.3% had a high level in the game of HC "Dniproanka" against HC "Economi-University" (the team below the class). In the game against HC "Real" (the team is equal in class), 20% of the players had an average level of psychological readiness for the competition and 80% were above the average. In the game against HC "Galichanka" (team above the class), 61.5% of handball players with an average level of mental readiness for the competition and 38.5% with above the average were found. Conclusions: the achieved level of mental readiness can be considered sustainable and stable. This gives grounds for asserting that Kherson handball players are confident in their pre-start period, and during the competition they are persistently and fully capable of fighting to achieve the goal.

Keywords: anxiety, excitement, inhibition, emotion, confidence.

INTRODUCTION

The current specificity of the sports training, aimed at achieving high results, requires the athlete to have a large, and sometimes limiting strain of all physiological reserves of the body, including mental capabilities (Bolotin, and Bakayev, 2017; Gavrilova, Shelkov, Churganov, and Matochkina, 2015; Huzar, 2001b). In these conditions the dependence of the effectiveness of human activity on the individual properties of the nervous system increases. The boundary level of physical activity, combined with high emotional stress, often leads to over-strain of physiological systems, their shifts, and a decrease in the functional state of the organism as a whole (Bolotin, and Bakayev, 2017; Bolotin, Bakayev, and

Bochkovskaya, 2018; Huzar, and Havrylchenko, 2001a). Against the background of the expressed physiological manifestations of overtraining, the often hidden, but very important psychological changes can be found, since the participation of athletes in competitions of various levels requires, above all, the internal stability of a man (Huzar, Shalar and Norik, 2014; Kozina, Slyusarev, and Volkov, 2004). Achievement of high sports indexes depends on the corresponding level of technical, tactical, physical and psychological training of athletes (Platonov, 2018; Zhanneta K., Irina S., Tatyana B., Olena R., Olena L., and Anna I, 2015 Huzar, 2000b). This statement is relevant throughout all sports. The central place of physical fitness is also determined by the fact that other aspects of athletes' preparedness (technical, tactical, psychological) are implemented simultaneously and to a large extent depend on the level of development of

motor abilities, physical development and functional capabilities of the athlete's body, which determines the content of physical training (Platonov, 2019; Huzar, 2001a; Huzar, 2000a). Direct physical training of handball players is one of the most important components in achieving sports results (Nesen, Pomeshchikova, Druz, Pasko, and Chervona, 2018; Strykalenko, Zhosan and Shalar, 2017; ZhL, K, 2004), but psychological training plays an important role in an athlete's sports career (Strykalenko, and Shalar, 2017; Zhosan, Strykalenko, and Shalar, 2014; Shalar, Zhosan, Shum, and Strykalenko, 2014). In modern sports, the requirements for the training of athletes are increasing. Without diminishing the importance of such components in the preparation of athletes, as physical, technical and tactical, it should be emphasized that the psychological component is no less significant. From the practice of sports activities, it is known that the results of an athlete's performance depend on such personal qualities as emotional and nervous-psychic stability, anxiety, aggressiveness, and others (Yakovlev, and Babushkin, 2016; Gryn, 2015; Ilyin, 2010; Weinberg and Gould, 1998). General psychological training is closely linked to the educational and ideological work of athletes. This is especially true of the formation of ideological beliefs, the cultivation of the personality traits. The program of psychological training should include events aimed at the formation of a sports character and positive interpersonal relationships in the handball team (Huzar, Shalar, and Mordiew, 2016; Shalar, Snopova, and Strykalenko, 2010). The research aim is to develop a methodology for assessing the pre-emergent psychological readiness of handball players and to determine the readiness for competitions with rivals of a different class.

MATERIALS AND METHODS

The research was conducted on the basis of the Kherson High School of Physical Culture. A female handball team of the Super League "Dniproanka" was involved in the research and included 15 handball players aged 19 to 32. Sports Masters of Ukraine were a contingent of the team. The research lasted for 3 years (2015-2017), took place in three stages, and was conducted in the form of observation, psychological testing, measurement of anthropometric data of athletes and conducting control sports standards. To assess the psychological properties of handball players, the method of L.V. Volkov "Estimation of the properties of the nervous system of athletes", the method of Ch. D. Spielberger - Yu. L. Hanina "Scale of reactivity: situational and personal anxiety" and the method "Self-assessment of the temperament structure" were applied to determine the properties of temperament. As for the definition of mental and pre-star conditions, the method of L.V. Volkov "Test questionnaire of the pretesting condition of an athlete" and the method of R. S. Weinberg-D Gould "Self-confidence" were used. Also, during our

research, the author's method "Diagnosis of the pre-start state of handball players" was developed. This technique included observing the external manifestations of certain attributes of athletes in the period that covered the time interval before the start of the competition, and directly during the competition. The components of this technique are as follows: a) sober confidence in their strength; b) the desire to fight towards the end to achieve a common goal and victory; c) the optimal level of emotional excitement; d) resistance to shocks; e) the ability to manage their actions, feelings, and behaviour. All data received during the process of monitoring the players was recorded in the protocol. Each component had to be assessed by the scale in 3 points, where 1 point was low, 2 points were average and 3 points were a high level of expression.

RESULTS

According to the results of evaluating the strength of the nervous system from the side of excitement, all players of the team "Dniproanka" had a high level. The strength of the nervous system from the side of the braking manifested itself at a high level of 80%, as well as indices of mobility related to nervous processes encompassed 93.3% of handball players. According to the second feature, it was found that the overwhelming majority, namely, 12 out of 15 athletes, were marked by the strength of the nervous system from the side of inhibition.

They are more calm and balanced during trainings or competitions. Among the three girls with low scores, who are also Masters of Sports aged 21-23 (a goalkeeper and two line players), there were periodic problems with distraction and mood change during exercise (Table 1). The personal anxiety of all handball players of the "Dniproanka" team is mostly moderate, except for 2 players - a goalkeeper - 23 years old, and a far right - 19 years old, who had a high level of personal anxiety.

They are Masters of Sports and played handball from 10-11, but in their game positions they are secondary numbers. Significant deviations from the level of moderate anxiety require special attention of the trainer, sports doctor and psychologist, because high anxiety involves the tendency of athletes to have obsessive thoughts about failure in future competitions. Situational or the so-called reactive anxiety at a high level was found only in one team player - he's also a goalkeeper - 23 years old and a Master of Sports. In this case, the coach who works with an athlete is useful to reduce the subjective significance of the competitive situation and the tasks of future activities, that is, to shift

the emphasis on understanding the process of its future competitive activities and the formation of an athlete's feelings of confidence and success on the basis of adopted tactical manoeuvres at the competitions, even if the opponents can oppose the athlete by doing something else.

This induces the athlete to think not about the outcome of the competition, but about their actions in the competition, which optimizes the level of his reactive anxiety (RA). In 9 handball players, there was a low pre-competition anxiety.

Low anxiety, on the contrary, requires increased attention to the motives of the activity and increased sense of responsibility of the athlete. According to the properties of temperament, it can be noted that in the "Dniproanka" team, most players, namely 60%, are extrovert. Introverts comprise 40%.

They are mostly goalkeepers. Rigidity and plasticity are in the ratio of 66.6% to 33.4%. Rigid athletes degrade the quality of the exercises in the competition, in comparison with training, not disturbing, emotionally non-excited and impulsive. More rigid handball players in the competition, on the contrary, show better exercises than during training.

Emotional excitability prevails over the balance – 86.6%. This is admissible because handball is a very impulsive, emotional and intense game. Therefore, players in the course of their sports career adapt and possess such skills. The reaction rate in 73.4% of the team is fast. This is characterized by the fact that these athletes have very good attention, a quick reaction to the ball, the opponent or other game aspects.

The activity is not very high. This is due to the fact that the test was conducted almost at the end of the game season, and the strength and activity of athletes have already weakened a little. The high sincerity of the answers to the test questions was found in 60% of the team, with 33.4% of average honesty, so you can generally trust the results of

this test. The assessment of the level of confidence in handball players was carried out in the form of an open questionnaire, which determined the following features: uncertainty, confidence, excessive confidence. Based on these findings, a high level of confidence was found in nine handball players out of fifteen.

These players have been doing sports, handball, for more than 10 years. Margaryta G. (a guard) and Tetyana K. (a goalkeeper) were second numbers in their playing positions, and seven other girls with high levels of confidence: Kateryna K. (a guard),

Anastasia G. (line player), Valeria K. (left half-median), Tatiana P. (far left), Alyona S. (a guard), Julia T. (far right), Tatiana Ch. (a goalkeeper) were the players of the main team. The highest level of confidence was noted by Margarita G. (88%).

She is a Master of Sports and a guard player. Six handball players had an average level of confidence. Basically, these are second-class players or young players. We also managed to identify two girls with an average level of over-confidence: Karolina S. (49%) and Maryna P. (35%).

These players are Masters of Sports, have not participated in high-level competitions, international competitions and played for the Ukrainian national teams. The insecurity of all "Dniproanka" team players was low.

This is evident, because the "Dniproanka" team in the handball tournament table among the Women's Super League teams took the third place, but had all chances to fight for a silver medal. Consequently, most players in the team had high levels of self-confidence, which is very important in the team sport.

The pre-start condition of handball players was evaluated in three components, namely: physical, emotional and cognitive. The test was conducted before the important game with the team "Carpathians" in Uzhhorod, therefore, the majority of players on the team had a sufficient level of mental status for all components (Table 2)

Table 1: Assessment of the anxiety level in handball players from HC "Dniproanka", Kherson

Level	Features	Personal	Reactive (pre-competition)
Low		-	60
Average		87	34
High		13	6

Table 2: Self-assessment of the pre-start state of Kherson HC "Dniproanka" handball players

№	Name	Physical (Ph)			Emotional (E)			Cognitive (C)		
		A	B	C	A	B	C	A	B	C
1	Anastasiya H.	20	80	-	20	50	30	70	30	-
2	Hrystyna G.	30	50	20	40	50	10	70	30	-
3	Margaryta G.	30	70	-	50	30	20	40	50	10
4	Valentyna D.	10	80	10	30	70	-	30	70	-
5	Kateryna K.	10	80	10	20	60	20	40	50	10
6	Valeriya K.	20	80	-	20	60	20	10	50	40
7	Anna S.	10	70	20	30	50	20	70	30	-
8	Tetyana P.	10	80	10	20	60	20	70	20	10
9	Maryna P.	40	50	10	50	30	20	60	30	10
10	Alona K.	10	90	-	60	20	20	40	60	-
11	Tetyana K.	10	80	10	40	10	50	60	40	-
12	Alona S.	30	70	-	50	30	20	50	40	10
13	Karolina S.	10	70	20	30	30	40	40	50	10
14	Tetyana Ch.	10	80	10	30	60	10	30	60	10
15	Julia T.	10	80	10	60	40	-	50	30	20

Notes: A - better than usual
 B - as always
 C - worse than usual.

According to the results of the conducted testing, we can say that all handball players of the HC "Dniproanka" were at an adequate level when it comes to the indicator of physical condition, because they evaluated their physical strength – "as always". As for the emotional component, the athletes showed different levels, namely: "better than usual" emotional component was felt by five handball players. They are set to play and set apart in actions and behaviour. The level "as always" was found in eight athletes, it is mainly handball players of the main team. The state of "worse than usual" was felt by two handball players, a goalkeeper and a line player who, according to their game positions, have second numbers, so they were worried before the game a little more than others. The cognitive component of most team players is revealed to be at a high level. In 53.3% of the girls, this index was "better than normal", and 46.7% of athletes stated "as usual".

The state of "worse than usual" was not found in any of the handball players of the HC "Dniproanka".

DISCUSSION

Mental readiness for competitions as an athlete's position at a certain time may help or hinder the full manifestation and realization of all its capabilities in a particular competitions (Grin, 2015). According to G. Lozhkin, the component composition of mental readiness should include motivational, cognitive, professional, regulatory and behavioural components (Lozhkin, 2011). Another opinion is adhered by G. Babushkin, who believes that the athlete's readiness is determined by: sober confidence in their strength; the desire to fight

towards the end to achieve a common goal and victory; the optimal level of emotional excitement; resistance to shocks; the ability to manage their actions, feelings, and behaviour. (Yakovlev, and Babushkin, 2016). These features were taken into account when constructing the author's technique. To assess the level of the HC "Dniproanka" handball players' psychological readiness, the author's method "Diagnosis of pre-start condition of athletes" was applied to the competition. The study of psychological readiness for competitions in handball players of the "Dniproanka" team in games against the Super League teams of Ukraine was conducted during three games (Table 3). In the first game, the HC "Dniproanka" against "Econom-University", it was found that 35.7% of athletes had an average level of mental readiness, 50% had above the average, and 14.3% had a high level (Table 3). In our opinion, the indexes were adequate for this game. The "Econom-University" team, at this stage of the competition, was the outsider of the championship tournament table. For the Kherson team, there were no grounds for excitement, all the girls knew it well, but the responsibility for the outcome of the game still laid on their shoulders, so they were not allowed to give themselves a weakness. Infusion of team players was concentrated. All athletes dominated the optimal level of emotional excitement, before the game, the girls smiled and joked with each other and with the coach. There was a desire to fight towards the end to achieve a common goal and victory, so there was no thought about defeat.

The ability to manage their actions, feelings and behaviour did not hurt any of the athletes. However, in this game, there were obvious leaders. The right midweek player and part-time mainstream defender Daryna S. and right-wing far player Julia T. in this game were distinguished by a high level of mental readiness and their brilliant game. We can note that most team players had a sufficient level of mental readiness to compete against this rival, that is, athletes were in combat readiness, which is very important in games of this level. In the second game of the HC "Dniproanka" against HC "Real" (opponent equal in class), we found that 20% of the teams had an average level of psychological readiness for the competition and 80% had above the average. It is worth noting that these 80% are mainly players of the main team of "Dniproanka", those are the players responsible for the outcome of the match. They play almost all the game without a substitute, without fear, take on the initiative of the game, even making mistakes and listening to the displeasure of the coach, do not drop their hands and continue to fight for victory. The other 20% are second-class players and young players who compete to show them, first of all, the level of responsibility, as well as gain

experience and experience the "taste of the game" in adult competitions. This game was very responsible and, in turn, fundamental, because HC "Real", we can say, "was breathing down their neck" according to the results of the tournament table. The victory gave our team the opportunity to finally consolidate on the 3rd stage of the championship tournament table among Super League. The infusion of the team was highly focused. All athletes dominated the optimal level of emotional excitation, sometimes experiences were noted, but not significant. Before the game, the girls talked about the upcoming game, cheered with each other and consulted with the coach about the nuances of the game. There was a desire to fight towards the end to achieve a common goal and victory, because the price of the victory was high. Managing the actions, feelings and behaviour in some periods of the game was very difficult not only for athletes, but also for the coach, but they managed to remain cool and concentrated. It may be noted that most "Dniproanka" team players were in high combat readiness.

According to the results of the investigation of the third game of the HC "Dniproanka" against the HC "Galichanka" (the team of the highest class), 61.5% of the team players had an average level of psychological readiness for the competition and 38.5% had above the average. It is possible to note that the "Galichanka" team is an unattainable leader in the championship, playing with this team is always very difficult, athletes are experienced, played with each other to trivialities, the level of preparation for each of the players of the Lviv team exceeds the level of training of our players, and this is obvious, because their team repeatedly participated in international competitions, European Championships, Challenge Cup and Baltic League. A large group of players of HC "Galichanka" are representatives of national teams of the country, while we have much less of them. But it's nice to note that sober confidence in the forces of the team "Dniproanka" was at a sufficient level, so all players and coaches knew well that the goal of the team in this game was not to win at all costs, but to play no less than their strength, improve tactics of attack and defence, and give the chance to young players to show themselves. Therefore, the indexes of psychological readiness of the HC "Dniproanka" players for the competition are adequate for this game. The desire to fight for victory was found to be medium and low. The optimal level of emotional excitement and resistance to disturbing factors also manifested itself at an average level. But the ability to manage their actions, feelings and behaviour was at an adequate level. This suggests that athletes successfully completed the coach's advice. Achieving the full (high level) psychological readiness of handball players for the competition is difficult because of the fact that there are many young athletes in the team. Also, there is always dynamism when it comes to the states of mental readiness, namely: the transition from one level to another. Therefore, the higher the level of mental readiness, the more stable it becomes and, accordingly, the athletes in the competitions are better.

Table 3: Mental readiness for the competition of "Dniproanka" handball players in games against Super League teams of Ukraine

Team	Level	Low	Below average	Average	Above average	High
Econom- University, Ternopil		-	-	35.7	50	14.3
Real, Mykolaiv		-	-	20	80	-
Halychanka, Lviv		-	-	61.5	38.5	-

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In the second game of the HC "Dniproanka" against HC "Real" (opponent equal in class), we found that 20% of the teams had an average level of psychological readiness for the competition and 80% had above the average. It is worth noting that these 80% are mainly players of the main team of "Dniproanka", those are the players responsible for the outcome of the match. They play almost all the game without a substitute, without fear, take on the initiative of the game, even making mistakes and listening to the displeasure of the coach, do not drop their hands and continue to fight for victory. The other 20% are second-class players and young players who compete to show them, first of all, the level of responsibility, as well as gain experience

and experience the "taste of the game" in adult competitions. This game was very responsible and, in turn, fundamental, because HC "Real", we can say, "was breathing down their neck" according to the results of the tournament table. The victory gave our team the opportunity to finally consolidate on the 3rd stage of the championship tournament table among Super League. The infusion of the team was highly focused. All athletes dominated the optimal level of emotional excitement, sometimes experiences were noted, but not significant. Before the game, the girls talked about the upcoming game, cheered with each other and consulted with the coach about the nuances of the game. There was a desire to fight towards the end to achieve a common goal and victory, because the price of the victory was high. Managing the actions, feelings and behaviour in some periods of the game was very difficult not only for athletes, but also for the coach, but they managed to remain cool and concentrated. It may be noted that most "Dniproanka" team players were in high combat readiness.

According to the results of the investigation of the third game of the HC "Dniproanka" against the HC "Galichanka" (the team of the highest class), 61.5% of the team players had an average level of psychological readiness for the competition and 38.5% had above the average. It is possible to note that the "Galichanka" team is an unattainable leader in the championship, playing with this team is always very difficult, athletes are experienced, played with each other to trivialities, the level of preparation for each of the players of the Lviv team exceeds the level of training of our players, and this is obvious, because their team repeatedly participated in international competitions, European Championships, Challenge Cup and Baltic League. A large group of players of HC "Galychanka" are representatives of national teams of the country, while we have much less of them. But it's nice to note that sober confidence in the forces of the team "Dniproanka" was at a sufficient level, so all players

and coaches knew well that the goal of the team in this game was not to win at all costs, but to play no less than their strength, improve tactics of attack and defence, and give the chance to young players to show themselves. Therefore, the indexes of psychological readiness of the HC "Dniproanka" players for the competition are adequate for this game. The desire to fight for victory was found to be medium and low. The optimal level of emotional excitement and resistance to disturbing factors also manifested itself at an average level. But the ability to manage their actions, feelings and behaviour was at an adequate level. This suggests that athletes successfully completed the coach's advice. Achieving the full (high level) psychological readiness of handball players for the competition is difficult because of the fact that there are many young athletes in the team. Also, there is always dynamism when it comes to the states of mental readiness, namely: the transition from one level to another. Therefore, the higher the level of mental readiness, the more stable it becomes and, accordingly, the athletes in the competitions are better.

CONCLUSION

Athlete's mental readiness is an important component of the success of competitive activities. It represents one of the athlete's mental states which includes certain attributes: a sober self-confidence; the desire to fight to achieve the goal; optimal level of emotional excitement; noise immunity against knock down factors; the ability to manage their actions and behaviour. These features became the basis for developing the author's method for assessing the pre-competition psychological readiness of handball players. Due to the developed method and application of reliable psychological tests and questionnaires, the readiness levels of the HC "Dniproanka" handball players for competitions with rivals of different classes were determined. The dynamism of the handball players' psychological readiness for the competition did not decrease even with a very strong rival - the team of HC "Galichanka". That is, the achieved level of mental readiness can be considered sustainable and stable. This gives grounds for asserting that Kherson handball players are confident in their pre-start period, and during the competition they are persistently and fully capable of fighting to achieve the goal.

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PSIHOLOŠKA SPREMNOST IGRAČA RUKOMETA NA TAKMIČENJE

Spremnost sportista na takmičenje je obilježena nizom karakteristika (funkcionalnih, mentalnih, fizičkih, tehničkih i taktičkih, itd.) koje se očituju u svom jedinstvu. Cilj: utvrditi spremnost igrača rukometa na takmičenje sa protivnicima koji pripadaju drugoj grupi. Materijali i metode: istraživanje je provedeno na osnovu Srednje škole za fizičku kulturu iz Hersona. "Dniproanka" ženski rukometni tim Super lige je bio uključen u istraživanje, te se sastojao od 15 rukometnih igrača u dobi od 19 do 32 godine starosti. Sports Masters iz Ukrajine su bili kontingent tima. Istraživanje je trajalo 3 godine (2015.-2017.), provedeno je u tri faze, te je imalo oblik posmatranja, psihološkog testiranja i popunjavanja upitnika. Rezultati: istraživanje psihološke spremnosti na takmičenje rukometnog tima "Dniproanka" je provedeno tokom utakmica sa timovima Super lige iz Ukrajine, a koji se od njih razlikuju po pitanju atletskih vještina i iskustva. Prema tome, 35,7% igrača rukometa je imalo prosječni nivo mentalne spremnosti, 50% je bilo iznad prosjeka, a 14,3% je imalo visok nivo mentalne spremnosti tokom utakmice između rukometnog kluba "Dniproanka" i rukometnog kluba "Econom-University" (tim koji pripada nižoj grupi). Tokom utakmice protiv rukometnog kluba "Real" (tim koji pripada istoj grupi), 20% igrača je imalo prosječan nivo psihološke spremnosti za takmičenje, a 80% je bilo iznad prosjeka. Tokom utakmice protiv rukometnog kluba "Galichanka" (tim koji pripada višoj grupi), 61,5% rukometnih igrača je imalo prosječan nivo mentalne spremnosti za takmičenje, a 38,5% je bilo iznad prosjeka. Zaključci: postignuti nivo mentalne spremnosti se može smatrati održivim i stabilnim. Ovim se dokazuje da su igrači rukometa iz Hersona samouvjereni tokom perioda prije početka takmičenja, a tokom takmičenja su neprekidno i potpuno sposobni da se bore za ostvarenje cilja.

Ključne riječi: tjeskoba, uzbuđenje, inhibicije, emocije, samouvjerenost

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FACTOR ANALYSIS OF BIOCHEMICAL CHARACTERISTICS IN YOUNG SWIMMERS FROM BOSNIA AND HERZEGOVINA

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ABSTRACT

This research has the character of a transversal study with the aim to determine the biochemical characteristics of young swimmers belonging to the national team of Bosnia and Herzegovina, who have undergone a programmed training process for a long period of time. Seven blood parameters were analysed in the biochemical characteristics space: erythrocytes, leukocytes, lymphocytes, platelets, volume, sedimentation and haemoglobin which have been exposed in the previous period. For the first factor, leukocytes and sedimentation are taken together, they are monitored, which is logical and, in this case, they are positive. Although each swimmer should be individually monitored for a detailed analysis, however, it can generally be concluded that the indicators are, by what we can conclude, balanced and a conditionally expressed reflection of health. The second factor is much simpler because it is primarily defined by erythrocytes and almost equally by haemoglobin. That is, a factor that describes the buffering ability of the blood.

Keywords: young swimmers, biochemical characteristics, blood count, training process

INTRODUCTION

Many factors that affect swimming performance have been studied extensively in adults. Performance in swimming has been related to different anthropometrical, physiological, and biomechanical parameters. Specifically, maximal performance in swimming depends on the amount of metabolic energy (Cs) spent in transporting the body mass of the athlete and on the economy of locomotion over the unit of swimming distance. It has been reported that Cs varies largely from one swimmer to another, mainly depending on the specific anthropometrical and technical characteristics of the athlete (Jürimäe et al., 2007). The structure of the anthropological dimensions of swimmers should be viewed in relation to the very specific structuring of individual circuits, since it is obvious that these circuits are formed under the influence of numerous factors and in ways that are directly related to the methodical principles of

training (Voločanšek, B. 2002). Front crawl swimming velocity depends to a great extent on the swimming technique, the components of which are modified depending on the swimming distance. The swimming time ranges from 20 s in short-distance events to several minutes at long distances (Strzala M., Tyka, A., Krężałek P. 2007). In order to carry out a quality training process and develop a training plan and programme based on the individual needs of athletes, it is necessary to objectively, validly and reliably collect data on a number of factors upon which the athletic performance depends. The primary task of the trainer's methodical work with swimmers, that is, athletes in general, is manifested in his willingness to, at all times, manage the procedures related to planning and programming, selecting and applying methodical organizational forms of work, methodical procedures, dosing the volume and intensity of work, monitoring and evaluating the effects of work during swimmer training. Undoubtedly, the health status based on age and sex is significant, but the level of athletes' training and the type and duration of the physical effort are also important.

In addition, ruling out the potential contribution of illegal pharmacological assistance used in some sports by both professional athletes and leisure sports participants is difficult (Gajda et al., 2019). In order to get an answer to the question of why one should work with swimmers or more precisely, what are the effects of working with swimmers, including the part related to their immediate preparation for the competition, it is necessary to conduct continuous monitoring and evaluation of their work in order to direct the training process on the basis of the obtained results which is, in principle, the ultimate goal of this paper. Namely, in order to keep the necessary and possible influence of the training process under control and keep the overall training and competitive activity of swimmers within the limits of useful and efficient, constant and current feedback on those we work with is needed, which is impossible without professional and a constant review of their work and progress (Bonacin, D. 2006). This practically means that a systematic, comprehensive, realistic and objective evaluation of work and results is a basic condition for receiving not only feedback on how close each swimmer is to the defined goal and tasks of the program, but also what are the effects of the programme, that is, its work. Certainly, when it comes to assessing the effects of the work done by the younger categories, as in this case, this process requires an increased dose of sensitivity due to their still insufficient stability. Almost all physiological and biochemical processes in the human body are subject to change during and after physical activity, relative to the resting state. Haematology tests are used to understand the health status of athletes, and the stability of the haematological status is one of the key determinants of optimal competitive performance (Matković, B., Ružić, L., 2009). One of the aims of this paper is to analyse and describe the influence of the programmed training process for top young swimmers on the status of the blood picture based on the conducted research. The subject of this research are the selected biochemical characteristics of young swimmers, representatives of Bosnia and Herzegovina. The aim of the research is to determine the latent dimensions of the factor composition related to the blood picture, that is, the biochemical characteristics that have been treated by this research.

METHODS

The test was conducted on a sample of 10 (ten) swimmers, national representatives of BiH in swimming, participants of the national championship of BiH. The selected variables, in this study, hypothetically cover the space of biochemical characteristics, implying seven parameters of blood count: erythrocytes (KERI), leukocytes (KLEU), lymphocytes (KLIM), platelets (KTRO), volume (KVOL), sedimentation (KSED) and haemoglobin (KHEM). In accordance with the research issues, a systematic methodological approach was implemented,

using appropriate logical mathematical and statistical methods. For the purposes of this paper, the analyses involving factor analysis with orthoblique assembly were applied.

RESULTS

As we can see in Table no. 1, in the space of biochemical characteristics, that is, in the space of the blood picture with seven parameters: erythrocytes (KERI), leukocytes (KLEU), lymphocytes (KLIM), platelets (KTRO), volume (KVOL), sedimentation (KSED) and haemoglobin (KHEM), two latent dimensions are obtained, which are largely logical. For the first factor, namely, leukocytes and sedimentation are taken together, they are monitored, which is logical and, in this case, they are positive. On the completely opposite side are lymphocytes, which also have a high projection value on this factor, but with a negative sign. Logically, in normal situations, it would seem that these are healthy people. On the positive side, there are also platelets, which would also be logical since they are a part of the sediment, so this indicator would be attached via the fact that they belong to the sediment as such. It can generally be said that these are relatively healthy people who were in a very intense phase of preparation for the competition, but not immediately a few days before the competition. Therefore, it is quite possible that their total accumulation of energy and other conditions led to a specific structuring of the blood picture, which may not be as variable as we sometimes think. Although each swimmer should be individually monitored for a detailed analysis, however, it can generally be concluded that the indicators are, as we know now, balanced and a conditionally expressed reflection of health.

Table 1: A set of latent dimensions

Variable	1	2
KERI	-0.0385	(1.0000)
KLEU	(0.9401)	0.0538
KLIM	(0.8367)	-0.1279
KTRO	(0.5959)	-0.2676
KVOL	-0.1525	(-0.8375)
KSED	(0.9424)	0.0328
KHEM	-0.1232	(0.9593)

The second factor is much simpler because it is primarily defined by erythrocytes and almost equally by haemoglobin. This is quite simple because haemoglobin and erythrocytes are responsible for the transfer of oxygen, so this is a completely pure factor. On the opposite side is the negative value of the volume, and if the volume actually speaks to the total amount of non-plasma elements in the blood, then there should be a negative projection. Because, again, this means the same thing - that the viscosity is reduced, the density is lower, the flow rate is higher, and the blood's ability to transport oxygen with haemoglobin and erythrocytes is maximal. This, then, is a factor that describes the buffering ability of the blood.

Table 2: Orthoblique factor correlations

	1	2
1	1.0000	0.1644
2	0.1644	1.0000

The latest information in the biochemical measurement segment in (Table 2) tells us that we have two factors. The correlation between these two orthogonal shapes, therefore, is obliquely rotated and is relatively small, and we cannot call it significant, it is almost 90 degrees, which means that the two dimensions are relatively independent. Therefore, that which we might specifically call sediments, leukocytes, etc. on the one hand, and lymphocytes on the other is what defines the principle of a healthy person, while sedimentation and lymphocytes are found in different sexes, meaning that the organism functions well.

So this is one local blood count. The real blood picture that is more interesting to us in essence is the second factor that speaks about oxygen transport, and this is actually what we should be most interested in. But, we cannot ignore this first information (factor) as it is also interesting. In principle, in training, in the training methodology, first of all, we would be interested in the following, which is the second factor: What is the ability of the swimmer's transport system?

When we knew that it was okay to monitor haemoglobin and erythrocytes, it was global, and then we would go into detail as probably the first quality factor and quality. And that is, in principle, a healthy swimmer with a great ability to transport oxygen.

CONCLUSION

When it comes to changes of Hb levels during the pre-competition training, successful pre-competition training is the one that provides appropriate training loads to athletes, and helps them recover from fatigue and reach their potential in the competition. (Li et al. 2012). Success in swimming is determined by several factors: anthropological, functional as well as metabolic and biochemical characteristics, efficient biomechanical performance of movement in water, conative and cognitive characteristics, which ultimately should result in a valid work plan and programme.

A large number of haematological-biochemical studies have been carried out in the field of all sports and physical activities. Such research is of great importance because it provides an insight into an individual's health status, which may be impaired by intense efforts during the training process. As part of the projects carried out at the diagnostic centre of the Department of Sport and Health at the Faculty of Teacher Education, "Džemal Bijedić" University in Mostar, a number of tests have been conducted so far in the field of biochemical analysis in various sports, with top athletes. The sample of this research was 10 (ten) swimmers, national representatives of BiH in swimming, participants of the national championship of BiH in swimming.

This research was aimed at obtaining information on the biochemical characteristics of young swimmers conditioned by a programmed training process, based on blood count parameters. Blood makes up one-third of the extracellular fluid. The average blood volume in adults is about 5 L, which is about 7% of body weight. Approximately 60% are plasma and 40% are erythrocytes, but these values differ significantly in humans because they depend on gender, body weight and some other factors (Matković, B., Ružić, L. 2009). Several earlier studies on swimmers have shown that intensive training results in a decrease in haemoglobin and haematocrit levels, while in the pre-competition period, when training is lower in intensity, this level is higher. Top swimmers can have a haematocrit level of 40 - 42% without reduced circulating haemoglobin. The results of this study support this data.

In swimming, as with any physical activity, changes in the haematological status occur. Based on the analysis of the results obtained in this research, as well as on the basis of the analysis of some previous studies, changes were found in almost all blood cell types and subspecies. Changes in the number and volume of haemoglobin, which is of great importance in oxygen transport, have been reported. The number of white blood cells and their subspecies also showed a tendency for a certain type of change. These changes are caused by inflammatory processes in the athlete's body, possibly due to fever. The results of this study tell us that the first factor did not show a major impact on the result, and the second

is at the limit, which concludes that in some future research on this topic, more attention should be paid to the parameters of blood flow in training, to monitor the condition of the swimmer, that is, to see how,

due to certain elements in the periodization, he changes in this sense. All these parameters give the trainers valuable information, which can be of great importance to them when planning and programming the training activity.

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FAKTORSKA ANALIZA BIOHEMIJSKIH KARAKTERISTIKA MLADIH PLIVAČA IZ BOSNE I HERCEGOVINE

Ovo istraživanje ima karakter transverzalne studije sa ciljem utvrđivanja biohemijskih karakteristika mladih plivača reprezentacije Bosne i Hercegovine koji su podvrgnuti programiranom treningu duži vremenski period. Sedam parametara krvne slike je analizirano u prostoru biohemijskih karakteristika: eritrociti, leukociti, limfociti, trombociti, zapremina, sedimentacija i hemoglobin, a koji su bili izloženi u prethodnom periodu. Kada je u pitanju prvi faktor, leukociti i sedimentacija su mjereni zajedno, zatim praćeni, što je i logično, te su, u ovom slučaju, pozitivni. Iako bi svaki plivač trebao biti pojedinačno praćen kako bi se provela detaljna analiza, moguće je donijeti općeniti zaključak da su indikatori, prema onome što smo mi zaključili, izbalansirani i predstavljaju uslovno izraženu sliku zdravstvenog stanja. Drugi faktor je mnogo jednostavniji iz razloga što je prvenstveno definisan eritrocitima, te hemoglobinom u skoro jednakoj mjeri. Drugim riječima, to je faktor koji opisuje puferski kapacitet krvi.

Ključne riječi: mladi plivači, biohemijske karakteristike, krvna slika, trening.

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CONSTRUCTING AND VALIDATING A SPORT CONSUMER BEHAVIOUR QUESTIONNAIRE

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ABSTRACT

Objective: This study was conducted to make an instrument and determine the validity and reliability of sport consumer behaviour in sport for all. **Methodology:** 560 people participating in sport for all were selected through stratified random sampling. 21 questions were prepared by studying and collecting texts and articles related to sport consumer behaviour. To check the validity of questionnaire, content and construct validity were used, respectively, as well as the Cronbach's alpha as the method of test reliability. **Results:** After reviewing the results of validity, the questions whose content validity index was less than the acceptable limit were edited and necessary changes were done. Then, the process of validity was repeated until the desired level, content validity ratio, was gained in the value of more than 0.7. The results of exploratory factor analysis revealed three dimensions named as "participation frequency", "purchase intentions" and "media consumption". Then, confirmatory factor analysis showed that one of the items had a factor loading less than optimal range and thus, by eliminating that item, confirmatory factor analysis was conducted again. The results showed that all the items had the optimum factor loading. Finally Cronbach's alpha test was conducted and 0.857 was obtained, showing the appropriate reliability of tools. **Conclusion:** The current study provided a suitable instrument having good reliability and validity to assess sport consumer behaviour so that the scientific and research community of sport marketing could benefit from it to develop the sports industry.

Keywords: young swimmers, biochemical characteristics, blood count, training process

INTRODUCTION

Nowadays, countries in the world, especially the developed countries, are trying to promote public health through the development of public participation in sport and physical activity, as well as to benefit other advantages such as economic and social development. There is a lot of evidence about the known benefits of physical activity, however, various reports from all over the world represent a high percentage of disabled people. Physical activity is an essential part of public health (Malina and Little, 2008). Various studies also show that while the percentage of participants in the sport for all in most of the countries is increasing, significant development hasn't taken place in our country in spite of various sports organizations. According to the Federation of Sport for All, people's participation in public activities and sports is less than 20% (Sports for

All Federation of the Islamic Republic of Iran, 2014). Therefore, in addition to emphasizing the importance of physical activity in all age groups, it is necessary to encourage people to exercise. In this regard, sport marketing as a fledgling science that tries to study all topics related to sport products and services to meet the demands of customers and sport consumers looks for a better understanding of consumers and consuming behaviour (Fernandez et al., 2013). Despite the fact that sport is of great importance in reducing disease and crime and developing the overall health of the community, nowadays, it has gone beyond a physical activity, it has relatively developed in different countries so that sport is considered as a business and industry in most countries and governments consider sport as an important trade and industry along with other industries in the developed countries. In other words, it can be said that the development of sport for all will affect various industries and economic development (Hosseini, 2008). Consumer behaviour is a topic in its infancy. The first textbook on this subject was written in the 1960s,

although the source of this idea goes back to many years ago. For example Thorstein Veblen has spoken about the "Conspicuous Consumption" in 1899. At the beginning of the 1900s, writers began to debate how advertisers can use the principles of psychology. In the 1950s, the ideas of Freudian psychology became epidemic by motivation researchers and were used by advertisers. Although the need to study consumer behaviour was reorganized, this important subject wasn't materialized until announcing the marketing concept in 1950 (Mowen, 2012).

The marketing concept implies the idea that industry is a customer-satisfaction process rather than a good-producing process. It is not possible to predict a response to customers' needs and desires without access to knowledge and an understanding of consumer behaviour. Although exploring the current and future needs of clients is a complicated task, this is possible and accessible with the use of marketing research (Hawkins, 2006). Rowe et al. (2013) note that during the last twenty years, a majority of studies have been conducted in the field of championship sport, fans or entertainments and sport have been studied a little as an opportunity for people's participation and involvement in the participating mass of people and their consumption behaviour. This narrow focus of researches on participation of people provide opportunities for managers and researchers to have some considerations on how to increase participation in physical activity due to the high prevalence of inactivity (Henderson, 2009).

According to the definition, a consumer is an individual or an organization who purchase goods and services repeatedly or non-repeatedly or use it such as buying books, clothes, tickets for a sporting event, going to the cinema or the gym, buying a newspaper or visit web pages. Based on the above definition, a consumer is an organization or individual who buys goods and services for personal consumption or possession (Ranjbarian, 2013). Sport consumers constitute the core of sport marketing because the foundation of the science of marketing and consumer behaviour has been based on recognition of consumers and the ability to provide their satisfaction (Solomon, 2014). Sport consumers are those individuals or groups who purchase or use a variety of sport products and services, and based on the definition of sport marketing, this consuming can involve purchasing or using tangible goods such as sport shoes and shirts or intangibles like watching sports and Internet search in sports sites (Smith, 2008). Of course, most participants and volunteers in sports are sport fans too and they use various kinds of sport goods and services. It is the best reason to believe that sport consumer motivation is complicated. Division of sport consumption is easier than sport consumers. In fact, based on the various consumption sectors, it is clear that the motivations of supporters, spectators and sports fans are the most complex motives and needs to be further investigated. Consumer behaviour is influenced

by many internal and external factors. Although marketers cannot have any control over these factors, it does not mean that they are unaware of them. Sport marketers can find an effective way to help their clients find consumers by identifying the factors influencing consumer behaviour (Schwartz, Jason and Lafleur, 2013). One of the basic activities of sport marketing is encouraging people to participate in sport. Moreover, sport marketers are engaged in the marketing of sport equipment and clothing necessary to participate in sports. It can be imagined that sport participants constitute a huge and growing market in America and internationally (Shank and Lyberger, 2015). It is often difficult to measure the exact amount of the purchase. One way to solve this problem is to verify whether consumers have the intention to buy or not. Since the intention to buy is a replacement index, it can be an alternative to measure real buying or selling. Will is one of the strong preconditions for consuming. Purchase intention can be considered as a substitute for actual behaviour, in other words, actual consumption of the product.

However, it is clear that the planned behaviour and actual behaviour can be quite different (Smith, 2008). Using media can be considered as one of the growing factors in the sports industry. As Fernandez (2013) states, studies show that there are confusing attitudes and behaviours in sport consuming. As one person watches sport competitions on TV and the other one spends most of his time searching sport sites on the Internet, and the others follow it through reading newspapers and sports magazines. Sport marketers are trying to increase their audiences through various news media that include the press and television or cable networks and satellite (Dwyer and Drayer, 2010). Sport media has created unique relationships in sport marketing because traders can give importance to what they want to sell by help of the media and interest customers to the goods and services by advertising (Echenfelder and Lee, 2001). Following the development of sport in the world, different industries have been created to advance the professional level of sport activities, various competitions and championships. Among them, industrialists have taken many uses. Shoes, clothes, accessories, drinks and various sport supplements have been produced in response to the needs of consumers and, while providing this necessity, it has had economic and financial interests.

Nowadays, as the technology and information advance, we also see the distribution of science, news and sports events in a very fast mood that various media contribute to this issue, from various printed publications up to different sites, and all of them are trying to distribute news and sport events in which an interaction has been created

between sport and media. NabiZadeh (1994) studied different models of consumer behaviour in an article. He noted that, for accurate identification of consumer behaviour changes, three aspects of this issue such as economics, psychology and sociology, should be considered and each of the scientists and experts has a particular view about that. Finally, the comprehensive model of consumer behaviour based on economic, social and psychological factors known as Harvard-Shethmodel has been studied, though the model has been faced by criticism for lack of usability by scientists. Derakhshideh and Emad Zadeh (2012) studied attitudes and purchasing behaviour of young people and showed that the purchasing behaviour of young people showed a different kind of model of consumer behaviour, and they buy more based on intrinsic and extrinsic motivation rather than need. In an article, McDonald et al. (2002) studied several theories related to analysis of sport spectators and participants' behaviour in their sport marketing. He noted, in this study, the theories such as their beneficial effects, seek stimulation and stress, aggression and releasing of excitement, entertainment and wanting success for assessing the behaviour of participants and spectators.

Casper (2008), in a study about sport consumer behaviour, studied two factors of participation and purchase intentions and concluded that there is a significant difference in sport commitment based on age, a significant difference in the frequency of participation based on skill level and that there is a significant difference in intentions to buy based on income levels. Funk et al. (2012) showed that sports consumer motivation explains the variance more than 60% of the tournament, media consumption, wearing favourite team sports and sports products. Rowe, Shilbury et al., in a paper referred to the importance of study in the field of physical activity in communities, noted the lack of research in this area in relation to sports championship. Fernandez et al. (2013) revealed sports consumer behaviour in three structures of frequency of participation, the intentions of purchase and media consumption. It can be noted that studies about the evaluation of consumer behaviour and determining its structures are very limited or have no validity and acceptable reliability to be able to use in carrying out research on sport consumer behaviour cognition. As mentioned before, sport consumer behaviour, as a new scientific study, is going to develop and expand and assessment tools are required in this way to better understand consumers. Despite this issue, there is no standard questionnaire for it. While researchers knew this matter, they conducted this study in order to provide tools and questionnaires with acceptable validity and reliability and appropriate for the sport market environment, specifically sports for all.

METHODS

The aim of this study is applied and the nature of it is analytic-descriptive. The study population included all people participating in sport for all in East Azerbaijan province. To obtain a proper sample size, a pilot study was carried out and the sample size was determined as 560 on the basis of its variance by using statistical formulas. The collection tools of this study were researcher-made, ones designed based on the background and resources related to sport consumer behaviour. The methods of relative content validity (CVR), exploratory factor analysis, and confirmatory factor analysis were used to evaluate the validity of the questionnaire and Cronbach's alpha was used to assess the reliability of the test. SPSS21 and Amos21 software was used for statistical analysis. Initially, after reviewing the previous studies and all available literature related to sport consumer behaviour, a questionnaire containing 23 questions was designed by researchers, and after reviewing it again, two questions were eliminated.

Determining the validity of the questionnaire:

Two types of validity were evaluated to realize the validity of the questionnaire such as content validity and construct validity. The model Lawshe (1975) was used to determine the validity of the questionnaire, in this way the questionnaire was given to experts and they were asked to comment about each item on the judgment scale which has been determined. The group of experts and specialists should at least consist of 4 members (Walz et al., 1991), in which this questionnaire with the objectives and hypotheses of the study were given to 11 experts in sports management. The questionnaire submitted to a group of experts was designed with Likert scale at four ranks "no relationship, little is relevant, relevant, very relevant" by scoring from 1 to 4, and was given to experts and they were asked to comment about the relationship between items and the variables. The content validity ratio provided by Lawshe was used to quantify the votes of members of the expert group. The formula is as follows.

$$CVR = \frac{ne - \frac{N}{2}}{\frac{N}{2}}$$

In this formula: CVR - content validity ratio; Ne shows the number of assessors or judges and state that the intended item is essential or beneficial or a high correlation to the subject; N is the total number of evaluators or referees. According to Lawshe, content validity ratio for the sample of 11 must be greater than 59% so as to ensure the content validity of the

questionnaire (Polit et al., 2007). The content validity of each item was calculated by using the formula that ultimately all of the items earned higher coefficient and

were retained in the questionnaire. The results of content analysis regarding consumer behaviour items are shown in Table 1 below.

Table 1: Results of content analysis regarding consumer behaviour items

Items	CVR	Ne
1 - To what extent have you done physical activity and exercise in your lifetime?	0.64	9
2 - To what extent (hours) per week do you spend for exercise and physical activity?	0.65	9
3 - How much - how many times per week do you do physical activity and sport?	0.82	10
4 - To what extent do you do various physical activities and sports?	0.82	10
5 - To what extent have you experienced various sports?	0.82	10
6 - To what extent do you attend hiking conferences and sport?	1	11
7 - To what extent do you choose different places for physical activity and exercise?	1	11
8 - To what extent do you want to buy and use sports shoes?	1	11
9 - To what extent do you want to buy and use sports clothes?	0.64	9
10 - To what extent are you willing to buy and use sports equipment (balls, rackets, tables, sports benches, fitness equipment, sports glasses, etc.)?	0.82	10
11 - To what extent are you willing to buy and use sports drinks and dietary supplements?	0.82	10
12 - To what extent would you like to pay tuition to join a sports club?	0.64	9
13 - To what extent do you want to buy tickets for sporting events?	0.82	10
14 - To what extent would you like to buy printed magazines and newspapers?	1	11
15 - To what extent would you like to purchase posters, memorial and sports badges?	1	11
16 - To what extent would you spend to watch TV Sports programmes?	1	11
17 - How much time do you spend to search the online sports sites?	0.82	10
18 - To what extent do you spend your time to study published sports media (magazines, newspapers ...)?	0.82	10
19 - To what extent do you spend time to listen to radio sports programmes?	0.82	10
20 - To what extent do you go to arenas and stadiums to watch sporting events?	0.64	9
21 - To what extent do you spend time to surf the sports web with a mobile phone or tablet?	0.82	10

After confirming the content validity of the questionnaire, exploratory factor analysis was used in order to discover the components of consumer behaviour. The use of exploratory factor analysis of items was divided into three components. These three components explain 56.14 percent of the total variance. KMO index value equals to 0.72 and the significant level of Bartlett's test equals 0.001. Given that the KMO index is greater than 0.5 and significant level of Bartlett's test is less than

0.05, it can be concluded that the data were suitable for factor analysis and sampling adequacy is established. According to the content of questions as well as research literature, the obtained components were named as constructs of participation frequency, purchase intentions and media consumption, respectively. Components and their factor loading are shown in Table (2). Factor Loading of all the items is larger than 0.5. This issue indicates the high reliability of the component.

Table 2: Results of exploratory factor analysis of consumption behaviour items

Items	component		
	Participation Frequency	Purchase intentions	Media consumption
1 - To what extent have you done physical activity and exercise in your lifetime?	0.850	0.178	0.109
2- To what extent (hours) per week do you spend for exercise and physical activity?	0.835	0.081	0.126
3 - How much - how many times per week do you do physical activity and sport?	0.832	0.162	0.099
4 - To what extent do you do various physical activities and sports?	0.749	0.032	0.246
5 - To what extent have you experienced various sports?	0.648	0.299	0.297
6 - To what extent do you attend hiking conferences and sport?	0.553	-0.133	-0.087
7- To what extent do you choose different places for physical activity and exercise?	0.507	0.240	0.269
8 - To what extent do you want to buy and use sports shoes?	0.377	0.795	0.091
9 - To what extent do you want to buy and use sports clothes?	-0.038	0.786	-0.019
10 - To what extent are you willing to buy and use sports equipment (balls, rackets, tables, sports benches, fitness equipment, sports glasses, etc.)?	0.486	0.717	-0.051
11 - To what extent are you willing to buy and use sports drinks and dietary supplements?	0.374	0.701	0.192
12 - To what extent would you like to pay tuition to join a sports club?	0.134	0.669	0.454
13 - To what extent do you want to buy tickets for sporting events?	-0.005	0.659	0.428

14 - To what extent would you like to buy printed magazines and newspapers?	-0.072	0.616	0.457
15 - To what extent would you like to purchase posters, memorial and sports badges?	0.045	0.526	0.347
16 - To what extent would you spend to watch TV Sports programmes?	0.122	0.134	0.774
17 - How much time do you spend to search the online sports sites?	0.165	0.237	0.694
18 - To what extent do you spend your time to study published sports media (magazines, newspapers ...)?	-0.087	0.049	0.622
19 - To what extent do you spend time to listen to radio sports programmes?	-0.047	0.091	0.594
20 - To what extent do you go to arenas and stadiums to watch sporting events?	-0.136	0.023	0.570
21 - To what extent do you spend time to surf the sports web with a mobile phone or tablet?	0.468	0.047	0.543
KMO index		0.72	
Bartlett's test	Sig.= 0.001	df = 21	684.35
The amount of explained variance	$X^2= 56.14$		

Cronbach's alpha was used to test reliability. Cronbach's alpha for the whole questionnaire of consumer behaviour was 0.89, for the component of participation frequency is was 0.85, the component of purchase intentions amounted to 0.85, and for the component of media consumption, it was 0.77. Given that Cronbach's alpha coefficients are greater than the value 7.0 standard, it is concluded that the questionnaire has acceptable reliability (Table 3).

Research findings

The demographic profile of respondents was as follows: of the total sample, 37.9 percent were female and 62.1 percent were male. 52.3 percent were unmarried and 47.7 percent were married. Education degrees: 8.9 percent had a high school diploma, 14.3 percent had a diploma, 15.5 percent had an Associate Degree, 42.5 percent had a Bachelor Degree,

Table 3: Results of Cronbach's alpha

Variable	Number of items	Cronbach's alpha coefficient
Consumption behaviour	21	0.89
Participation frequency	7	0.851
Purchasing intentions	8	0.847
Media consumption	6	0.771

14.8 percent had an M.A. and 3.9 percent had PhD. When it comes to jobs, the results were: 29.3% were employed, 2% were retired, 9.1% were housewives, 25.7% were self-employed, 27.9 percent were students and 6.1 percent were unemployed. Sport skill levels were: 23.9 had beginner level, 49.3 had an average level and 26.8 were skilled. 12.9 percent exercise once a week, 25.7 percent exercise twice a week, 28.9 exercise three days a week and 32.5 percent exercise more than three days a week. The average age of respondents is 29.80, the minimum age is 13 and the maximum age is 58 years. After identifying the components of the questionnaire and confirming its reliability, the questionnaire was distributed among 560 people in order to check its construct validity and conduct a confirmatory factor analysis. Confirmatory factor analysis was used to check the validity of consumption behaviour. Factor analysis was conducted in the Application of Amos graphic. Consumption behaviour includes three components such as participating frequency in sports (items are shown with frequency), purchase intentions of consumer (items are shown with intention) and media consumption (items are shown with media).

The results are presented in Figure 1. According to the figure, we see that the factor loadings for all the items of the components consumer purchase intentions and media consumption are larger than 0.4 and they have sufficient validity to maintain in the measurement model. But, the sixth item, participating frequency in a sport (frequency 6), has factor loading equal to 0.38 which indicates that it should be excluded from the model. The item has been deleted and the calculated results have been presented in Table 4 and Figure 2. According to the figure, we see that the factor loadings for all the items of components consumer purchase intentions and media consumption are larger than 0.4 and they have sufficient validity to maintain in the measurement model. The results of the fit model are presented in Table 5. Fit indexes have three types such as absolute, adaptive and thrifty, and at least two cases have been reported of each of them. If at least three of the criteria are acceptable, it can be concluded that the model is fit enough. According to the Table, we see that the comparative fit index (CFI) is equal to 1.0, parsimonious normalized fit index (PNFI) is equal to 0.73, and the root mean square errors amount (RMSEA) is equal to 0.078 which represents the acceptable amount for optimal fit model. So, the construct validity of questionnaire was confirmed.

Figure 1: Factor loadings of items related to the consumption behaviour aspects

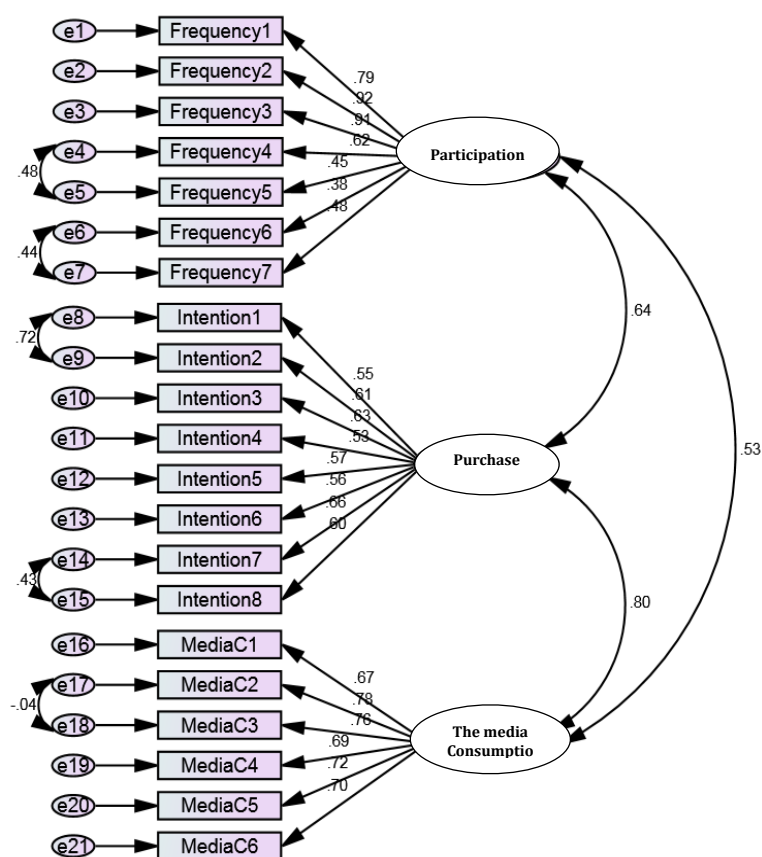


Figure 2: Factor loadings of items related to consumption behaviour after the removal of items with less factor loadings

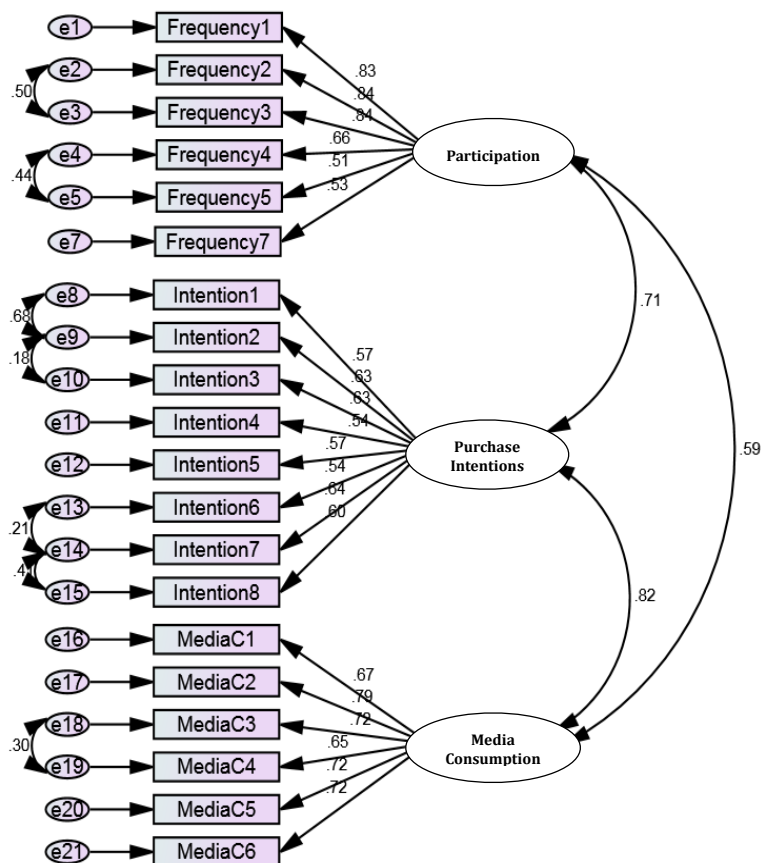


Table 4: Factor loadings of items related to consumption behaviour after the removal of items with less factor loadings

Independent variables (or items)	Dependent variable (or index)	Estimated coefficient	Estimated standard error	Critical ratio	Significance level	Standard Estimated coefficient
	frequency					
Frequency7	---> frequency	1			0.001	0.528
Frequency5	---> frequency	0.899	0.096	9.408	0.001	0.509
Frequency4	---> frequency	1.147	0.103	11.153	0.001	0.661
Frequency3	---> frequency	1.444	0.116	12.439	0.001	0.836
Frequency2	---> frequency	1.453	0.117	12.470	0.001	0.844
Frequency1	---> Purchase	1.349	0.108	12.468	0.001	0.826
Intention8	---> Purchase	1	0.071	15.395	0.001	0.600
Intention7	---> Purchase	1.090	0.094	10.406	0.001	0.637
Intention6	---> Purchase	0.979			0.001	0.544

Intention5	--->	Purchase	1.050	0.107	10.355	0.001	0.567
Intention4	--->	Purchase	1.111	0.097	11.592	0.001	0.539
Intention3	--->	Purchase	1.126	0.90	11.564	0.001	0.627
Intention2	--->	Purchase	1.036	0.093	11.767	0.001	0.625
Intention1	--->	Media	0.997			0.001	0.568
MediaC6	--->	Media	1	0.062	15.723	0.001	0.717
MediaC5	--->	Media	0.972	0.059	14.224	0.001	0.718
MediaC4	--->	Media	0.843	0.057	15.740	0.001	0.652
MediaC3	--->	Media	0.905	0.063	17.168	0.001	0.721
MediaC2	--->	Media	1.085	0.062	14.670	0.001	0.789
MediaC1	<--->	Purchase	0.913	0.027	80.027	0.001	0.668
frequency	<--->	Media	0.215	0.035	9.608	0.001	0.708
Purchase	<--->	Media	0.340	0.031	8.037	0.001	0.818
frequency	<--->		0.246			0.001	0.588

Fitting indexes of measuring consumption behaviour model

Interpretation	Criterion	Amount	Fitting indexes	
acceptable	Less than 5	5.21	CMIN/DF	Absolute
unacceptable	More than 0.05	0.001	p-value χ^2	
acceptable	More than 0.90	0.893	(VFI) Validity of the Fit Index	Comparative
acceptable	More than 0.90	0.868	(TLI) Toker-Luis Index	
Good fitness	More than 0.90	1.0	(CFI) Comparative Fit Index	
Good fitness	Less than 0.08	0.078	Root Mean Squared Error of Approximation (RMSEA)	Parsimonious
Good fitness	More than 0.05	0.73	Parsimonious Normal Fit Index (PNFI)	

DISCUSSION AND CONCLUSION

One of the important features of any scale in order to use it is to have reliability and validity of the test. This study provided designed tools that had validity and reliability for assessing sport consumer behaviour. The present study is one of the first studies that covered designing valid and reliable instruments in the area of sports marketing to measure sport consumer behaviour. As statistical analysis showed, the relative content validity (CVR), as a scientific method, is of quantitative type that could provide better content validity than the qualitative one and this method was not used in prior research. On the other hand, the exploratory factor analysis revealed three factors such as

“participation frequency”, “purchase intentions” and “media consumption” and the results were consistent with Casper and Fernandez. Frequency participation, as the first factor, correlates with six items; this factor has the ability to examine people’s participation actively in sports and physical activity as well. Purchase intentions, as the second factor, are correlated with eight items. This factor can check the intention of people to buy or use sport products and as a strong key prerequisite to purchase sport goods and services. The third factor, media consumption, is correlated with six items and it is capable to check the consumption of sport media. The fitting indexes of confirmatory factor analysis revealed that the Comparative Fitting Index (CFI) is equal to 1.0, Parsimonious normalized fit index (PNFI) is equal to 0.73 and the Root Mean Squared Error of Approximation (RMSEA) is equal to 0.078 which

represents acceptability of this amount for optimal fitting model. The tool has good construct validity. Checking the reliability, Cronbach's alpha were obtained respectively for the whole questionnaire consumption behaviour in the amount of 0.89, for many sub-components in the amount of 0.85, purchasing intentions in the amount of 0.85 and for media consumption in the amount of 0.77. In other words, the coefficient Cronbach's alpha for the subscales of the questionnaire showed good internal consistency within the questionnaire of consumer behaviour indicating that the designed measurement tools are accurate. Different types of consumer behaviour in many ways in sport can be seen and it can be studied that these behaviours are developing with the development of human societies and technological progress. Therefore, it is necessary to have a new attitude at each time period. As mentioned in the literature review, few studies have been done in this regard and no study has been done in the country and only two pieces of research which implicitly addressed it are found abroad. Casper et al. (2008) have covered only two structures such as purchasing frequency and consumption intentions in their study. Their tools have been reported as having no reliability and no validity. It is the same with Fernandez et al. (2013) who have specified three factors such as participation frequency, consumption intentions and media consumption to measure sport consumer behaviour, but their tools have been reported as having no reliability and no validity. The number of questions for assessment were very limited. In the case of the studied little structures in the research of Casper and his colleagues, it can be referred to the

emergence of new technologies which did not exist until a few years ago; the factors like media which is rapidly developing every day that were available a little or that had not yet been introduced at that time; the use of internet, tablets and smartphones are examples of these improvements. However, in another study by Fernandez et al. (2013), this gap is partly filled, but the need for further studies to construct and validate a questionnaire was still felt. This study is included in the first pieces of research that have used standard statistical methods like the content validity estimation (quantitative) and exploratory factor analysis and confirmatory factor analysis through a comprehensive study of history and literature related to consumer behaviour. The major advantage of the studied questionnaire is the use relatively comprehensive methods and, in accordance with consumer behaviour sport for all, the use of quantitative and updated statistical methods in estimating its reliability and validity, and the results of this study indicate that the designed tool with good reliability and validity can be used in studies related to the field of sports marketing as well as researchers of sport consumer behaviour, managers and programme-makers can understand core marketing, i.e., sport consumer better and more accurately with the right tools. Of course, due to the dynamic market environment, amendments or revision will be necessary. It is suggested that this questionnaire should be tested in samples and different communities so that its suitability and reliability could be confirmed or likely reviewed.

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IZRADA I PROVJERA UPITNIKA O PONAŠANJU SPORTSKIH POTROŠAČA

Cilj: Ova studija je provedena kako bi se izradio instrument i utvrdila ispravnost i pouzdanost ponašanja sportskih potrošača u sportu za sve. Metodologija: 560 osoba koje su učestvovala u sportu za sve je izabrano putem stratificiranog nasumičnog uzorkovanja. 21 pitanje je pripremljeno proučavanjem i prikupljanjem tekstova i članaka vezanih za ponašanje sportskih potrošača. Kako bi provjerili ispravnost upitnika, koristili smo ispravnost sadržaja i konstrukcije pojedinačno, kao i Cronbach's alpha kao metodu pouzdanosti testa. Rezultati: Nakon provjere rezultata ispravnosti, pitanja čiji je indeks ispravnosti sadržaja bio manji od dozvoljene granice su promijenjena, te su se izvršile potrebne izmjene. Nakon toga, proces provjere ispravnosti je ponovljen sve dok željeni nivo, koeficijent ispravnosti sadržaja, nije dostigao vrijednost višu od 0,7. Rezultati istraživačke faktorske analize su otkrili tri dimenzije naziva "frekvencija učešća", "namjere za kupovinu" i "korištenje medija". Potvrdna faktorska analiza je zatim pokazala da jedna od stavki ima faktor opterećenja manji od optimalnog opsega, te smo, eliminišući ovu stavku, ponovno proveli potvrdnu faktorsku analizu. Rezultati su pokazali da sve stavke imaju optimalni faktor opterećenja. Naposljetku, test Cronbach's alpha je proveden uz dobijanje rezultata u vrijednosti od 0,857, što ukazuje na odgovarajuću pouzdanost alata. Zaključak: Ova studija je osigurala odgovarajući instrument sa dobrom pouzdanosti i ispravnosti koji se koristi za procjenu ponašanja sportskih potrošača kako bi naučna i istraživačka zajednica sportskog marketinga imala koristi od njega za razvoj industrije sporta.

Glavne riječi: ponašanje sportskih potrošača, korištenje sporta, sportski marketing, alati za procjenu potrošnje, sport za sve

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DIFFERENCES IN THE PERCEPTION OF PUPILS' PHYSICAL ACTIVITY AND PHYSICAL ABILITY IN RELATION TO THE TYPE OF SCHOOL

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ABSTRACT

The main goal of this paper is to determine the differences in perceiving physical activity the physical ability of students in relation to the type of school, what are the attitudes of children towards physical activity in primary schools, and the pupils' relationship with physical exercise. The study was performed on a sample of 160 students from V to VIII grades (ages 11-14), in two elementary schools of the Municipality of Travnik.

Based on the obtained results, it can be noted that, when it comes to the tendency towards physical activity, pupils from both schools exhibit a significantly high level of preference for physical activity, i.e., physical exercise. Therefore, when it comes to the perception of physical activity, statistically significant differences between the pupils of both schools have not been identified. When it comes to the perception of physical ability, it can be noted that a statistically significant difference between subjects was determined. When it comes to the urban school and the students' tendency towards physical abilities, it can be noted that the students attending this school exhibit a high level of preference for physical fitness. In suburban schools, the perception of physical fitness is at a significantly lower level compared to the subjects attending the urban school.

Keywords: perception, physical activity and personality, pupils, school, differences.

INTRODUCTION

Although the term sport originates from the Latin word *disportare* or *desportare*, which marked the relief after work, sport was not always tied to this term, but on the contrary, during its entire development it used different, and often completely opposite purposes. Also, the situation gets complicated by the fact that sport is only one of several aspects, i.e., the form in which physical activity is manifested. During the entire development, sport has, more or less, managed to develop through different strategies. Although its strategy was often a necessary evil and a consequence of different circumstances, it cannot be denied that it has managed to survive to this day and has become a global phenomenon. If looked upon throughout history, it can

be observed that, in the original human community, it was a strategy related to survival, then, during the old century, it was used for conquest, warfare and development of the body, and later used for the development of the spirit and a harmonious Man (Athens) in addition to entertainment and Leisure (ancient Rome). In the new century and during the modern age, sport was in the service of education, but also political regimes, and today, the strategy is changed again in order for it to continue to exist. (Berčić and Đonlić, 2009). No sports business can exist without sport, and still, no business can be considered as sport. This is a very important specificity of the sports industry, because it is a

fundamental activity that is very close to art. As long as sport and its philosophy come first, there will also be a sports industry. The moment the basic characteristics of sport disappear (uncertainty, excitement, lucidity, humanity, admiration, rivalry, etc.), the industry that accompanies it also disappears. Having all this in mind, it is necessary to develop proper awareness in the young generation about sport and physical activity. Its key role also extends into the field of active and regular physical exercise, as well as the necessity of sport in the value system of the pupils, thereby promoting a healthy lifestyle and nurturing physical, mental and emotional education (Mikić et al., 2011). Consequently, it is necessary to first reach out to the young generations' reasoning about the sport itself, to explore their occupation, and, only then, try to impose sport on the children in a non-violent way as a priority. Of course, not all children are athletes, and not all children will have the same attitudes towards physical activity. For this reason, we will consider the perception of primary school pupils' attitude towards physical activities and physical abilities, investigate what they think about it, and whether they have the need to engage in sports, physical activity, importantly, whether they are actively involved during the teaching hours of physical and health education. We are also interested in the differences between the pupils of the two schools (urban and suburban) when it comes to their attitude, i.e., the perception of physical activity and physical fitness. The main goal of this paper is to determine the differences in perceiving physical activity the physical ability of students in relation to the type of school, what are the attitudes of children towards physical activity in primary schools, and the pupils' relationship with physical exercise.

METHODS

The sample of respondents

The population that is the subject of this study are students from the fifth to the eighth grade of elementary school. The study was performed on a sample of 160 students from V to VIII grades (ages 11-14), in two elementary schools of the Municipality of Travnik.

- 1) two elementary schools are involved in this research. One school is located in the suburban area, while the other school is located in the city itself.
- 2) all pupils are clinically healthy, with no distinct morphologic deviations and damage to the locomotor system.

3) respondents regularly attend physical and health education classes.

4) respondents have the same conditions for engaging in physical activity.

Sample variables and description of the research
During the research, a questionnaire will be used as a test instrument, with two forms of questions: a) the parts related to the perception of preference for physical activity and b) the parts related to the perceptions of physical ability. Questions are asked in the form of an alternative choice, which means that, when completing the questionnaire, respondents choose between two opposing claims.

The questions relate to the active and inactive assertion. The respondent chooses between two claims and opts for the assertion which best describes his condition, and then the subject decides whether or not the selected claim is accurate or somewhat accurate. The parts are scored from 1 to 4, with the highest value reflecting positive and the lowest value reflecting a negative perception of physical activity, ability or tendency towards physical activity.

This means that the selected active claim is scored with a value of 3 (somewhat accurate to me) or 4 (completely correct for me), and the negative one is scored with a value of 1 (completely incorrect for me) or 2 (somewhat incorrect for me). The respondent marks the selected claim with an X sign.

Data processing methods

Data processing was done in the SPSS programme and descriptive and comparative statistics are used for the obtained data. Descriptive parameters were made to analyse the current situation in schools, and comparative analysis was made to identify the differences between urban and suburban schools. When it comes to the mean value, Median test and Mean are used. Mann-Whitney Test was used to determine the differences between the groups, in which, according to the criteria, the sample of respondents was divided into two groups.

RESULTS AND DISCUSSION

Variations in the perception of tendency towards physical activity versus school type

In (Tables 1 and 2), the differences in the applied sets of variables are presented when it comes to urban and suburban schools. The results show that there are no statistically significant differences in the variability of perceptions related to the tendency towards physical activity compared to the type of school.

Table 1: Mann-Whitney Test - Perception of physical activity

Descriptive Statistics					
	N	Mean	Std. Deviation	Minimum	Maximum
I'm anxiously expecting to be playing a motor school game. I'd rather do something else.	160	3.19	1.025	1	4
I really like playing motor games. I don't like to play motor games.	160	3.30	.996	1	4
I have a good time during sporting activities. Sports activities are not very entertaining.	160	3.51	.824	1	4
I'm really enjoying the sport. I don't like to play sports.	160	3.48	.868	1	4
I like to play motor games outside. I'd rather read books or play video games.	160	3.22	.995	1	4
I like to play motor games outside. I like to observe games that are played outdoors.	160	3.38	.860	1	4
During my school vacation, I like to play motor games. I like to spend my school vacation in peace.	160	2.56	1.153	1	4
I like to play motor games. I like to read books or play peaceful games.	160	3.30	.917	1	4
I like to play motor games on weekends. On weekends, I like to relax and watch TV.	160	2.90	1.193	1	4
Groups	160	1.50	.502	1	2

Table 2: Mann-Whitney Test - Perception of physical activity

	I eagerly await playing a motor game after school. I'd rather do something else.	I really like to play motor games. I don't like playing motor games.	I have a good time during sports activities. Sports activities are not really fun for me.	I really enjoy the sport. I don't like to play sports.	I like to play motor games outside. I prefer to read books or play video games.	I like to play motor games outside. I like to watch games outside.	I like to play motor games during school holidays. I like to spend school holidays in peace.	I like to play motor games. I like to read books or play quiet games.	I like to play motor games on the weekends. On weekends, I like to relax and watch TV.
Mann-Whitney U	3130.000	2785.000	2740.000	2769.000	3084.000	3165.000	2882.000	2885.000	3138.000
Wilcoxon W	6370.000	6025.000	5980.000	6009.000	6324.000	6405.000	6122.000	6125.000	6378.000
Z	-.261	-1.604	-1.909	-1.786	-.436	-.136	-1.123	-1.197	-.224
Asymp. Sig. (2-tailed)	.794	.109	.056	.074	.663	.892	.261	.231	.822

Based on the obtained results, it can be concluded that, when it comes to the tendency towards physical activity, students from both schools show a significantly high level of physical activity preference, i.e., physical exercise. Thus, when it comes to perceptions of physical activity, no statistically significant differences were found between the students of both schools.

Differences in variables of perceiving physical fitness in relation to the type of school

In (Tables 3 and 4), the differences in the applied sets of variables are presented when it comes to urban and suburban schools. The results show that there are statistically significant differences

in the variables: "I'm good at motor games." and "It's hard for me to play motor games", where the 1 - urban school group showed greater statistical significance, "It's easy to learn to play motor games." and "I have a hard time learning how to play motor games", where the 1 - urban school group showed greater value for statistical significance, "I'm good at physical and health games." and "Physical and health education games are difficult for me", where the 1 - urban school group showed greater value for statistical significance.

In suburban schools, perceptions of physical fitness are significantly lower than those in urban schools. When it comes to the perception of physical fitness, it can be stated that a statistically significant difference was found between the respondents.

Table 3: Mann-Whitney Test - Perception of physical fitness

Ranks				
Groups		N	Mean Rank	Sum of Ranks
I'm good at motor games. It's hard for me to play motor games.	1	80	88.63	7090.00
	2	80	72.38	5790.00
	Total	160		

	Total	160		
I easily learn to play motor games. I have a hard time learning to play motor games.	1	80	86.91	6952.50
	2	80	74.09	5927.50
	Total	160		
I think I'm the best in sports.	1	80	85.42	6833.50
I don't think I'm good at sports.	2	80	75.58	6046.50
	Total	160		
I'm good at physical and health education games. Physical and health education games are hard for me.	1	80	90.90	7272.00
	2	80	70.10	5608.00
	Total	160		
Usually, I will be chosen among the first to play motor games. I will be chosen among the last to play motor games.	1	80	83.02	6641.50
	2	80	77.98	6238.50
	Total	160		
I'm good at sports teams. I'm not good enough for sports teams.	1	80	83.78	6702.50
	2	80	77.22	6177.50
	Total	160		

Table 3: Mann-Whitney Test - Perception of physical fitness

	I'm good at motor games. It's hard for me to play motor games.	I easily learn to play motor games. I have a hard time learning to play motor games.	I think I'm the best in sports. I don't think I'm good at sports.	I'm good at physical and health education games. Physical and health education games are hard for me.	Usually, I will be chosen among the first to play motor games. I will be selected among the last to play motor games.	I participate well in sports teams. I'm not good enough for sports teams.
Mann-Whitney U	2550.000	2687.500	2806.500	2368.000	2998.500	2937.500
Wilcoxon W	5790.000	5927.500	6046.500	5608.000	6238.500	6177.500
Z	-2.466	-1.958	-1.451	-3.210	-.733	-1.008
Asymp. Sig. (2-tailed)	.014	.050	.147	.001	.464	.314

CONCLUSION

The study was conducted on a population of students from the fifth to the eighth grade of primary school. This research was applied to a sample of 160 students from the fifth to the eighth grades (ages 11-14) in two schools in Travník.

The main aim of this paper is to identify the differences in the perception of physical activity and physical fitness of students in relation to the type of school, what are the attitudes of children towards physical activity in primary schools, and the attitude of children towards physical exercise.

For the purpose of obtaining relevant data, a survey questionnaire was used as a test instrument, in two question forms: a) Parts related to the Perceptions of Physical Aptitude Subscale and b) Parts related to the Perceptions of Physical Aptitude.

The questions were asked in the form of an alternative choice, which means that, when answering the questionnaire, the respondents choose between two opposite statements. The questions relate to an active and inactive claim. The respondent chooses between the two offered claims and opts for the claim that best describes his or her condition, and then the respondent decides whether the selected claim is completely true or somewhat true for him.

Based on the obtained results, it can be concluded that, when it comes to the tendency towards physical activity, students from both schools show a significantly high level of physical activity preference, i.e., physical exercise. Thus, when it comes to perceptions of physical activity, no statistically significant differences were found between the students of both schools...

Concerning the perception of physical fitness, it can be stated that a statistically significant difference was found between the respondents. When it comes to the urban school and the students' tendency towards physical fitness, it can be stated that the students attending this school show a high level of inclination towards physical fitness.

In suburban schools, perceptions of physical fitness are significantly lower than those in urban schools. Today, scientific achievements indicate a significant impact of physical activity on the human body, that is, its health status and the ability to improve motor and functional abilities.

This research shows that primary school students have a significant perception of physical activity and physical fitness, which obliges us to pay considerable attention to creating lifelong exercise habits through the education of students in the field of physical and health education, in addition to health and physical fitness and socialization of children.

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RAZLIKE U PERCEPCIJI TJELESNE AKTIVNOSTI I TJELESNE SPOSOBNOSTI UČENIKA U ODNOSU NA VRSTU ŠKOLE

Osnovni cilj ovog rada je utvrđivanje razlika u percepciji tjelesne aktivnosti i tjelesne sposobnosti učenika u odnosu na vrstu škole, kakvi su stavovi djece prema tjelesnoj aktivnosti u osnovnim školama, te odnos učenika prema tjelesnom vježbanju. Istraživanje je obavljeno na uzorku od 160 učenika od V do VIII razreda (uzrast od 11-14 godina), u dvije Osnovne škole Općine Travnik. Na osnovu dobivenih rezultata može se konstatirati kada je u pitanju sklonost prema tjelesnoj aktivnosti da učenici iz obje škole iskazuju značajno visoku razinu sklonosti prema tjelesnoj aktivnosti, odnosno tjelesnom vježbanju. Dakle, kada je u pitanju percepcija prema tjelesnoj aktivnosti nisu utvrđene statistički značajne razlike između učenika obje škole. Kada je u pitanju percepcija tjelesne sposobnosti, može se konstatirati da je utvrđena statistički značajna razlika između ispitanika. Kada je u pitanju gradska škola i sklonost učenika prema tjelesnoj sposobnosti, može se konstatirati da učenici ove škole iskazuju visoku razinu sklonosti prema tjelesnoj sposobnosti. Kod ispitanika u prigradskim školama, percepcija tjelesne sposobnosti je na značajno nižoj razini u odnosu na ispitanike gradske škole.

Ključne riječi: percepcija, tjelesna aktivnost i sposobnost, učenici, škola, razlike.

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INTERVENTIONAL EFFECTIVENESS, THE ROLE OF PERSONAL - SOCIAL AND PHYSICAL ENVIRONMENT FACTORS ON EMPLOYED WOMEN'S PHYSICAL ACTIVITY

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ABSTRACT

Although active lifestyle is one of the main determining factors of health, the amount of regular physical activities in women is less than in men, and even this amount decreases with aging. The main purpose of the present study was to investigate the interventional effectiveness, the role of personal - social and physical environment factors among university-employed women. The research method was achieved based on semi-experimental methods, including two groups consisting of the control and intervention ones, along with pre-post test measurements. The number of the population was about 160 women from Shabestar city university employees as the research sample in this study, and they were also categorized into two groups consisting of control (80) and intervention (80) ones, accidentally chosen in this study. The intervention group was achieved for eight weeks based on a socio-ecological pattern in one public session and 4 educational sessions in the form of a group discussion and daily jogging for 30min in this study. Healer jogging-measurement was applied in order to measure the objective physical activity and IPAQ international physical measurement was also used to measure the perceived physical activity. The related variables regarding the socio-ecological pattern were also measured by the use of socio-ecological pattern questionnaire. The covariance analysis, statistical tests and U-man and Whitney tests were also utilized to analyse the statistical data in this study. The results showed that the implemented interventional protocol of the related research led to change the main parts of the socio-ecological pattern in the intervention group. The degree of the light, moderate and intense physical activity had the highest significant increase in the intervention group compared to the control group in this study. In addition, the degree of the objective physical activity had the highest increase in the intervention group compared to the control group. Although there was not any significant relation among the model components' means in both the control and intervention groups ($p>0/01$), there was a significant relation among the components of socio-ecological model and the relation among the other structures. The components of the model including social support (132/8), self-efficacy (16/04), physical environment (96/4), perceived benefits (22/09), and perceived barriers (20/91) indicate that the final estimated mean in all the components in the intervention group is more than that in the control group. In general, the results indicated that the intervention based on the socio-ecological pattern approach could significantly influence the degree of university women's physical activity optimization process potential.

Keywords: physical activity, individual factors, environmental factors, employed women.

INTRODUCTION

Although active lifestyle is one of the main determining factors of health, the amount of regular physical activities in women is less than in men, and even this amount decreases with aging. Nowadays, contagious diseases are known as one of the biggest problems of the society. Coronary artery disease is the major cause of death in women. Statistics show that the number of deaths caused by heart disease in women will increase by 28 percent until 2016. It is estimated that a lack of physical activity is one of the main causes of diseases such as diabetes, breast cancer and colon rectal cancer, all over the world, and it causes 22% percent of ischemic heart disease. In today's world, almost half of the Americans and one third of European people have not met the suggested levels of physical activity. Therefore, improving the quality of lifestyle by increasing the amount of physical activity and preventing heart disease, which in turn, can cause a variety of individual, social and economic problems, is emphasized. Some of the benefits of physical activity include losing weight, maintaining the ideal weight, reducing the risk of heart disease and improving physical and mental health. For this reason, the importance of regular physical activity can be very effective to maintain the body, and this behaviour is one of the most essential factors out of the 15 factors in changing the health recovery behaviour and the scientific observations have shown that the physical activity can be very influential in all ages (2-3). In the results of meta-analysis conducted in 27 studies of the World Health Organization, it is shown that regular physical activity can be very effective to effectively reduce about 35-55% of cardiac infarction and physical activity can also decrease the rate of mortality. In 2014, the US Sport Medicine Faculty stated three to five physical activities per week, and this suggested time is very similar to the World Health Organization as the physical activity behaviour (4). New Zealand Health Organization has categorized physical activity, based on its intensity, in three levels: light, moderate and intense (5).

Physical activity is multi-factorial behaviour which can influence interpersonal, environmental and social factors efficiently (3-8-7-6). One of the most essential theoretical frameworks for perceiving the physical activity pattern is subjected to the social ecology as the main hypothesis being recognized by Glanz (9). The elements of this related pattern include interpersonal factors being effective in increasing and decreasing physical activity and these factors include the consciousness, attitude, obstacles and perceived resources, self-efficacy, comments and motivation, special sport and motor skills, disability and damages, age, gender, literacy, social-economical status and employment situation, and the social environment includes communication, culture and social factors that the person is related with others. This environment has a significant influence in physical activity. For example, a similar person can influence other people regarding the parents' physical activity

level, family support, partner, job location and social organizations, co-workers, accessibility to social support net instead of being socially detached. Physical environment can influence the degree and type of physical activity and this influence can also be positive such as accessibility to parks and sport facilitation and/or negative influence such as job location, schools and homes as the main restrictors for sport issues. Politics: this can influence the hidden regulations and policies efficiently; the policies such as legislations include those formal legislations which can be applied by the local government or the government as a whole. Also, it includes a series of informal local regulations which can be utilized in some establishments such as schools and job locations so that the strategies of implementing these policies will also be hard in optimising physical activity (9). The strength point of this pattern around the physical activity behaviour can help in recognising the related opportunities for optimizing, participation of physical activity and multi-factors in behaviour.

Any struggles for changing the periodical behaviour will be successful when the multi-levels influence is determined simultaneously. The carried-out studies have also shown that women have got less physical activity than men (11-12). The World Health Organization has reported that the degree of the lack of agility occurrence takes place for Iranian women in the ages between 15 and 64 (76.3%) (6). In a study, Cooli et al. (2011) carried out the estimation of sport participation among people who were between 20 and 79 years old in Canada and the results represented the fact that about 15% of adults in Canada have got 150min of physical activity (moderate to intense) and 5% have got 30min of physical activity (moderate to intense) per week. Men are more active than women; the lack of agility time for men is 68% and this is 69% for women. Total lack of agility for men is estimated to be about 575min and this rate is also anticipated to be 585min for women on a daily basis (13). Flori and Lee (2006), in a study about the physical activity of Afro-American women, showed that the social support from family and friends are the main motivational factors for achieving physical activity; in a week, about 150min has been allocated to these women and this has also been estimated as the lowest rate for fulfilling physical activity; having a sports partner is also one of the most crucial factors for doing sport activities (14). In a study led by Young and Stewart (2006) on women, it has been shown that the support from family and friends has made a significant influence on physical activity and social support has predicted the daily energy consumption significantly (15). In a study led by Coker et al. (2010), aiming at optimizing physical activity to reach 10.000 walks a day, using the socio-ecological pattern, it was shown that, in this

study, 79 people in the control group and 68 people in the intervention group were established; the physical environment interventions using the stairs instead of an elevator for increasing the number of walks are very effective; the results showed that, in general, the number of walks has reduced in comparison with the beginning of the intervention group, but this reduction in the intervention group was also lower than the control group. In other activities, based on the questionnaire, there was no observed significant difference in this case (16). Ishi et al. (2010) investigated the influence of the personal, physical and social environment factors based on the socio-ecological pattern framework using the structural equations among Japanese people ranging from 20 to 79 years old, and the results showed that the physical environment only has an indirect influence on physical activity through the social and mental factors, but the personal and social factors have also directly and indirectly influenced the physical activity.

This study has claimed that the intervention strategies have been used to optimize physical activity (8). Bakhtari et al. (2013), investigating the effective factors on the physical activity of women working in Tabriz University, have shown that the personal factors have got a direct influence, but the social environment has got an indirect influence on the physical activity of these women, and there is a direct relationship between social support and the degree of physical activity. 18% of the participants had light physical activity and 50% had moderate, while 32% had intense physical activity. Since women employed in those occupations have not got enough physical activity such as official employees and office-based affairs as well as boring jobs, the mental and spiritual affairs should be also allocated in this case (17). In our country, due to the special cultural context, studies have shown that more than 70-80% of Iranian people have not got enough physical activity.

The report of the World Health Organization has claimed that the main reason for the lack of physical activity is subject to a change in jobs and lifestyle in developed countries and, the progression of technology has changed people so that they can achieve physical activity which has an impact on the physical activity of people. Hence, perceptions are the main factors for praising people to increase their physical activity; it is imperative to provoke people to pursue physical activity for increasing their body arrangement in this case. Having a healthy body along with a suitable healthy lifestyle as well as life welfare and mental and spiritual issues should be dedicated to all people in a society. Since most carried out studies have been achieved in the field of the effective factors on physical activities, it is not the only one of the most crucial

factors, but also the environmental, social and personal factors have to be carried out in this regard and that is why a study has been carried out aiming at investigating the effectiveness of an interventional cycle based on the socio-ecological pattern to efficiently optimize the physical activity of women working in Shabestar universities.

MATERIALS AND METHODS

This study is a semi-experimental type of study consisting of two interventional and control groups carried out on women working in Shabestar universities in 2015. The main purpose of the present study is to investigate the effectiveness of an interventional cycle based on the socio-ecological pattern on the degree of physical activity. The related population of the study includes all women working in Shabestar universities who have not got any chronic diseases in this regard. Additionally, these women are not pregnant in this study. The process of sampling is carried out in two phases. The first sampling phase is carried out as a cluster-accidental formation and the second phase is achieved by a non-probability sampling method as the available type of sampling in this study.

Among the population, 160 people are determined as the sample of the study. In order to determine the number of the sample, the early information based on Coker (2010), including the degree of F index for comparing the degree of the increase in the number of walks in both related groups using G-power software, is applied in every group and the number is estimated to be 68 people. By considering the degree of elimination, 5% of the sample volume, the population amounts to 80 people in every group in the beginning of the study and, in the end of the study, the number of the study participants is 76 people in the intervention group and 73 in the control group.

The data gathering tool includes the demographical information (age, height, weight, number of children, education, employment status, marital status, disease background, partner's job and education as well as regular participation in physical activity sessions).

The socio-ecological pattern questionnaire:

The perceived self-efficacy of the physical activity includes 18 questions led by Bendora (1997) with a LIKERT 4-point scale (18). The perceived benefits and the perceived obstacles in the questionnaire have 29 questions posed by Suchert (1987) with a LIKERT 4-point scale. For measuring the degree of agreement and disagreement of people there is an option of stating personal comments in this regard (19).

Social variables:

Salice et al. (1987) questionnaire has been applied in order to measure the perceived social support regarding physical activity in this study (20). In this questionnaire, 5 questions are established for friends and co-workers regarding physical activity during the last 3 months, with a LIKERT 5-point scale (never to always).

Physical environment variables:

Mojahed et al. 8-questions questionnaire with a LIKERT 5-point scale (2010) is applied in order to measure the availability to facilitations, security and environmental beauty (21).

Mental physical activity questionnaire:

The International Physical Activity Questionnaire IPAQ with 27 items in 4 fields including the physical activity related to the job, leisure times, going and coming home and performing the job at home has been also applied in this study to adjust the related items in this case. IPAQ measures all activities such as walking formation, moderate and intense activities for people during the last 7 days and one part is allocated to measuring the sitting position in this regard, and this has also been categorized based on the scoring protocol calculating personal physical activity. The degree of the total physical activity is measured based on MET consumptive index. The degree of one MET is equal to the degree of the energy consumption during the person's resting time. In this study, the obtained numbers of people from their metabolic values are applied as low (metabolic equality lower than MET-min/week 600), moderate (a combination of all walking activities, moderate and intense with MET-min/week 600) and intense (a combination of all walking activities, moderate and intense activities so that the total should be with at least MET-min/week 3000).

Walking measurement:

This aims at evaluating the physical activity as an objective using the Healer Model in this study. The related instrument is a simple electronical instrument 2*2 inches in size. This can be put on a belt or in a pocket showing the distance of the walks. Researchers have shown that the validity and reliability of the studies with Healer are acceptable. According to the manual programme of the Healer Model, people walking fewer than 7499 steps a day have been considered as low-agility people and people having 7500-9999 steps a day are moderate people, while people taking more than 10000 steps a day are the most agile people, taking the highest energy and being called energetic people (23). The validity of these instruments, achieving a study on 25 employed

women, with the application of Cronbach's alpha test for the self-efficacy structures in the values of 0.69 and the perceived benefits in the amount of 0.9, the perceived obstacles amounting to 0.9, social support with 0.84 value, physical environment amounting to 0.76 and the physical activity questionnaire with a value of 0.82 have been confirmed in this study, with the educational context subsequently designed and implemented in this case.

The members of the intervention group are categorized into six groups in order to make group discussions; a head-group is also selected for every group and this could help all sessions. For every group, 4 educational sessions and one public session have been designed and every session takes about 50min. The intervention approaches are aimed at employees to get familiar with the sessions and representation of all participants in this process in the first session. They also have to be familiar with the walking measurement for 8 weeks and conduct 30min walking sessions a day, as well as be familiarised with the way of registration and the benefits of achieving 10000 steps a day and the way of achieving the process of walking in this case.

All employees completed the consent and commitment form to achieve the walking process between 12 and 2 pm. The first session of the educational programme includes the attraction of the participants towards the implementation programme by making them conscious regarding the perceived benefits of physical activity and its side-effects as well as the lack of having sufficient physical activity, and then, they will be compared to decide about the physical activity behaviour. Subsequently, some lists have been given to these related participants to get confident about their self-efficacy for fulfilling the related tasks efficiently, and then they have to write all about the different conditions such as responsibilities, lack of time, having guests, travelling and holidays, other family problems as well as mental and spiritual disorders. In addition to taking daily half-hour walks, other activities can also be very effective for increasing the number of walks and this report of the participants can also successfully optimize the physical activity behaviour.

This will also make achieving 10000 steps a day easy for these participants and all these people have also been asked to divide their tasks into smaller parts in order to achieve the tasks easily in this regard. This perception and understanding of all employees can be potentially achievable. The third group discussion session emphasizing social support is one of the most essential targets

for changing the attitudes of these employees towards achieving physical activity, increasing their consciousness on the importance of the role ascribed to co-workers, family and friends in the optimization of the physical activity. The fourth group discussion session is also subjected to the physical environment, emphasizing the physical environment obstacles and the strengths of the same physical environment for achieving these tasks in the college-bound environment; discussion on simple behaviours can be very effective such as walking for half an hour, increasing the number of walks, going home by walking and the elimination of using an elevator. For the control group, without any interventions, a pre-test is conducted, and after 2-months, a post-test is conducted for all participants. Two-months after the end of the last educational session and 8 weeks of 30min walks in the interventional group, all questionnaires were gathered; all the related data used descriptive statistics (mean, deviation); a one-way covariance

analysis test is used for the interventional group, and the objective physical activity, U-men and Whitney tests are also applied to determine the difference in the degree of the mental physical activity, with the ANCOVA analysis test applied on the variables' difference scores.

RESULTS

The age domain of the investigated population ranges between 25 and 53 years of age with 5.44 ± 42.07 . Among them, 93.3% were married and 6.1% were single. 2.6% had a Diploma, 30% had AD, 61.7% had BA and 5.7% had MA. 93.5% of them had formal employment and 6.5% had informal occupations. Multi-variance analysis test was used to investigate the effect of the intervention protocol on the elements of the socio-ecological pattern. Due to the data on the difference in scores from the pre-test to the post-test of the two groups, the following results have been obtained in this study:

Table 1: Results of multi-variance analysis of the variables' difference scores

Elements	Total squares	df	Mean squares	F	Sig	Effect size	Statistical power
Social support	1537.05	1	1537.05	132.84	0.001	0.47	1
Self-efficacy	682.80	1	682.80	16.04	0.001	0.09	0.97
Physical environment	3072.34	1	3072.34	96.26	0.001	0.39	0.99
Perceived benefits	910.38	1	910.38	22.09	0.001	0.13	1
Perceived obstacles	271.71	1	271.71	20.91	0.001	0.12	0.99

According to Table 1, the statistics F is significant on the ecological pattern as follows: social support (132.84), self-efficacy (16.4), physical environment (96.26), perceived benefits (22.09) and perceived obstacles (20.91). All of these variables are significant in 0.01 significance levels showing that there is a significant difference between the two groups regarding the related elements.

According to Table 2, the mean difference data of the intervention group is higher than the control group regarding the socio-ecological elements. Due to the F test, all these changes are significant.

It can be also claimed that the carried-out interventions based on the socio-ecological pattern can increase the socio-ecological elements. One-way covariance analysis test is also used in order to determine the effect of the intervention based on the socio-ecological pattern on the objective physical activity of participants and the results have been given as follows in Table 3.

According to Table 3, the regression slope is confirmed. In Table 4, the results of covariance analysis have been given. According to Table 4, the statistics F of the objective physical activity in pre-test is 5987.04 and this is significant in 0.001 levels showing that there is a

significant difference between both related groups. The mean of the intervention group regarding the objective physical activity is 55200.87 which is higher than the control group with 29624.26. Also, according to the tables, the effect size shows that the participation of the interventional programmes based on the socio-ecological pattern can represent about 97% of the objective physical activity.

The power of the test is also one that it is higher than 0.70, representing the sufficiency of the sample volume in this case. U-men and Whitney tests are also applied in order to investigate the interventional effect based on the socio-ecological pattern on the degree of the participants' mental physical activity and the results have been given in Table 5 as follows:

Table 2: Estimated means to finalize the socio-ecological elements in the groups

Elements	Group	Mean	Std. error
Social support	Control	0.13	0.38
	Experimental	6.31	0.37
Self-efficacy	Control	-0.15	0.76
	Experimental	4.13	0.75
Physical environment	Control	-0.45	0.66
	Experimental	8.63	0.65
Perceived benefits	Control	0.06	0.75
	Experimental	5.01	0.74
Perceived obstacles	Control	-2.23	0.42
	Experimental	-4.93	0.41

Table 3: Investigation of the convergence of pre-test and post-test regression slope of the objective physical activity in both related groups

F	Sig.
1.26	0.26

Table 4: results of a one-way covariance analysis in the intervention and control groups and the degree of the objective physical activity

Total squares	DF	Mean squares	F	Sig.	Effect size	Statistical power
24031487611.2	1	24031487611.2	5987.04	0.001	0.97	1
586031128.8	146	4013911.8				

Table 5: results of the U-men and Whitey tests used to determine the difference in the degree of the mental physical activity in both related groups

	Light physical activity	Moderate physical activity	Intense physical activity	Total physical activity
U-men and Whitney	644.50	769.00	1966.00	842.00
Wilcoxon	3345.50	3470.00	4667.00	3543.00
Statistics Z	-8.68	-8.17	-3.09	-7.71
Sig. level	0.001	0.001	0.002	0.001

The results of U-men and Whitney tests used to investigate the difference between both related groups included light physical activity (644.50) with statistics Z (-8.68), moderate physical activity (769.00) with statistics *Z (-8.17), intense physical activity (1966.00) with statistics Z (-3.09), and

the total physical activity (842.0) with statistics Z (-7.71); these are all significant in 0.01 levels. Thus, the research hypothesis based on the intervention effect and the ecological pattern theory is confirmed on the degree of the mental physical activity among employed women.

DISCUSSION

The present study was a semi-experimental interventional study aiming at the investigation of the effect that the educational interventional period based on the socio-ecological pattern has on the degree of physical activity in women employed at Shaebstar universities. After the educational intervention and daily 30min walking for 8 weeks, the results of the study in the mean intervention group, in the degree of the objective physical activity by walking measuring (55200.87) is higher than the control group (29624.26). The difference is also significant and the mean numbers of the steps taken by the intervention group (in the beginning of the study 4204 steps and 7882 steps in the end) is significantly increased, but this has not been significantly increased in the non-interventional group. The mean number of steps in the present study was established in a level lower than that of the other studies carried out on Iranian males (9339±607) (24). Studies investigating the physical activity of college-bound employees in Australia show that the participants reached 8832 steps per day. In the UK, the number is 9007 steps per day (25), and in Spain, it is 9584 steps a day. This shows a clear difference compared to the mean steps of women working in Shabestar universities and the main

reason may be subjected to the tasks and conditions of all participants and their cultural status. The mean number of steps taken by people having fewer than 7499 steps is increased significantly and it is coincident with the present study. In the present study, the number of under-study group walks was really low and the intervention group could increase the number of their walks towards the end of the study which is also adaptive with the results of the present study (16). In a study led in Catalan University, the results do not coincide with each other and the reason may be subjected to the context of the intervention programme, tasks and conditions of all participants. On the other hand, the researchers of the study claimed that the consciousness of participants in Catalan University was really established in a low level regarding the benefits of the walking process. Hence, walking based on the Healer measuring programme can be considered as a very effective instrument for helping women increase their physical activity in this case (26). The results of the study showed that, before the intervention, there was no significant difference between the groups regarding the degree of physical activity, but after the related intervention, there was a significant difference between the mental physical activities of participants in both related groups. Due to the difference in the mean rates, it is specified that the degree of physical activity in the intervention group is 7632, being significantly higher than the non-intervention group (3543).

In the present study, the intervention group light physical activity ranges from 12.2 to 0, the moderate level ranges from 57.4 to 51.8, and the intense group ranges from 30.4 to 48.2 which is optimized in this regard. The study of Bakhtari et al., conducted in Iran, showed that about 18% of the participants had light physical activity, 50% had moderate and 32% also had intense physical activity which coincides with the results of the present study (27). Since women working and employing in those jobs do not have enough physical activity, they will have the lowest degree of physical activity, being wrecked in terms of spiritual and mental issues (11). Different studies have shown about 3% to 36% reduction of women's physical activities and this has been shown in the studies of Mark Veden. The reason for this difference can be seen in the target group of the study and the type of variables. Also, the age can be considered as the greatest reason for the related process. Different studies have shown that the increase of women's ages can negatively influence their physical activity issues. Of course, the lifestyle and industrialization of communities can also influence the degree of women's physical activities (15). The results of the present study also showed that the mean scores of the socio-ecological pattern elements are significantly related to the behaviour in the intervention group and this includes social support 132.84, self-efficacy 16.04, physical environment 96.26, perceived benefits 22.09 and perceived obstacles 20.91.

All these variables are significant in 0.01 levels which coincides with the results of Jalilian et al. The results of the present study showed that the support provided by friends and family has got a significant relationship with physical activity (28-29) and these results are coincident with the present study. The study of Solhi carried out on students in order to optimize their physical activity does not coincide with the results of the present study and the reason may be subjected to the age difference (30). The present study is coincident with the results of the study carried out on Afro-American women, showing that the perceived social

support is at a low degree among these women in comparison to women having the highest physical activity. Ishi et al. (2010) investigated the effect of the personal, physical environment and social factors based on the socio-ecological pattern framework using the structural equations among the Japanese ranging from 20 to 79 years old, and they showed that the physical environment only has an indirect influence on physical activity through the mental and social factors, but the personal and social environment factors have directly and indirectly influenced the same physical activities and this study coincides with the results of the present study. We have also observed a significant progression between the daily life and daily activities based on the socio-ecological pattern for optimizing the physical activity behaviour among women working in a college-bound environment. That is why, it is imperative to recognize the qualitative-based studies for eliminating all obstacles in the regular basis of the physical activity behaviour.

Study Restrictions

This study has been carried out based on a sample of women employed at Shabestar universities from East Azerbaijan Province in Iran. This can also be recoverable in other areas of Iran. Additionally, other female groups may not be housewives, and the main purpose of the study is subjected to the age domain ranging from 25 to 53 years of age, with higher education. This cannot be recoverable for other ages and women with a low level of education.

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EFEKTIVNOST INTERVENCIJE, ULOGA FAKTORA LIČNE - DRUŠTVENE I FIZIČKE OKOLINE U FIZIČKOJ SPOSOBNOSTI ZAPOSLENIH ŽENA

Iako je aktivan stil života jedan od glavnih faktora za određivanje zdravstvenog stanja, obim redovnih fizičkih aktivnosti kod žena je manji nego kod muškaraca, te se isti smanjuje starenjem. Glavna svrha ove studije je bila istražiti efektivnost intervencije, ulogu faktora lične - društvene i fizičke okoline kod žena zaposlenih na univerzitetu. Metoda istraživanja je postignuta na osnovu polu-eksperimentalnih metoda, uključujući dvije grupe koje su se sastojale od kontrolne i grupe koja je podvrgnuta intervenciji, uz mjerenja prije i poslije provedbe intervencije. Broj osoba koje su činile uzorak populacije u ovoj studiji je bio oko 160 žena zaposlenih na univerzitetu u Shabestaru, a koje su raspoređene u dvije grupe koje su se sastojale od kontrolne (80) i grupe koja je podvrgnuta intervenciji (80), te koje su nasumično izabrane u ovoj studiji. Grupa koja je podvrgnuta intervenciji je provedena u trajanju od osam sedmica na osnovu socio-ekološkog uzorka tokom jednog javnog sastanka i četiri obrazovna sastanka u obliku grupne diskusije, kao i dnevnog trčanja u trajanju od 30 minuta tokom ove studije. Healer mjerenje tokom trčanja je primijenjeno kako bi se mjerio cilj fizičke aktivnosti, a IPAQ - međunarodni upitnik o fizičkoj aktivnosti je također korišten za mjerenje zapažene fizičke aktivnosti. Odgovarajuće varijable u vezi sa socio-ekološkim uzorkom su također mjerene korištenjem upitnika o socio-ekološkom uzorku. Analiza kovarijanse, statistički testovi i U-man i Whitney testovi su također korišteni kako bi se analizirali statistički podaci u ovoj studiji. Rezultati su pokazali da je primijenjeni protokol intervencije za ovo istraživanje doveo do promjene glavnih dijelova socio-ekološkog uzorka u grupi koja je podvrgnuta intervenciji. Nivo blage, umjerene i intenzivne fizičke aktivnosti je imao najveći značajan porast u grupi koja je podvrgnuta intervenciji u odnosu na kontrolnu grupu u ovoj studiji. Nadalje, stepen objektivne fizičke aktivnosti je zabilježio najveći porast u grupi koja je podvrgnuta intervenciji u odnosu na kontrolnu grupu. Iako nije zabilježeno postojanje značajnog odnosa između aritmetičkih vrijednosti komponenti modela u kontrolnoj i grupi koja je podvrgnuta intervenciji ($p > 0.01$), zabilježeno je postojanje značajnog odnosa između komponenti socio-ekološkog modela i odnosa između drugih struktura. Komponente modela uključujući društvenu podršku (132/8), samoefikasnost (16/04), fizičko okruženje (96/4), uočene koristi (22/09), i uočene prepreke (20/91) ukazuju da je konačna procijenjena aritmetička sredina u svim komponentama grupe koja je podvrgnuta intervenciji veća od one koja je zabilježena u kontrolnoj grupi. Rezultati su općenito pokazali da intervencija zasnovana na pristupu socio-ekološkog uzorka može značajno uticati na potencijalni nivo optimizacije procesa fizičke aktivnosti žena zaposlenih na univerzitetu

Ključne riječi: fizička aktivnosti, individualni faktori, faktori okruženja, zaposlene žene.

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