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ORIGINAL SCIENTIFIC PAPER

A Comparative Study of Motor Ability between Elite Basketball Players from Different Regions

Velisa Vukasevic¹, Milena Mitrovic² and Bojan Masanovic²

¹Basketball Club Vizura, Belgrade, Serbia, ²University of Montenegro, Faculty for Sport and Physical Education, Niksic, Montenegro

Abstract

The purpose of this research was to describe the motor abilities of basketball players from the elite ranking of competition in Montenegro and Serbia, and to make a comparison between them. The sample included 48 participants divided into two sub-samples. The first sub-sample comprised 24 participants who were competing in the First Basketball League of Montenegro and the second sub-sample comprised 24 participants competing in the Serbian Super League. Standardized tests were used to assess motor abilities. For each variable, the central and dispersion parameters were calculated. The differences were determined using a t-test for small independent samples. The results showed that a significant difference was found for distance ball throwing, while no significant difference was present for the remaining variables. Therefore, the results indicate that Montenegrin basketball players have well-developed motor abilities and, in this characteristic, do not lag behind Serbian players.

Keywords: *basketball players, motor ability, different regions*

Introduction

At the end of 1891, Canadian physician and physical education professor James Naismith adapted several sport branches and formed a single unit, wrote simple rules and created a new sport: basketball. Throughout its history, it has become a globally popular sport that engages many people regardless of age, gender, race, or continent in which they live (Narazaki, Berg, Stergiou, & Chen, 2009; Masanovic, 2018). However, as a professional sport, basketball is characterized by the complexity and high tempo of the game (Dogan & Ersoz, 2019), as well as the dynamism, variability, and atypicality of the game characterized by rapid continuous reactions in all stages of the match (Trninic, Perica, & Dizdar, 1999; Saavedra et al., 2018). Such a complex activity can be realized only with the involvement of several factors. The set of factors on which the success of basketball depends are morphological characteristics, motor abilities, functional abilities and psychological characteristics (Narazaki et al., 2009). Numerous studies show that motor abilities are crucial for achieving sport results (Gardašević, Georgiev, & Bjelica, 2012; Popovic, Bjelica, Jaksic, & Hadzic,

2014; Sermahaj, Popovic, Bjelica, Gardasevic, & Arifi, 2017; Gusic, Popovic, Molnar, Masanovic, & Radakovic, 2017; Balaban, 2018; Arifi, Bjelica, & Masanovic, 2019; Gardasevic, Akpinar, Popovic, Bjelica, 2019). Motor abilities are those competences that contribute to solving motor assignments and condition successful movement, regardless of whether they have been acquired by training or not (Malacko, 2000; Bjelica, 2006a; Bjelica, 2006b; Gardasevic, Bjelica, & Corluka, 2018; Gjonbalaj, Georgiev, & Bjelica, 2018; Gardasevic & Bjelica, 2019). Analysis of the basketball game determined the structure of the most crucial motor abilities for basketball: speed, strength, precision, balance, flexibility and coordination (Karalejić & Jakovljević, 1998).

One of the most essential segments of the basketball game is the fast-paced abilities of basketball players, which include rebound and agility (Bjelica, 2005; Jakovljevic, Karalejic, Pajic, & Mandic, 2011; Masanovic, 2019). They allow basketball players efficient movement during the game and, in the equation of the specification, their contribution is as much as 30% (Berria, Bachir, Nour Eddine, & Adel, 2018). A factor that largely determines success in



Correspondence:

B. Masanovic
University of Montenegro, Faculty for Sport and Physical Education, Narodne omladine bb, 81400, Niksic, Montenegro
E-mail: bojanma@ucg.ac.me

basketball is explosive power, manifested in jumps, initial acceleration, rapid changes in direction, deceleration and passing (Delextrat & Cohen, 2009). Stamina is a essential ability that enables the generation of energy necessary for all kinds of muscular activities, i.e., is the basis of the so-called energy-motor preparation of basketball players (Valdés-Badilla, Godoy-Cumillaf, Herrera-Valenzuela, & Ramírez-Campillo, 2015). High aerobic ability ensures slower fatigue and faster recovery in short pauses during the game, while anaerobic ability is responsible for durability in repetitive high-intensity activities (B.R. Matković, B. Matković, & Knjaz, 2005; Bjelica, Popovic, & Gardasevic, 2016).

The main goals of this research were to determine whether there are differences in the level of motor skills between the players of the First League of Montenegro and the players of the Super League of Serbia, and to determine whether the players who perform in the First League of Montenegro have good motor potential, i.e., if their motor potential lags behind players from Serbia who achieve exceptionally excellent results at the most prominent international competitions.

Methods

The sample of respondents comprised 48 basketball players of senior age, who play in top-quality teams, divided into two sub-samples. The first sub-sample consisted of 24 basketball players who play in the First League of Montenegro, with an average age of 24.75 ± 4.24 years, while the second sub-sample consisted of 24 basketball players who play in the Super League of Serbia, with an average age of 25.08 ± 5.56 years.

For the assessment of the motor status, nine standard motor tests were applied, which in previous studies were determined to carry relevant information on the fitness condition of the basketball players (Karalejić & Jakovljević, 1998). Movement tasks have been chosen to cover all the essential

physical characteristics of an athlete and an ever-increasing topographic muscular region. For assessment of speed, a 20m-high start running test was used. For assessment of explosive strength, the following tests were used: distance ball throwing, vertical jump–Sargent, and standing triple jump. For the assessment of speed endurance, a 30-second sit-up test and push-ups were used. For agility assessment, 4×5m running test and T drill test were used, while durability was assessed using a suicide test.

Testing was done just before the start of the competition season. The condition for participation in the experiment was optimal psychophysical health, a minimum of five years of active training and playing, as well as having played 70% of the games in the previous season. Respondents volunteered to participate in the experiment, and they were also able to revoke their participation in testing at any time, but none of them decided to do so.

The data obtained in the research were processed using descriptive and comparative statistical procedures. For each variable, central and dispersion parameters were processed, as well as measures of curvature and elongation. Differences in the motor skills of basketball players in the First League of Montenegro and the Super League of Serbia were determined using a discriminative parametric procedure, t-test for small independent samples, with a statistical significance of $p < 0.05$. All statistical analyses were conducted using SPSS software version 20.0 (Chicago, IL, USA).

Results

In Tables 1 and 2, the basic descriptive statistical parameters of the motor skills of basketball players of the two countries are presented; the calculated values of the central and dispersion tendencies are as follows: arithmetic mean (Mean), standard deviation (Std. Dev.), variance (Variance), minimal (Min) and maximal (Max) values, coefficient of curvature (Skewness) and elongation (Kurtosis).

Table 1. Central and dispersion parameters of variables for the assessment of the motor abilities of basketball players from the First League of Montenegro (N=24)

Variables	Min	Max	Mean±S.D.	Var	Skewness	Kurtosis
20m high start running	2.87	3.65	3.24±.22	.05	.407	-.727
Distance ball throwing	16.70	22.20	18.97±1.53	2.35	.561	-.254
Vertical jump	47.00	65.00	58.21±5.68	32.26	-.676	-.675
Standing triple jump	6.50	8.45	7.61±.57	.33	-.620	-.512
Sit-up for 30s	29.00	42.00	35.67±3.75	14.06	-.077	-.944
Push-ups	6.00	23.00	14.33±4.64	21.54	-.254	-.783
4X5m running	6.00	8.00	6.97±.34	.12	-.858	1.479
T drill	8.50	10.20	9.08±.46	.21	1.068	.568
Suicides	25.81	30.50	27.62±1.25	1.55	.714	-.031

Legend: Min-Minimal value; Max-Maximal value; Mean-Arithmetic mean; S.D.-Standard deviation; Var-Variance; Skewness-Measure of asymmetry; Kurtosis-Measure of flattening

Based on the values of Skewness and Kurtosis, differences in the distribution of results are observed. Skewness has a positive sign in distance ball throwing and negative sign in 4×5m running, which indicates that these results are lower from the mean value, among the lower values. For other variables, according to the results of the skewness, we observe better results from the mean value, i.e., among the higher val-

ues. Kurtosis has a positive sign in just two variables (T drill test and running 4×5 metres), in which case the distribution of the results is leptokurtic, which means that there are more results accumulated around the distribution centre. In other variables, Kurtosis has a negative sign, so the distribution of results is platykurtic, and more results are accumulated in the tails of the distribution.

Table 2. Central and dispersion parameters of variables for the assessment of motor abilities of basketball players from Super League of Serbia (N=24)

Variables	Min	Max	Mean±S.D.	Var	Skewness	Kurtosis
20m high start running	2.81	3.62	3.20±.23	.05	.099	-.958
Distance ball throwing	16.00	21.10	18.09±1.31	1.72	.204	-.172
Vertical jump	52.00	73.00	60.50±5.37	28.87	.436	-.447
Standing triple jump	6.90	8.60	7.73±.46	.21	-.28	-.208
Sit-up for 30s	30.00	42.00	36.00±3.44	11.83	.098	-.602
Push-ups	7.00	28.00	15.46±5.82	33.82	.521	-.66
4×5m running	6.00	7.00	6.91±.36	.13	-.331	-.869
T drill	8.50	10.48	9.06±.52	.27	1.368	1.758
Suicides	25.71	31.52	27.92±1.55	2.40	.761	-.051

For the basketball players from the Serbian Super League, Skewness, and Kurtosis values also indicate differences in the distribution of results. Skewness shows a positive asymmetric in distance ball throwing, vertical jump, sit-up for 30s, and push-ups while showing a negative asymmetric distribution in the running 4×5 metres variables, which means that these results are lower from the mean value, among the lower values.

For other variables, according to the results of the skewness, we observe better results from the mean value, among the high-

er values. Positive Kurtosis, i.e., leptokurtic distribution, has only one variable (T drill test), which means that we have more results accumulated around the arithmetic centre. Other variables have negative Kurtosis and platykurtic distribution, and more results are accumulated in the tails of the distribution.

To determine whether there are statistically significant differences in the analysed variables of elite basketball players of these two countries, the statistical procedure t-test was applied (Table 3).

Table 3. Differences between the arithmetic means of the variables for assessing the motor abilities of basketball players of the First League of Montenegro (N=24) and Super League of Serbia (N=24)

Variable	Country	Mean±S.D.	S.E.	t-test	Sig.	M.D.
20m high start running	Montenegro	3.24±.22	.045	.571	.571	.037
	Serbia	3.20±.23	.045			
Distance ball throwing	Montenegro	18.97±1.53	.313	2.126	.039	.875
	Serbia	18.09±1.31	.267			
Vertical jump	Montenegro	58.21±5.68	1.159	-1.436	.158	-2.292
	Serbia	60.50±5.37	1.097			
Standing triple jump	Montenegro	7.61±.57	.116	-.768	.446	-.115
	Serbia	7.73±.46	.094			
Sit-up for 30s	Montenegro	35.67±3.75	.765	-.321	.750	-.333
	Serbia	36.00±3.44	.702			
Push-ups	Montenegro	14.33±4.64	.947	-.741	.463	-1.125
	Serbia	15.46±5.82	1.187			
4×5m running	Montenegro	6.97±.34	.071	.538	.593	.055
	Serbia	6.91±.36	.074			
T drill	Montenegro	9.08±.46	.093	.153	.879	.022
	Serbia	9.06±.52	.107			
Suicides	Montenegro	27.62±1.25	.254	-.739	.463	-.300
	Serbia	27.92±1.55	.316			

Legend: Country-Subsample affiliation; Mean-Arithmetic mean; S.D.-Standard deviation; S.E.-Standard error; t-t test value; Sig-Statistical significance; M.D.-Mean difference

Based on the values obtained with the t-test, it can be observed that there is a statistically significant difference in the variables of distance ball throwing, and it is in favour of basketball players who play in the First League of Montenegro. In other variables, there is no statistically significant difference in the level of motor skills between the basketball players of the First League of Montenegro and the Super League of Serbia at the level of significance $p < 0.05$.

Discussion

The results of descriptive statistics show that the players of both examined groups achieved roughly the same results in tests of motor abilities. Players who play in the First League of Montenegro have achieved better results in four tests, while in five tests they were slightly weaker than players of the Super League of Serbia. A statistically significant difference in favour of the players of the First League of Montenegro appears in the

variable of distance ball throwing, in other tests, a significant difference was not found.

If the results of players covered by this study are compared with the results of professional players from other European countries, we will note that they are generally equal with them or better than them. For example, professional players from Norway ran a distance of 20 metres at an average of 3.2 seconds (Shalfawi, Sabbah, Kailani, Tønnessen, & Enoksen, 2011), players from Croatia in 3.2 seconds (Milanović, Jukić, & Marković, 2004) while the basketball players from Super League of Serbia ran the same distance for the average time of 3.2 seconds, while the players from the First League of Montenegro in 3.24 seconds, which is very similar. We observe that the same group of professional players of Norway, although equal in running, in the values of the vertical jump is lagging much behind the players of the elite Leagues of Montenegro and Serbia. The height of the average Norwegian jump is 48.2 cm, which is considerably lower than the 60.50 cm of Serbian Super League players and 58.21 cm of players from the Montenegrin First League. Also, significantly lower results on the same test were achieved by professional Tunisian players with a 49.5 cm jump (Chaouachi et al., 2009). These results are far lower than those obtained by players in the NBA league, which measured the average value of a vertical jump of 72.9 centimetres (Hoffman, 2006), which is not a surprise given that it is the highest quality basketball league in the world. Something similar is seen in the T drill test for the evaluation of agility, where the average running result of players of the First League of Montenegro (9.06 seconds) and Super League of Serbia (9.08 seconds), is slightly higher than the result of the professional players from Tunisia, resulting in 9.7 seconds (Chaouachi et al., 2009), and players who play in the strongest league in Turkey, which is 9.25 seconds (Alemdaroglu, 2012). However, the players from the elite league of Bulgaria have accomplished a better result than all the mentioned groups. Their average running time is 8.52 seconds. Finally, regarding specific basketball endurance, players from both subsamples showed better average values in the suicide test, because the time of 27.6 seconds for players from the Montenegrin First League and 27.9 seconds for players from the Serbian Super League, is slightly faster than the average running time for players of Australia, which is 28.1 seconds (Bloomfield, Ackland, & Elliot, 1994).

The tests used in this study are good indicators of explosivity, speed and agility that are very important for success in basketball, due to the need to suppress the opponent, the short duration of the attack (24 seconds) and the constant change in the direction of running in relation to the position of the ball. Therefore, modern players must possess these characteristics at a very high level, as this is the only way to satisfactorily respond to the demands of the game (Popovic, Akpinar, Jaksic, Matic, & Bjelica, 2013; Masanovic, T. Bavcevic, & I.

Bavcevic, 2019; Gardasevic, Bjelica, Corluka, & Vasiljevic, 2019; Gardasevic, Bjelica, & Vasiljevic, 2019; Krespi, Sporis, & Popovic, 2019; Gardasevic & Bjelica, 2020). Based on the mentioned results, we can still conclude that players who play in the First League of Montenegro and the Super League of Serbia have high motor potential. The fact that the measurement was performed before the start of the second part of the competitive season certainly influences the results, and it is to be expected that the results during the competitive period would be far better.

The main goal of this research was to determine whether the players from Montenegro have good motor potential, i.e., are they lagging behind the players from Serbia in terms of motor abilities, who achieve significant results at the highest international competitions. The data of descriptive statistics show that the players of both leagues have approximate mean values of the analysed variables, which is not surprising because they are players of the highest quality teams of the mentioned competition in Montenegro and Serbia, where there is a high concentration of quality players. The results of the t-test showed that a statistically significant difference in motor abilities between basketball players of the First League of Montenegro and Super League of Serbia exists only in one of the tested variables, the throwing of the basketball ball from the chest, and that difference is in favour of the players from Montenegro. Based on all this, we can conclude that these are basketball players who show good motor potential, and that Montenegrin basketball players do not lag behind Serbian basketball players when it comes to motor abilities. This confirms the good process of selection and quality preparedness of the basketball players of Montenegro, that is, the good basic and specific motor abilities that are necessary for a successful training and competitive process. Based on that, we can conclude that the reasons why the selection and teams from Montenegro achieve lower results than the selection and teams from Serbia, should be searched for in some other parameters, which also determine the success in basketball.

Moreover, these results can serve as model parameters in estimated variables for other players of the same rank of competition in Montenegro and Serbia, as well as for comparison with results obtained in other similar studies. It should be noted that players who want to play successfully in the league where the highest quality of basketball is played must have the characteristics set by the standards for this sport, which of course is reflected in the motor quality that the players possess (Vukasevic, Mitrovic, Zivanovic, & Masanovic, 2019). Limitations of this study are the small sample of respondents (two teams from the top of the standings, two teams from the middle of the standings, and two teams from the bottom of the standings would be a representative sample).

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Multi-Functional Technical Devices for Improvement and Control of Athletes' Preparedness in Martial Arts

Olha Zadorozhna¹, Yuriy Briskin¹, Maryan Pityn¹, Serhiy Smyrnovskyy¹, Zoryana Semeryak², Ivan Khomiak¹ and Ivan Hlukhov³

¹Lviv State University of Physical Culture, Department of Theory of Sports and Physical Culture, Lviv, Ukraine, ²Lviv State University of Physical Culture, Department of Fencing, Boxing and National Martial Arts, Lviv, Ukraine, ³Kherson State University, Department of Medical and Biological Foundations of Physical Education and Sports, Kherson, Ukraine

Abstract

The present work studied specifics of technical devices for the improvement and control of athletes' preparedness in martial arts. Their use is aimed at the improvement of different sides of athletes' preparedness, including technical and tactical skills, and theoretical knowledge. The main advantage of the devices is the opportunity not only to develop sports skills but also to have operational feedback between the athlete and the coach or team partner in real time. Three multi-functional technical devices were created: "TTT", "Cube", and "Device for the technical training of fencers". Their efficiency was estimated with two pedagogical experiments involving 52 young epee and foil fencers (age 11-15 years) and 45 epee fencers (age 11-15 years). The results of the first pedagogical experiments illustrated that the use of "TTT" simulator enabled increasing the sportsmen's level of knowledge at 48.3%-145.5% ($p < 0.05$). The results of the second pedagogical experiments illustrated that the use of "Device for the technical training of fencers" enabled increasing the sportsmen's technical preparedness ($p < 0.01$).

Keywords: technical devices, knowledge, tactical skills, competition, preparedness

Introduction

The evolution of competitive activity in martial sports identifies changes in training systems (Alekseenko, 1970; Bychkov, 2006; Harmenberg, 2007). The current development of fencing, boxing, wrestling, judo and other sports could be characterized by the intensification of competitive activity, changes in competition rules, and the improvement of various aspects of the training of experienced athletes (Jean-Marie, 2008; Johnson, 2016, 2017; Chen et al., 2017). Current trends in martial sports illustrate that the winner of different competitions is the person or team who quickly and effectively introduces new scientific developments and appropriately responds to evolutionary changes in the sport by the correction

of individual aspects of athletes' training, including technical, tactical, and theoretical aspects (Matveev, 2001; Lisitsyn, 2015; Kriventsova, Iermakov, Bartik, Nosko, & Cynarski, 2017; Johnson & Kang, 2018; Briskin, Pityn, Zadorozhna, & Khomiak, 2018). Moreover, the high level of tactical skills is impossible without an extensive technical arsenal and the skills to perform technical actions in their application in competition. Technical training provides a platform for the further improvement of tactical skills and achieving a high level of technical and tactical skills (Tupeev & Bojko, 2010; Saenko, Ivanov, & Stepanenko, 2011; Ryzhkova, 2014). Thus, to achieve a high level of technical and tactical skills, sportsmen ought to use effective technical devices.



Correspondence:

O. Zadorozhna

Lviv State University of Physical Culture, Department of Theory of Sports and Physical Culture, Kostyushko, 11, Lviv, Ukraine

E-mail: ozadorozhna@ukr.net

Analysis of recent research and publications illustrates that researchers in martial arts have been focused on issues of technical and tactical training, physical skills and their indicators, psychological aspects of training, and the formation of special knowledge (Pityn et al., 2017; Lisitsyn, 2015; Kriventsova et al., 2017; Johnson & Kang, 2018). At the same time, various technical devices have been developed and implemented, a great many of which enable using modern interactive technologies for the formation of tactical thinking of athletes, based on the receipt of operational feedback between the athlete and the trainer/partner on a team in real time, which leads to the development of technical skills (Harmenberg, Ceci, Barvestad, Hjerpe, & Nyström, 1991; Shevchuk, 2009; Johnson, 2016); others are devoted to the control and improvement of physical skills. In recent years, methods of technical and tactical training aimed at improving motor actions and solving situational tasks of competitive activity have been invented (Saenko et al., 2011; Ryzhkova, 2014; Kriventsova et al., 2017; Velychenko & Zherdzinsky, 2017).

The generalization of the scientific results gives the opportunity to make a conclusion about the objective of researchers in using universal or multi-functional devices that allow solving a wide range of tasks simultaneously or sequentially (for example, to formulate relevant knowledge, skills and abilities, and to control them using the same tools).

Based on all the above, the objective of this study is dual. First, there is a need to develop new effective devices for the improvement of athletes' preparedness, especially technical and tactical. Second, all of these means should be multi-functional and allow controlling various parameters of preparedness and require a minimum amount of time to use them.

Methods

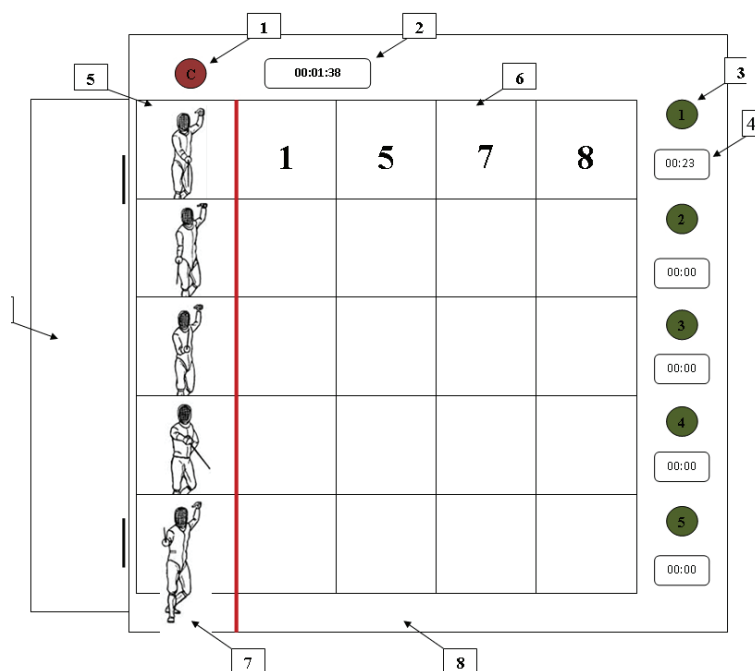
Our research included few stages and was devoted to devel-

oping and implementing several technical devices in martial arts. Theoretical analysis and generalization were used during work with literary sources on the problems of the research and identification of the main problems of technical and tactical training in fencing. A documentary method was used for the analysis of official documents of the International Federation of Fencing (FIE), the National Federation of Fencing of Ukraine, fencing programmes for youth and other documents.

Pedagogical observation was used to determine the arsenal of technical and tactical actions of highly experienced epee fencers. It was made by using official video of fencing bouts of FIE. One hundred bouts of epee fencers who took part in the World Cup, World Championships, and Olympic Games (seasons 2015-2016) were analysed. The scope and efficiency of technical and tactical actions were determined, taking into account ways of weapon control (in our paper, "weapon control" means the way of managing the weapon using two types of handles: a smooth one or a pistol grip). That information was used for constructing an experimental program.

Two surveys were also made. The first (2012-2013) was aimed at determining the significance of the formation of knowledge on different informational blocks (including technique and tactics) in fencing and the use of different methods for their study. The second (2015-2016) concerned the choice of weapons in epee fencing (epee with a smooth or pistol grip). Both surveys involved 40 Ukrainian fencing coaches. Their average experience was almost 15 years.

The next stage of our research included the development and implementation of several technical devices. The first one, the "TTT" simulator (Briskin, Pityn, Zadorozhna, & Smyrnovsky, 2014), was intended for enhancing the level of specialized technical and tactical skills of fencers, and improvement of tactical thinking and specific knowledge (Figure 1).



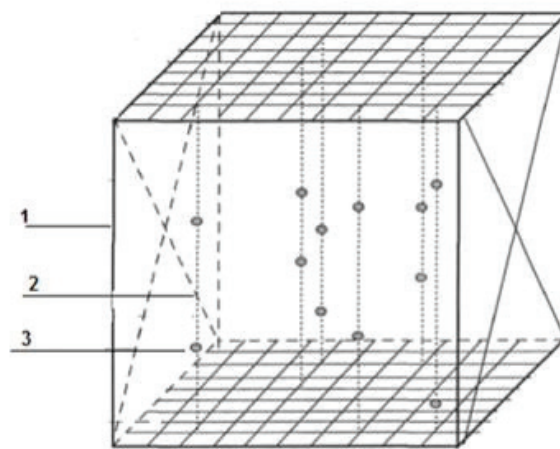
Legend: 1–The start button for a complex of tasks; 2–An indicator of the total execution time of complex tasks; 3–Stop button for completed tasks (each individually, only); 4–The time in the task (for each individual, only); 5–An image that is specified for the job (one for each task); 6–The image that selected by the athlete to respond to the task (one for each task); 7–Taskbar (estimated at 5 tasks images); 8–panel responses (generated by four possible answers to each of the five tasks); 9–The cover of the taskbar that lets you prevent premature perception of information from images

Figure 1. "TTT" Simulator

The “TTT” Simulator is a vertical platform with a task-bar (estimated at 5 tasks), the cover (which enables preventing premature perception information from images), panel of responses (generated for four possible answers to each of the five tasks), button to start a complex of tasks, an indicator of the total execution time a complex of tasks, a stop button for completed tasks (for each separately, only 5), time indicator of the task (for each separately, only 5). There are two sets of cards, one of which contains intellectual developmental tasks of technical, tactical and theoretical training in fencing, and the second the answers to them. The basis of the use of simulator is the assigned consistent solution of five intellectual tasks by choosing the correct options. The device can be used for a single training exercise or set of exercises in different types of weapons in fencing in the programmes of the Olympics Games and Paralympics Games. It could also be used for the

control of theoretical, technical, and tactical preparedness of fencers. However, in our research, it was used only for their improvement.

The second device, “Cube” (Briskin et al., 2014), was aimed at the control of technical and tactical preparedness of fencers by the use of a modular cube with sets of vertical rails and mobile roller targets, which were able to change location according to opponent's parameters (Figure 2). The fencer receives from the coach an algorithmic task that entails successively performing pricks in different sectors of the device that are located in line with the anthropometric characteristics and style of the opponent. The proposed device takes into account the anthropometric characteristics of opponents, bring the terms of training to conditions of real competitive activities, and controlling the technical and tactical preparedness of athletes.

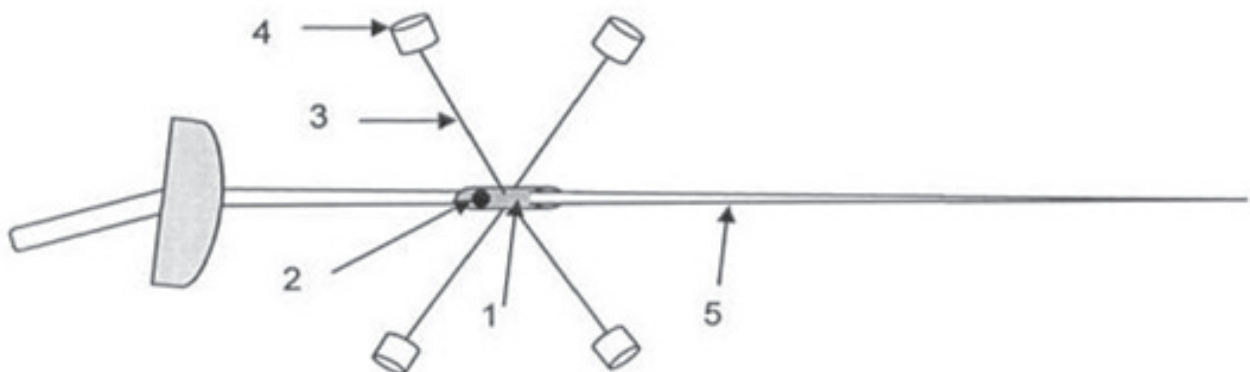


Legend: 1 – Prefabricated cube; 2 – Vertical guides; 3 – Ball targets

Figure 2. “Cube” (Device for technical and tactical training of fencers)

The third device – “Device for the technical training of fencers” – was designed to develop the technical skills of fencers based on improving the specialized feeling of the weapon (Briskin et al., 2014). The device is a metal cylinder that can be moved by the blade and fixed with the screw-clamp if it be necessary to regulate the centre of mass of the

weapon. On the base (cylinder), four multidirectional cores (tubes) with the length 120 mm, outer diameter 5 mm and an angle of 90° are mounted. At the proximal end of the core (tube), the weighting compounds of different weights are attached, which are selected according to age, gender and skills of fencers (Figure 3).



Legend: 1 - Metal cylinder; 2 - The hole for the blade; 3 - The tube of weighting compound; 4 - Weighting compound; 5 – The blade

Figure 3. Device for technical training of fencers

To verify the effectiveness of those devices, two experiments at four fencing clubs in Lviv, Ukraine were held. The first one (01.02.2013–20.12.2013) involved 52 young epee and foil

fencers (age 11-15 years). They were divided into two groups: experimental (n=27) and control (n=25). The experimental group used the developed devices for technical, tactical, and

theoretical preparedness; the control group used traditional means of technical, tactical, and theoretical training. The level of theoretical preparedness of athletes was determined using the author's questionnaire (Briskin et al., 2014), which included five blocks of questions. The observation of athletes' preparedness (the level of knowledge) was measured using the author's questionnaires before and after the experiment.

The second experiment was carried out to test the experimental programme for differentiation of the epee fencers' technical and tactical training, taking into account the ways of weapon control (the use of a pistol grip or a French one). It involved 45 epee fencers, divided into three groups (age 11-15 years), two of which were experimental, while the third group was a comparison one (control group). The first experimental group included epee fencers who applied the weapon with a French grip, whereas the second experimental group used the weapon with a pistol grip. Fencers in both experimental groups used a "Device for the technical training of fencers" to develop their technical and tactical preparedness. The third comparison group involved other fencers, whose method of weapon handling was not taken into account. They used traditional means of technical and tactical training. To estimate the efficiency of the programme, a special device for technical and tactical training of fencers ("Cube") was used. The mea-

surement was carried out at the beginning and at the end of the experiment.

Statistical analysis

Methods of mathematical statistics were used to study the results of the research. In particular, the average arithmetic mean square deviation was calculated. Student's t-test (for calculating the results of the first experiment), Wilcoxon signed-rank test, and Mann-Whitney U-test (for calculating the results of the second experiment) were also used.

Results

The devices described above ("TTT", "Cube", and "Device for technical training of fencers") were testified during pedagogical experiments. The results of pedagogical experiments illustrated that the use of such multi-functional devices is more effective than traditional means.

The results of the first experiment are shown in Table 1. For determining of the statistical significance of data before and after the experiment, we used Student's t-test. It was revealed that before the experiment there was no statistical difference between experimental and control groups ($p > 0.05$) within all informational blocks. After the experiment, the significant difference in both groups was at the 0.05 level.

Table 1. Indicators of theoretical preparedness within different informational blocks at the end of the first pedagogical experiment in experimental (N=27) and control (N=25) groups

variables (Informational block)	Group	Before experiment	p*	After experiment	p**	Increase, %	p***
"History of fencing"	EG	4.1±2.1	>0.05	8.5±1.0	<0.05	107.3	<0.05
	CG	4.3±2.3		5.1±2.2		18.6	<0.05
"Competitive activity"	EG	6.0±2.0	>0.05	8.9±0.6	<0.05	48.3	<0.05
	CG	5.6±2.0		5.2±2.2		-7.1	<0.05
"Technique and tactics of fencing"	EG	3.3±1.6	>0.05	8.1±1.1	<0.05	145.5	<0.05
	CG	5.0±2.0		5.8±2.1		16.0	<0.05
"Fundamentals of the theory and methodology of training of athletes"	EG	3.2±2.2	>0.05	7.3±1.4	<0.05	128.1	<0.05
	CG	3.8±1.7		4.2±2.0		10.5	<0.05
"Olympism"	EG	4.7±3.2	>0.05	8.1±1.3	<0.05	72.3	<0.05
	CG	5.3±2.5		5.3±1.9		0.0	<0.05

Legend: EG - experimental group; CG - control group; p* - significant difference at the 0.05 level between EG and CG before experiment; p** - significant difference at the 0.05 level between EG and CG after experiment; p*** - significant difference at the 0.05 level inside the groups

According to the results of the first pedagogical experiment, the growth of knowledge in the experimental group within different information blocks ranged from 48.3 to 145.5% ($p < 0.05$). The most significant growth of those levels was within the information block "Technique and tactics of fencing" at 145.5%. In the control group, the positive growth of the theoretical preparedness was only available in the blocks "History of fencing", "Technique and tactics of fencing", and "Fundamentals of the theory and methodology of training of athletes", ranging from 10.5 to 18.6% ($p < 0.05$). It should be mentioned that the level within the information block "Olympism" remained constant, while within the block "Competitive activity" it decreased by 7.1% ($p < 0.05$). The greatest increase in the theoretical preparedness in the control

group was recorded within the information block "History of fencing", by 18.6% ($p < 0.05$). The results of the first experiment illustrated that author's device "TTT" was more effective for improvement of sportsmen's skills (level of knowledge) within all informational blocks, while traditional means were useful only for three blocks ("History of fencing", "Technique and tactics of fencing", and "Fundamentals of the theory and methodology of training of athletes"). Moreover, the increase in the level of knowledge was higher in the experimental group.

During the second pedagogical experiment, the "Device for the technical training of fencers" and "Cube" were used. The first was used for the development of technical and tactical preparedness of fencers, while the second for its estimation. For determining of statistical significance of data before and after

experiment, we used the Wilcoxon signed-rank test. Also for determining the statistical significance of data between different groups, we used the Mann-Whitney U-test. As shown in Table 1, the use of author's device allowed increasing the accuracy of technical actions in both experimental groups more than in the control group (significant difference at the 0.01 level). In particular, one of the most significant indicators of the effectiveness of our experimental program were indicators of the technical skills of fencers. In all experimental groups, we have tested the accuracy of simple attacks, the accuracy of avoidance attacks, and the accuracy of attacks with weapon actions. We used such indicators because they are most commonly used by

young sportsmen. Tests were held before and after the experiment. Before the experiment, we found no statistically significant differences between results in three experimental groups. After the experiment, all results rose. These data are statistically significant. However, the results of simple attacks had more progress in experimental group 1; attacks with weapon actions had more progress in experimental group 2. In our opinion, such progress is connected with the development of weapon feeling and weapon control skills, which enables athletes to perform the techniques more precisely and faster. These data show that our programme of differentiation of technical and tactical training with account of weapon control is effective.

Table 2. Indicators of technical skills at the beginning and at the end of the second pedagogical experiment in experimental groups EG1 (N=15) and EG2 (N=15), and in the control group (N=15)

Indicators	Groups	Before experiment (amount of effective hits in 10 attempts)	After experiment (amount of effective hits in 10 attempts)	Increase
Accuracy of simple attacks	EG1	7.1±0.6	8.9±0.8	1.8*
	EG2	7.3±1.0	8.8±0.7	1.5*
	CG	7.1±0.9	8.0±0.92	0.9**
Accuracy of simple attacks with avoidance	EG1	6.7±0.6	8.8±0.8	2.1*
	EG2	6.5±1.0	8.8±0.8	2.3*
	CG	6.7±0.8	7.9±0.96	1.2**
Accuracy of attacks with weapon actions	EG1	7.3±0.6	8.3±0.9	1.0*
	EG2	6.9±0.8	8.6±0.7	1.7*
	CG	7.0±0.8	7.5±0.91	0.5**

Legend: * - significant difference at the 0.01 level; ** - significant difference at the 0.05 level; EG1 - experimental group 1; EG2 - experimental group 2; CG - control group

Discussion

Analysis of the relevant scientific literature illustrates that some research studies were aimed at the development and experimental implementation of different devices for boxers and fencers. Among them: the "Spuderg simulator" by Savchin (2003), the computer programme "Analysis and modeling of competitive activity of fencers" by Shevchuk (2009), the "Spartak" fighting simulator by Velychenko and Zherdzinsky (2017), "A device for evaluating some of the special physical skills of the boxer" by Saenko et al. (2011), and "Tyshler's Simulator (TTD)" by Tyshler and Ryzhkova (2010). In our opinion, the disadvantage of those methods is that they could be used only for the improvement of the individual aspects of preparedness, and did not provide integral control over the technical, tactical, special physical, and psychophysiological aspects of the preparedness of martial arts. Moreover, their use does not involve the acquisition of specific knowledge of sports theory by athletes and the fulfilment of tasks in the conditions of counteracting the opponent in real time. That is why we have presented several devices aimed not only for the improvement of different aspects of preparedness, but also for their control.

To testify the effectiveness of developed devices, two pedagogical experiments were used. During the first one, fencers of both groups studied information on five blocks: "History of fencing", "Competitive activity", "Technique and tactics", "Fundamentals of the theory and methodology of training", and "Olympism". However, the experimental group used the "TTT" simulator while the control group used traditional

means. The use of the "TTT" simulator enabled increasing the sportsmen's level of knowledge at levels of 48.3%-145.5% ($p<0.05$). Such progress could be explained by the fact that they studied a greater amount of information of different directions, quickly analysed it and learn to use it in situations that simulate the conditions of competitive activity (the lack of time and conflict interaction). It should be mentioned that this approach to improving theoretical preparedness was not used in other research studies.

The idea of the second pedagogical experiment was to demonstrate that there should be a difference in the training programmes for sportsmen who apply the weapon with a French (smooth) or with a pistol grip. None of the previous research studies considered such an opportunity. For that purpose, in our program, we used a special device for the development of technical skills and weapon feeling. The results of our research illustrated that in the experimental group 1, the indicators of the test for the accuracy of the hits in performing simple attacks and attacks with avoidance are significantly higher than in the experimental group 2 ($p<0.01$), and the control group; the results of the test for the accuracy of hits in the course of attacks with weapon actions are also significantly higher in experimental group 2 ($p<0.01$).

Thus, the results of both pedagogical experiments illustrated that the use of such multi-functional devices is more effective than using traditional means. Moreover, all devices could be modified and used in other kinds of martial arts (judo, wrestling, taekwondo, boxing, etc.).

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Participation of Adolescent Pupils in Recreational Activities with Greek Dances and Their Preference for Group Work at School

Lemonia Darginidou¹, Dimitris Goulimaris², Soultana-Anna Toumpalidou¹ and Filippou Filippou²

¹Democritus University of Thrace, Komotini, Greece, ²Democritus University of Thrace, Department of Physical Education & Sport Sciences, Komotini, Greece

Abstract

This paper aimed to study the adolescents' preference from group work at school when participating in recreational activities with Greek dances. The sample of the research consisted of 280 adolescents, aged 12-13, divided into three groups as follows: 97 adolescents who had not dealt with any physical activity systematically, 84 adolescents who had only participated in physical activity programmes with Greek dances organized by secondary schools, and 99 adolescents who had participated in recreational activities with Greek dances organized by non-profit cultural societies. The measurement instrument was the first factor, "preferring group work", from the questionnaire Feelings towards Group. Three measurements took place. For the statistical analysis of the data, the methods used were: analysis of the variance of two factors with one of them being repeated. Consequently, the adolescents' participating in recreational activity programmes with Greek dances contributes to their preference for group work and developing positive feelings about it.

Keywords: traditional dance, adolescents, preference for group work

Introduction

Group and group work

What leads to the establishment of group work is the fact that it constitutes a way of using human energy to make quality decisions and take initiatives for problem-solving. The power of a group is defined by its team spirit and depends on the actions of its members. The ability of a group to achieve its goals is defined by participation. Being flexible, a group can respond to quick changes and demands and adjust to new information and challenges. It can also understand procedures better and thus reduce lost time, improve communication and effectiveness, helping its members to develop their cognitive skills and other characteristics of their personalities (Diaz & Pintozzi, 1999; Mpourantas & Papalexandri, 1998). Successful

group work is the result of the cooperation and social interdependence of its members, who are willing to contribute to the creation of a positive and effective environment, without individualized competitiveness (Tarricone & Luca, 2002). Interaction and communication among groups of students improve performance and create qualitative characteristics that aid in the development of knowledge (Joyce & Weil, 1992; S. Sharan & C. Shachar, 1988; Slavin, 1987). Freeman (1996) asserted that students' tendency to group work predicts their effective performance.

At school

Education constantly attempts to redefine curricula and use new cognitive strategies, drawing from data that show that



Correspondence:

L. Darginidou
Democritus University of Thrace, Komotini, Greece
E-mail: ldargini@phyed.duth.gr

group work improves students' social and academic performances (Slavin, 1995). The educational process applies social interaction as a central, fundamental, and thus indispensable element in the cognitive process. It is known that in a sociable environment, students create friendships and inter-personal relationships that help them better understand and apply social skills and join social groups in order to improve their quality of life. For education in Greece, creating a team spirit is a useful strategy since it contributes to the development of a cognitive, social, and moral individual autonomy, as well as to the development of collective practices and attitudes, which should be the objective of a school. As a result, teaching has an intense social-shaping character that reduces antisocial behaviour through obeying given rules. Group/cooperative strategy is applied by creating small groups, planning and organizing, as well as presenting collective activities (Goudas, Hasandra, Papacharisis, & Gerodimos, 2006; Mountakis, 2006). Greek schools, in general, apply educational programmes and activities with Greek dances, which focus on the interaction between individuals and groups. These programmes are carried out with the voluntary participation of male and female students and supervised by school teachers after the end of the school day (extra-curricular) supporting the school curriculum.

Recreational activities with Greek dances

Recreational activities with Greek dances are capable of reassuring the suitable cooperative teaching/learning environment, reducing competitiveness, and developing team spirit, which promotes positive social behaviour (Arnold, 1998). Greek dance is a popular activity that, being recognized as recreational, involves adolescents in pleasant activities, combining learning and moving. It is a kind of a group physical and recreational activity that is connected to the quality of life, increasing well-being and reducing anxiety (Mavrovouniotis, Argiriadou, & Papaioannou, 2010). Participating in recreational activities with Greek dances reinforces socializing and bonding, and creates a pleasant environment of good mood and entertainment, which helps the participants attract more people in their groups (Zanou, Hasandra & Goudas, 2001). The adolescent participants are motivated to have fun, feel like members of a group and meet with friends, which increases their good mood (Doulias, Kosmidou, Pavlogiannis, & Patsiaouras, 2005). Participating in such activities creates broader social dimensions, since it is followed by a system of values, such as the collective conscience of a social group, the development of team spirit, and the shaping of the personality of young people. Participants can express themselves both individually and as a group in a collective unity, which reflects the ideological, psychological, and social world of the group (Zografou, 2003). The way these dance programmes function establishes collectivity and solidarity among the participants through the common target of creating a functional dance group, and it is a proof for the existence of social dynamics (Goutsidis, 2004; Maisonneuve, 2001). Dance programmes also constitute social events, and this sociability is expressed throughout the procedure by the whole group/community, regardless of the social or financial status of the participants (Mpougiesi, Zisi, Grigoriou, & Pollatou, 2011). Within the environment of recreational activities with Greek dances, male and female adolescents are in a constant educational process of social embodiment. Incorporating in a group of recreation-

al activities, such as Greek dance programmes, requires communication, cooperation, coordination, and understanding of role distribution. In other words, adolescents must display a high level of social skills in order to be successful.

Adolescents who participate in Greek dance programmes are individually independent, and they simultaneously feel accepted in the groups of their peers, family, and community, which enhances their active participation. The environment of the dance community is perceived as something familiar, an extension of the family, and thus complementary to their education and evolution (Zikos, 1992).

Participation in Greek dance programmes develops young people's motor, observational, and perceptive skills, as well as their concentration, initiative, responsibility, and communication (Mpournelli, 2003). In addition to offering special dance skills, Greek dance uses the body as a tool for action, communication, and creativity (Koutsoumpa, 2007). Therefore, adolescents are given the opportunity to discover rhythm and creative skills, develop their relationships, communicate, and cooperate with their peers, learn and accept group rules, boundaries, and limitations (Likesas, Tsapakidou, Kostantinidou, & Papadopoulou, 2002). Furthermore, skilled dancers prefer group work at school (Darginidou & Goulimaris, 2016).

This study aimed to investigate the extent to which adolescents prefer group work at school when they participate in recreational programmes with Greek dances.

Methods

Participants

The participants of the research were 280 adolescents, aged 12-13, who studied in the first year of a junior high school. There were three groups. The "control group" consisted of 97 male and female adolescents, who had not dealt systematically with any extra-curricular physical activity. "Experimental group 1" consisted of 84 male and female adolescents who, for the first time, dealt with extra-curricular activities with Greek dances organized by their school. "Experimental group 2" consisted of 99 male and female adolescents who, for the first time, dealt with extra-curricular activities with Greek dances organized by non-profit cultural societies.

Measurement Instrument

To evaluate the adolescents' perceptions and emotions towards group work at school, the method used was the questionnaire "Feelings Towards Group" by Cantwell and Andrews (2002), which was adjusted for the Greek language (Magotsiou & Goudas, 2009) and previously used in research studies in Greece (Filippou & Kouthouris, 2014; Gousia & Kouthouris, 2011). The questionnaire consists of 24 questions grouped into three factors. The first factor used was called "preference for group work". It includes eight questions, such as "I like working in groups because in this way we help each other". The specific factor reveals a general preference expressed by adolescents towards group work in class, their satisfaction drawn from the composition and organization of the group they are part of, as well as an intense sense of responsibility and self-knowledge in relation to the role that each one plays in that group.

Procedure

The completion of the questionnaires took place after the end of the lessons. The participants were told that they could stop the procedure any time they wished, since their partic-

ipation was voluntary. There were three measurements. The final one (2nd measurement) took place seven months after the initial (1st measurement), and the preservation measurement (3rd measurement) took place two weeks after the 2nd and final measurement. The elaboration of the collected data was carried out with the statistical packet SPSS.18.

Data analysis

For the statistical analysis of the data, the researchers used

elements of descriptive statistics. There was also a reliability analysis for the calculation of a Cronbach and analysis of variance of the two factors, one of which was repeated.

Results

Estimation of internal cohesion

To estimate the internal cohesion of the examined factor, there were reliability analyses for a Cronbach. Table 1 shows the reliability analyses in the three measurements.

Table 1. Reliability analysis of the factor "Preference for Group Work"

	α Cronbach		
	Measurement 1	Measurement 2	Measurement 3
Preference for Group Work	0.71	0.76	0.79

Research for differences in the initial measurement

There was a one-way ANOVA analysis of variance of the independent samples to investigate the differences among the groups in the initial measurement. The analyses showed that there were no statistically significant differences in the factor "Preference for Group Work" in the initial measurement $F(2, 278)=0.411$, $p=0.66$ (Table 2).

Analysis of variance of two factors, one of which was repeated for the factor "Preference for Group Work"

To confirm the existence of statistically significant differences in the sample (which was separated according to an independent (group) and a repeated (measurement) factor) concerning the factor "Preference for Group Work", there was an analysis of variance of two factors, with one of them being repeated. It was confirmed that there was a statistically significant interaction between the two factors ($F(4,550)=195.667$, $p<.05$). When analysing the interaction for each scale of the independent factor, it was found that there was a statistically significant influence of the repeated factor "measurement" on the "control group" ($F(2,278)=119.472$, $p<.05$), the "experimental group 1" ($F(2,278)=52.633$, $p<.05$) and the "experimental

group 2" ($F(2,278)=105.740$, $p<.05$). The Bonferroni multiple comparison test showed that there were statistically significant differences in the "control group" throughout the measurements. It was also found that in "experimental group 1" and "experimental group 2" there were statistically significant differences between the initial and the other two measurements. Following observation of the means (Table 2), it can be confirmed that in the "control group" there was a reduction concerning group work at school throughout the measurements. In "experimental group 1" and the "experimental group 2", there was an increase of the means concerning group work at school, which was kept on the same levels until the end of the measurements, with the "experimental group 2" displaying higher means. In relation to the differentiation among the groups, there were statistically significant differences during the second measurement ($F(2,277)=226.55$, $p<.05$) and the third measurement ($F(2,277)=324.127$, $p<.05$). The Bonferroni multiple comparison test showed that there were statistically significant differences among the three groups of adolescents. Following the observation of the means (Table 2), during the second and the third measurement, it can be confirmed that the highest means appears in the "experimental group 2".

Table 2. Mean and standard deviations in the measurements for the three groups, during the three measurements

		CG	EG1	EG2	total
		M\pmSD	M\pmSD	M\pmSD	M\pmSD
Preference for Group Work	Measurement 1	3.78 \pm 0.55	3.76 \pm 0.38	3.83 \pm 0.53	3.79 \pm 0.50
	Measurement 2	3.18 \pm 0.54	4.30 \pm 0.35	4.52 \pm 0.48	3.99 \pm 0.76
	Measurement 3	2.98 \pm 0.51	4.30 \pm 0.35	4.53 \pm 0.47	3.93 \pm 0.83

Legend: CG – control group; EG1 – experimental group 1; EG2 – experimental group 2, M – arithmetic mean; SD – standard deviation

Discussion

This paper investigated the adolescents' preference for group work at school when they participate in recreational activities with Greek dances. Male and female adolescents prefer to work in groups in class, when they are satisfied by the organization and dynamics of the group to which they belong and when they have developed self-confidence, responsibility, and capability for their role and function in the group (Magotsiou & Goudas, 2009). There was a general estimation that the adolescents who participated in the research had a very good level of preference towards group work at school, since their means concerning group work fluctuated from 3.79 to 3.99 on a five-scale climax (Table 2).

During the measurements, the groups that participated

in recreational programmes with Greek dances differentiated their means of preferences towards group work at school. There was also a differentiation in the means concerning group work at school among the groups, with the highest ones being the means of the group that participated in recreational programmes with Greek dances in societies, as shown in the preservation measurement (Table 2). All groups differentiated their means concerning group work at school, as shown by the results that are in accordance with those of other research studies (Darginidou & Goulmaris, 2016). It is known that programmes with Greek dances satisfy the participants' needs for individual expression and creation (Dimas, Vagenas, & Giosos, 2003). Participating in Greek dance programmes requires communication, cooperation, team spirit, coordina-

tion, and acceptance of the distinction of roles. It seems that the adolescents who participate in recreational activities with Greek dances have learnt to overcome difficulties within the group, communicating, and helping each other. In addition, they discover rhythm, creative skills and they develop or improve relationships, they communicate and cooperate with peers and they learn to obey rules and accept limitations (Likesas, Tsapakidou, Kostantinidou, & Papadopoulou, 2002).

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

The Influence of Professionally Oriented Physical Training Means on the Operator's Physical Ability Level

Volodymyr Klymovych¹, Artur Oderov¹, Serhii Romanchuk¹, Mukola Korchagin², Andrii Chernozub³, Oleh Olkhovyi³ and Vitalii Zolochovskyi⁴

¹National Academy of the Army, Department of Physical Education, Special Physical Training and Sports, Lviv, Ukraine, ²Military Institute of Armored Forces of National Technical University Kharkiv Polytechnic Institute, Department of Physical Education, Special Physical Training and Sports, Kharkiv, Ukraine, ³Petro Mohyla Black Sea National University, Faculty of Physical Education and Sports, Mykolaiv, Ukraine, ⁴Kozhedub Air Force University, Department of Physical Education, Special Physical Training and Sports, Kharkiv, Ukraine

Abstract

To study the effect of professionally applied vocationally-directed physical training on the level of professionally important physical qualities of operators, a three-year experiment was conducted to implement a programme of special (professionally-directed) physical training in the daily professional activity of servicemen-control systems-operators. The analysis of scientific and methodological literature and the domestic experience of organizing vocationally applied physical training supports the claim that a large number of fundamental and applied scientific research studies are devoted to the problem of formation of professionally important physical qualities, in which the current directions and tendencies of the orientation of physical education professions and culture are presented. The use of an experimental programme, based on the means of vocationally directed physical training, enabled the statistically significant improvement of the level of development of professionally important physical qualities of experimental group (EG) operators in relation to the control group (CG): aerobic endurance by 2.2% ($p < 0.05$), agility by 3.7% ($p < 0.05$), strength endurance by 9.4% ($p < 0.05$), static endurance of back and neck muscles by 13.2% ($p < 0.05$), general static endurance by 11.1% ($p < 0.05$). Studies show that through the purposeful use of exercise, it is possible to form a certain level of development of professionally important physical qualities, in order to ensure constant physical readiness to perform professional tasks.

Keywords: *physical training, physical abilities, military operator, automated systems, ability level*

Introduction

Applied professional physical training of operator specialists is done for the preparation of military personal for concrete future military activity (Olkhovyi, 2015). It promotes the development of physical and mental abilities that are necessary for their future profession, and for forming the motor skills, according to the profile of future military activity (Rayevsky & Kanisevsky, 2010). Physical readiness, performance optimization, and injury prevention are critical to the military profession and specifically to the individual operator (Klymovych &

Olkhovyi, 2016). Modern ideas about physical activity extend this statement so that it includes the improvement of physical condition, the preservation of health, and the lengthening of professional longevity.

According to Kamaiev et al. (2018), the effectiveness and reliability of the operator profile specialists are closely related to the development level of professionally important physical qualities. Analysis of the most recent research and publications shows that military operators are specially trained to perform their tasks on the battlefield (Korchagin, Kurbakova,



Correspondence:

V.B. Klymovych

National Academy of the Army, Department of Physical Education, Special Physical Training and Sports, Heroyiv Maydanu, 79012 Lviv, Ukraine

E-mail: klimovichvolodymyr@gmail.com

& Olkhovyi, 2017).

The problem of the development and improvement of special (professionally important) physical and physiological qualities of future specialists in the modern professional education system is solved by professionally applied physical preparation (Klymovych, Olkhovyi, & Romanchuk, 2016). If general physical training provides readiness for work in general, professionally oriented physical training is aimed at preparing military personnel for a specific professional activity (Rolyuk et al., 2016).

The problem of the development and improvement of professionally important physical abilities is relevant not only at the stage of professional education, but also at the stage of adaptation to the conditions of professional activity (outside the educational institution), the stage of formation, and the direct professional activity of specialists (Bolotin, Bakayev, & Vazhenin, 2016). Regarding the continuity of the physical education process of a person during his lifetime and the constantly changing negative health-affecting factors of professionals, it is advisable to combine the subsystems of professional-applied physical training and culture in a professional-oriented physical training system. The concept of such training of Ukrainian higher military educational institution graduates was proposed by Finogenov (2015). Logically, the proposed model of professional-oriented physical training of military personnel may be adapted to the requirements of various specialties' activity. The issues of professionally important physical abilities development, improvement and maintenance at the optimum level should be solved throughout the whole period of specialist's professional activity (Kruszewski et al., 2017).

During the previous research study, conducted on the base of Ukrainian Air Forces (Oderov et al., 2017), it was determined that the professional-important physical abilities of this category of operators were: static endurance of the back and neck muscles, static endurance of "muscle of the press" exercise, aerobic endurance, power endurance and agility. A block-periodization model was suggested for the Ukrainian Air Force automatic system personnel while managing operational duty schedules. The benefits of the block-periodization model are in the short cycles (microcycles), allowing concentration on the development of important physical abilities by professionally oriented physical training means.

The purpose of the article is to study the influence of professionally oriented means of physical education on the level of professionally important physical abilities of military operators of automated systems.

Methods

Pedagogical methods of investigation, testing of physical abilities level and statistical analysis of the results were used in the study.

Eighty-six (86) military automatic system operators (22-30 years old) from the Ukrainian Air Forces were involved in the research. All operators were informed about the experiment and gave their assent. All of them were clinically healthy and had no recent history of infectious disease, asthma, or cardio-respiratory disorders. They were divided into two equal groups (control and experimental), which were tested before, during, and after the implementation of author's special physical training programme. The experimental group (EG) performed the block-periodization model training, whereas the control group (CG) continued performing the current training

programme. The total duration of the study was three years.

A battery of tests was used for assessment of professionally important physical abilities level.

1. 3 km running (for aerobic endurance assessment);
2. Complex power test (for power endurance assessment);
3. Complex agility test (for agility assessment);
4. Keeping horizontal back position (for back and neck static endurance assessment);
5. L-sit on parallel bars with knees bent (for assessment of the static endurance of abdominal muscles).

The pedagogical experiment was used to determine the influence of means of professional-applied physical training on physical development and the level of development of professionally important physical qualities of operators. A control ($n=43$) and an experimental ($n=43$) group of operators of the same level of professional preparedness were formed. During the experiment, representatives of the experimental group, trained for the author's programme of professional-oriented physical training, performed professional duties in the usual mode.

Pedagogical testing was conducted to assess the level of physical fitness of the operators by means of control exercises: running at 3 km, complex exercise on dexterity, complex exercise, maintaining straight legs on gym equipment, static holding of the horizontal back position.

Methods of mathematical processing of the obtained results were used to characterize the groups studied and to identify the difference between the groups among the groups with the help of functions (arithmetic mean in groups - mean square deviations - σ , errors of arithmetic mean - m). The probability of differences on one sign before and after the experiment and in two different groups was evaluated according to the t-test.

The following tools were used to build the author's programme of special (professional-oriented) physical training: isotonic general development exercises, isometric exercises for the muscles of the back, neck and the press, cyclic exercises of low and moderate intensity, sets of physical culture pauses, exercises for relaxation and muscle stretching, sports and games, and hydrothermal procedures.

To study the aspect of the influence of special physical training on the level of professionally important physical qualities of operators, a three-year experiment was conducted to implement a programme of special (professional-oriented) physical training into the daily activities of servicemen-operators.

Results

The effectiveness of the formation of indicators of professionally important physical qualities of operators is shown in Table 1 (where EG is an experimental group using the author's programme of professionally applied vocational-directed physical training, performed professional duties in the normal mode and CG is the control group, which engaged in the usual programme).

A comparative analysis of the level of development of endurance (average arithmetic run time running 3 km) from the operators showed that an increase in this indicator from the representatives of the CG in relation to representatives of the EG was observed during the experiment, and this difference is 2.2% at $t=2.12$.

A comparative analysis of the level of development of strength endurance (average arithmetic number of repetitions of a complex exercise) showed a statistically significantly bet-

Table 1. Research results indicators of professionally important physical qualities of operators

Period of determination	EG (n=43) M±SD	CG (n=43) M±SD	Difference (%)	T-test	Sig.
Endurance - Running 3 km (s)					
Before experiment	835.26±5.61	836.51±5.79	0.2	0.16	p>0.05
After experiment	838.09±5.60	856.53±6.68	2.2	2.12	p<0.05
Complex force exercises (s)					
Before experiment	39.95±1.38	39.88±1.21	0.2	0.04	p>0.05
After experiment	41.74±1.29	38.14±1.11	9.4	2.11	p<0.05
Dexterity - Comprehensive exercise on dexterity (s)					
Before experiment	11.33±0.11	11.36±0.12	0.3	0.21	p>0.05
After experiment	11.14±0.10	11.57±0.12	3.7	2.82	p<0.05
angle on gymnastic bars (s)					
Before experiment	39.28±2.08	38.95±1.46	0.8	0.13	p>0.05
After experiment	41.49±1.54	37.33±1.25	11.1	2.11	p<0.05
Hold the body in a horizontal position (s)					
Before experiment	76.79±3.28	76.88±2.79	0.1	0.02	p>0.05
After experiment	84.95±3.31	75.05±2.86	13.2	2.26	p<0.05

ter result of EG operators in relation to representatives of CG at 9.4% at t=2.11.

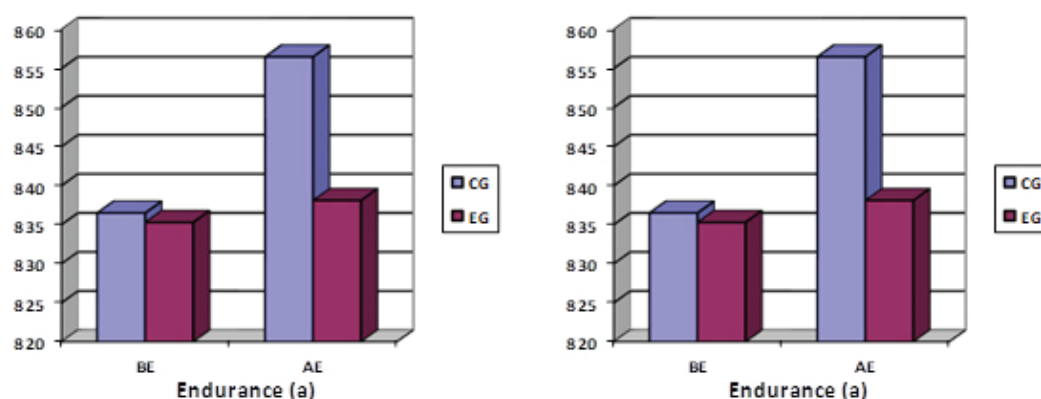
The results of the evaluation of agility in EG operators after the experiment are statistically significantly different from the results of this indicator for the representatives of the CG; the average arithmetic mean of the time of execution of the exercise on agility was lower by 3.7% at t=2.82.

Similarly, after the third year of the pedagogical experiment, the difference between the mean arithmetic mean of the exercise time on the static endurance of the muscles of the press and the static endurance of the muscles of the back and

neck in the two groups was statistically significant: 11.1% at t=2.11, respectively and by 13.2% at t=2.26.

Discussion

To confirm the influence of means of professionally directed physical training on the level of professionally important physical qualities of specialists during the three years of using the author's programme, a study of the dynamics of the level of development of physical qualities of representatives of two groups of operators of automated control systems (Figure 1, 2 and 3) was conducted.

**Figure 1.** Dynamics of the level of development of aerobic endurance and strength endurance during the experiment

An analysis of the dynamics of the level of development of professionally important physical qualities of the CG operators stated that during three years of the experiment, as a result of aging of the body, statistically significantly deteriorated: aerobic endurance by 2.4% at p<0.01 (Figure 1a), strength endurance by 4.4% at p<0.001 (Figure 1b). The level of development of aerobic endurance of representatives of EG for three years of the experiment has not undergone statistically significant

changes (Figure 1a). Instead, the power endurance of the operators of EG for three years of the experiment has statistically significantly improved by 4.5% at p<0.001 (Figure 1b).

The dynamics of the level of agility of operators (Figure 2) in the three years of the experiment showed that the agility of the representatives of the CG statistically significantly deteriorated by 1.5% at p<0.01 (Figure 2), but the physical quality improved by EG operators by 1.9% at p<0.001.

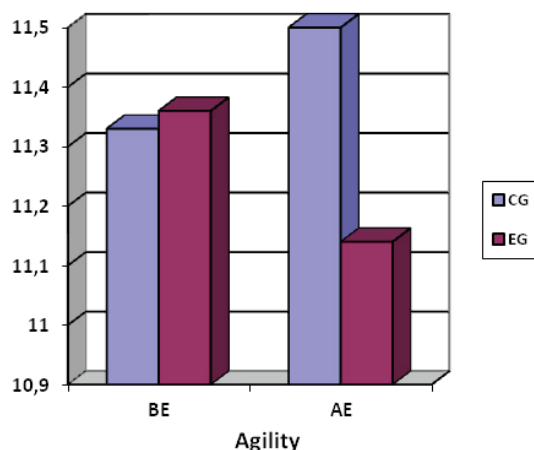


Figure 2. Dynamics of the level of development of agility during the experiment

The results of determining the static endurance of the muscles of the press, back, and neck of the CG operators indicate that these physical qualities have not undergone statistically significant changes (Figure 3). However, in the EG operators,

the static endurance of the muscles of the press statistically significantly improved by 3.8% at $p < 0.001$ (Figure 3a), while the static endurance of the muscles of the back and neck was 7.5% at $p < 0.001$ (Figure 3b).

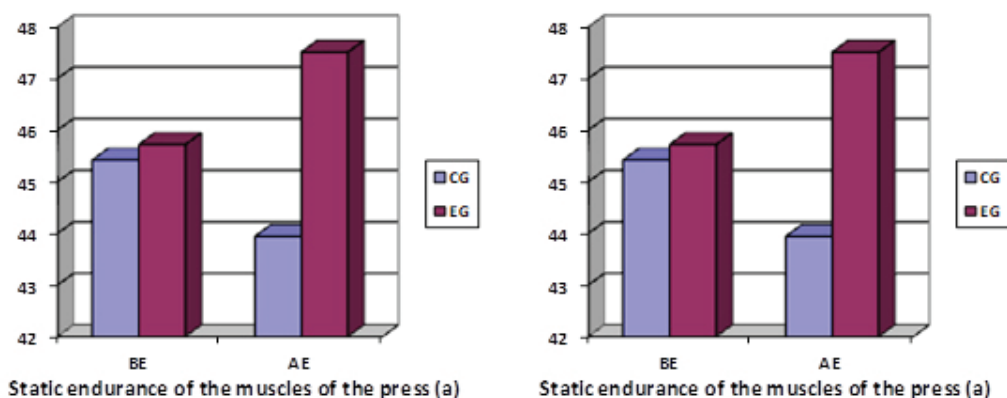


Figure 3. Dynamics of the level of development of static endurance of the muscles of the press, back and neck during the experiment

The use of an experimental programme based on the means of professional-directed physical training enabled statistically significant improvements of the level of development of professionally-important physical qualities of EG operators in relation to CG: aerobic endurance at 2.2% ($p < 0.05$), agility at 3.7% ($p < 0.05$), strength endurance at 9.4% ($p < 0.05$), static endurance of the back and neck muscles by 13.2% ($p < 0.05$), static endurance in Pressure of the press at 11.1% ($p < 0.05$).

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Conflict of Interest

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ORIGINAL SCIENTIFIC PAPER

Analysis of Sports Halls in Terms of Eliminating Noise: Case Study on an Example in Podgorica, Montenegro

Svetislav G. Popovic¹, Sanja Paunovic Zaric¹ and Irena Rajkovic¹

¹University of Montenegro, Faculty of Architecture, Podgorica, Montenegro

Abstract

Noise in a learning environment is unwanted and depends on many factors, which are particularly evident in sports halls because of the noisy nature of sports activities. This paper analyses three school sports halls in Podgorica, Montenegro, in terms of detecting noise and providing guidelines for its elimination. Through three characteristic sports hall typologies, sources and numerical indicators of noise levels, generated during the usage of the sports hall for games and sports, have been detected. The results obtained through measurements give specific values that can be compared with applicable standards, and by using a comparative method, the ranking of noise levels for the three types of sports halls will be made. Through three typical examples, this paper gives specific guidelines for improving the conditions for using sports halls, with the help of positive examples in solving the same or similar problems in the region, and beyond.

Keywords: sports hall, noise, sound barriers, noise source, typology of school sports halls

Introduction

In the process of improving the educational system, strategies that are being implemented are mainly aimed at improving the curriculum, while the conditions for teaching, learning, and the impact on the environment are insufficiently treated. Through the study of sports halls and possibilities for creating a network of sports facilities in cities, it is evident that sports halls are mainly present in educational institutions: schools. (Popovic, 2014). For this reason, they represent a vital resource for research on the conditions in which physical education classes are carried out. The transmission of sound through space is one of the critical factors for quality classes. Every sound carries specific information that can be but is not necessarily understandable and useful. If the information contains too much useless and incomprehensible content, it creates noise and thus distracts students. Noise is an unwanted type of sound in the space in which classes are carried out

because it has a negative impact on understanding among participants of the teaching and educational process.

The ability of teachers and students to hear one another is an essential part of academic excellence (Klatte, Bergstroem, & Lachmann, 2013; Woolner & Hall, 2010). Poor acoustic conditions cause discomfort and negative psychosocial behaviour among students (Crandell, Smaldino, & Flexer, 2005), while the attention of students and their participation in class is improved in the conditions of reduced noise levels (Dockrell & Shield, 2012). Although acoustic conditions are recognized as very important in the teaching process, they are deficient in most spaces where classes are carried out.

Speech is a combination of direct and reflected sound that travels from teacher to student. Direct sound starts from the teacher and becomes a reflected sound when it strikes one or several obstacles and surfaces in space. The position of a student in a sports hall causes the perception of a specific com-



Correspondence:

S.G. Popovic
University of Montenegro, Faculty of Architecture, Bulevar Džordža Vasiingtona bb, 81000, Podgorica, Montenegro
E-mail: svetislav@ac.me

bination of direct and reflected sound. The distance between the teacher and student determines the necessary amount of acoustic energy of direct and reflected sound. Due to the size of a sports hall, this distance is larger than in a classroom. Sports halls are a noisy environment because the space is built of hard materials from which sound bounces, while the surfaces of the walls, floor and ceiling are generally smooth and hard so that they may be used for a longer time for a variety of sports and activities, which all increases the reverberation time, impairs comprehensibility of speech and increases noise level in space (Jurak, Strel, Kovač, & Leskošek, 2015).

Noise in sports halls

The acoustic conditions in which classes are carried out are particularly demanding in sports halls in which physical education is carried out in schools. A large number of students stay still and run in halls, and sometimes different groups of students at the same time perform different activities. Because of the activities that are carried out in sports halls: using balls for different sports, running, loud cheerleading, using whistles, etc., sports halls in schools are most subject to the negative impact of noise during classes.

The poor acoustics in these spaces is also a health problem for teachers. As students, due to noise, can barely hear their teachers and therefore their attention is reduced during classes in a larger space, teachers barely manage to be loud enough to overcome the surrounding noise and convey the desired message to students. Therefore, voice (Kovač, Leskošek, Hadžić, & Jurak, 2013; Simberg, Sala, Vehmas, & Laine, 2005; Smith, Kirchner, Taylor, Hoffman, & Lemke, 1998) and hearing problems (Kovač et al., 2013; Lemoyne, Laurencelle, Lirette, & Trudeau, 2007) are among the most common occupational health problems faced by physical education teachers. Due to the above-described working conditions, physical education teachers have voice problems more often than other teachers do (Jonsdottir, Boyle, Martin, & Sigurdardottir, 2002; J. Preciado, Perez, Calzada, & P. Preciado, 2005; Smith et al., 1998). Frequent exposure to noise has long-term consequences, such as fatigue during the day, increased psychological and emotional tension, feelings of nervousness and irritation, concentration problems, roughness of voice, and coughing (Augustynska, Kaczmarek, Mikulski, & Radosz, 2010). For the above reasons, it is necessary to analyse the noise level in sports halls, detect the problem, and address resolving the noise and its impact on classes, teachers and students.

Standards and Framework

In this paper, the applicable national and international standards have been taken into consideration. Noise regulation includes measuring techniques, specifications for the equipment used, and procedures for making accurate and reproducible measurements, established by the national, state or provincial, and municipal levels of government.

"Acoustics — Guide to International Standards on the measurement of airborne acoustical noise and evaluation of its effects on human beings" is the title of ISO 2204, that defines basic terms and measuring methods and also gives a reference list of other applicable standards (Herlufsen, 1984). Wróblewska (2010) has studied acoustical standards used in the design of school spaces in Europe, America, and New Zealand. Two documents, SFS 5907:2004 and NS 8175:2005, make a difference between the acoustical classes of building

depending on the values that are recommended. "The main purpose of regulations is to decrease the noise and to ensure the proper acoustical conditions for good communication, speech intelligibility and the sound of music [...] Rooms for education of students with hearing impairment or language classrooms should have the acoustical requirements concerning reverberation stricter by about 20%".

In accordance with national standards, the noise indicator is a physical measure that expresses the level of noise in the environment in relation to its adverse impact, while the limit value of noise is the highest allowed noise value in the environment expressed by the indicator L_{den} or L_{night} and L_{day} and Levening, respectively (Law on the Protection against Environmental Noise - Official Gazette of Montenegro, No 28/11, 01/14). The rulebook on the limit values of noise in the environment, the method of determining a noise indicator and acoustic zone and methods of evaluation of adverse effects of noise, defines the limit values of noise in the acoustic zones. These values refer to the total noise level from all sources in the acoustic zones. According to this rulebook, noise must not exceed the limit value of the noise level of 65 dB (A). The method for determining the equivalent noise level is determined by MEST standards ISO 1996-1 and ISO 1996-2 MEST (Official Gazette of Montenegro, No 28/11, 01/14).

Montenegro indicated that the Noise Directive 2002/49/EC had been transposed mainly by the Law on Environmental Noise Protection (2011) and the Rulebook on limit values of environmental noise and acoustical zoning (2011). The legal framework for the stipulation of technical requirements and conformity assessment procedures for products covered by Directive 2000/14/EC (manufacturing, importing, and placing on the market and/or putting in use are): the Law on Protection against Environmental Noise (Official Gazette of Montenegro, No 28/11, 01/14); Rulebook on conformity marking for sources of noise (Official Gazette of Montenegro, No 13/14) and the Rulebook is fully aligned with the requirements of Directive 2000/14/EC. Neither of these regulations recognizes noise protection as an essential element in designing school facilities, and school sports halls are not recognized as a separate category and a potential cause of noise pollution.

Methods

Noise is created in sports halls directly through each maker of unwanted or harmful sound, i.e., by each usage of halls in which attention was not paid either to the presence or the solution of noise pollution. The study carried out measurements in the examples of three topologically different sports halls of elementary schools in Podgorica (Montenegro): Sports Hall 1 – a free standing school sports hall, Sports Hall 2 – a sports hall located in the centre of a primary school, and Sports Hall 3 – a curved soccer tent with a steel construction positioned in a school yard. The economic and social statuses dictate the guidelines and the direction of improving working conditions in halls in terms of noise generated by their usage.

Noise measurements were made with detailed documentation of the measurements and results. The measurement report contains the following information:

- A precise sketch of the school halls' measurements with the exact dimensions (room size, room volume, dimensions of openings, cross sections etc.), as well as the location of the microphone in the objects being measured.
- Standards and framework, according to which measure-

ments were made. According to national standards, the measurement must take at least 15 minutes. Otherwise, the measurement is not relevant.

- The type and serial number of the measuring instruments used are a Bruel & Kjaer phonometer, type 2250B (specially made for noise measuring) and a Bruel & Kjaer Microphone, type 4189 (for noise measuring).
- Calibration was carried out using the reference calibre for sound, which is calibrated by the absolute reciprocal method in a laboratory for non-electrical measures ML-03 (Technical Test Center, Sector for Meteorology in Belgrade). Calibration was done just before measurement by a Bruel & Kjaer acoustic calibrator, type BK4231. Measurement uncertainty is expressed in accordance with EA-4/02; uncertainty corresponds to a coverage probability of approximately 95%. (Calibration date: November 6, 2016).
- The type of sound that has been measured is NOISE.
- The background noise level was measured for Sports Halls 1 and 2. Background noise was not detected.
- The location of the measurement was Podgorica, Montenegro. The measurements have been carried out along one receiver line at the height of 1.3-1.5 m above

the floor, at least 2 m away from walls and partitions.

- Atmospheric conditions at the time of measurement were as follows: the temperature (t) was from 17°C to 20°C, relative humidity (Rv) had a range from 27% to 24%, wind speed and direction (V) N/a, air pressure (P) was 1017.0mb (Freemeteo, 2017).
- The date of measurement performance is March 17, 2017, in the interval between 10:05 a.m.–2:35 p.m. The exact time of measurement is given in each graph.

Results

Sports Hall 1

Sports Hall 1 is a free standing school Sports Hall in the Maksim Gorki primary school and has a volume of approximately 2140.6 m³, with a floor area of approximately 389.2 m² and a height of 5.5 m. From a height of 4.1 m above the ground floor, the walls have been lined with PVC openings with an area of approximately 71.15 m². The windows do not have any acoustical window inserts. The dimensions of the hall are 27.8 × 14 × 5.5 m. The hall is designed as a sports hall, without any bleachers and with sufficient ceiling height for the performance of most sports activities. The floor plan, cross section, and hall appearance are presented in Figure 1.

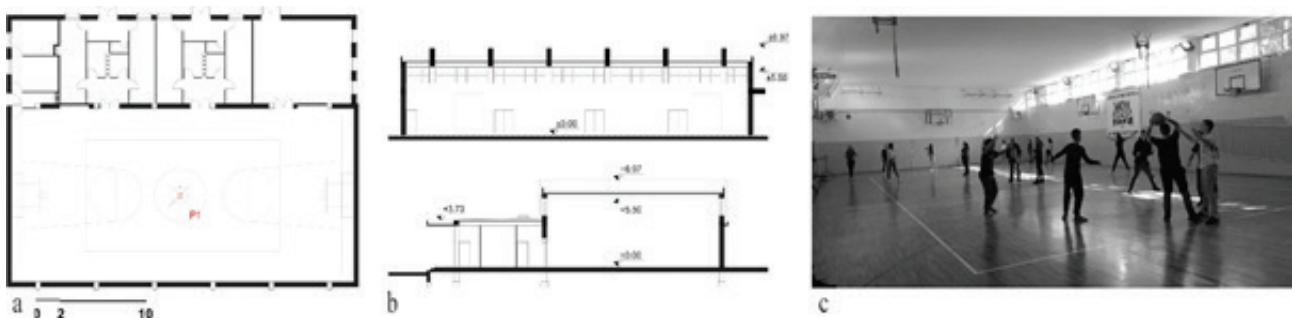


Figure 1. Sports hall in Maksim Gorki primary school in Podgorica, Montenegro (a - Hall plan with the position of the measuring instrument; b - Hall cross section; c - Free standing school)

Figure 1a also shows the position of the measurement instrument used. Measurements were carried out along one receiver line at the height of 1.5 m above the floor at the central axes of the room. During measurements the outdoor micro-climate

conditions were as follows: the temperature (t) was 17°C, relative humidity (Rv) had a range from 27 to 24%, wind speed and direction (V) N/a and the air pressure (P) was 1017.0mb. The exact time of measurement is given in the graphs in Figure 2.



Figure 2. a - Noise level in sports hall without activities; b - Noise level in sports hall during activities; c - Environmental noise level in the yard near the sports hall

The sports hall was renovated in 2014. During the renovation, the wall coverings made of carpet (for sound isolation) were removed, which caused more complex and inadequate acoustic conditions. Figure 2 shows three characteristic situations: the sports hall without activities (Figure 2a), the sports hall during activities (Figure 2b) and the environmental noise level in the yard near the sports hall (Figure 2a). Figure 2 shows that the noise equivalent is 45.2 dB (Figure 2a) before class and ranges up to 84.9 dB (Figure 2b) during class with 28 students. The students were exposed to the noise equivalent from 65.8 dB (Figure 2b) to 99.5 dB (Figure 2b) during class. Infiltration of external noise was not detected, which had been proven by environmental noise measurements (Figure 2c). Taking into account the fact that teachers sometimes have up to 7 classes per day, during class 90.7% of measurements

of the noise level were above 77 dB (Figure 2b), which falls within the global determinations of hearing risk that is based on exposure for a maximum limit of eight hours per day.

Sports hall 2

Sports Hall 2 is an integrated part of the Milorad-Musa Burzan primary school building and has a volume of approximately 1281.69 m³, with a floor area of approximately 212.2 m², which is the sports area and a height of 6.04 m, and approximately 120 m² of toilets and wardrobe with a height of 4.12 m. In the hall, there are 10 windows with PVC openings that cover an area of approximately 25.5 m². Windows do not have any acoustical window inserts. The floor plan, cross section, and hall appearance are presented in Figure 3.

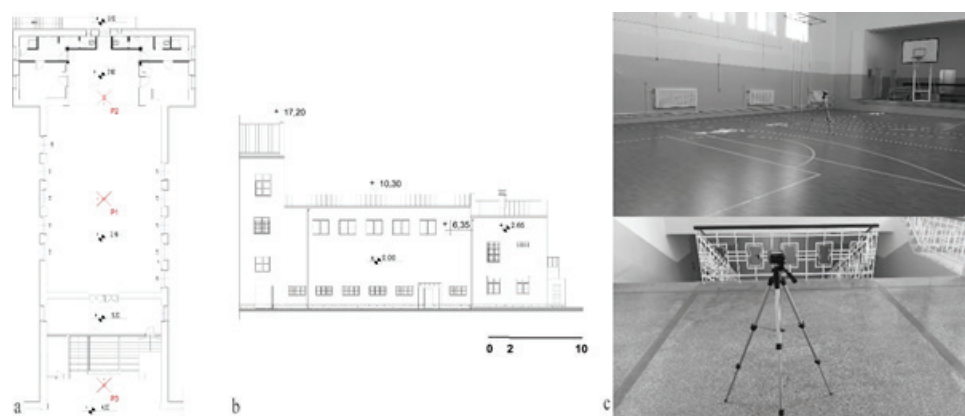


Figure 3. Sports hall in Milorad Musa Burzan primary school in Podgorica, Montenegro (a - hall plan with the position of the measuring instrument; b - Longitudinal façade; c - Free standing school sports)

Figure 3a also shows the position of the measurement instrument used. Measurements were carried out along one receiver line at the height of 1.5 m above the floor at the central axes of the room. During measurements the outdoor micro-climate conditions were as follows: the temperature (t)

was 19°C, relative humidity (Rv) 24%, wind speed 19-20 km/h and direction (V) was N/a, and the air pressure (P) was 1016.0 mb. The exact time of measurement is given in the graphs in Figure 4. The sports hall was renovated in 2016 in the context of improving the thermal conditions.

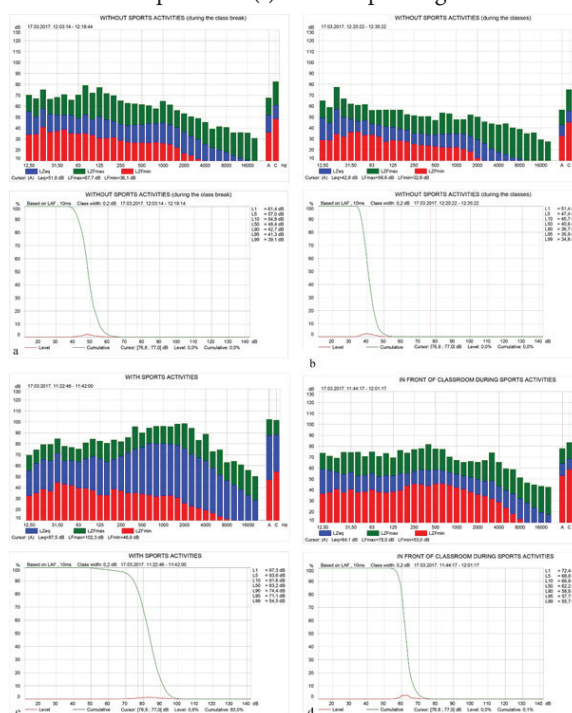


Figure 4. a - Noise level in the sports hall without activities (during the class break); b - Noise level in the sports hall without activities (during classes); c - Noise level in the sports hall during activities; d - Noise level in front of the classrooms during sports activities in the hall

Figure 4 shows four different situations: the hall without activities - during the class break (Figure 4a), the hall without activities - during class (Figure 4b), the hall during sports activities (Figure 4c) and noise from the hall measured in front of the classrooms (Figure 4d). Figure 4 shows that the noise equivalent without sport activities during the class break is 51.8 dB (Figure 4a) and during classes 42.8 dB (Figure 4b). The noise equivalent in the hall during sports activities during class with 32 persons in the hall and which was 87.5 dB (Figure 4c). Students were exposed to noise levels up to 102.3 dB (Figure 4c) during class. Also, Figure 4 presents the impact of noise from the hall on the school environment (the hall in front of the classrooms), where the noise equivalent was measured starting from 64.1 dB, with a maximum level of 78.0 dB (Figure 4d). It shows the impact of hall noise during

sports activities on classes in classrooms, which was especially increased after renovation when old wooden doors were replaced with new metal ones.

Sports hall 3

Sports Hall 3 is a free standing soccer curved tent with a steel construction positioned in the school yard at Sutjeska primary school and has a volume of approximately 8445.2 m³, with a floor area of approximately 1053.5 m² and a height of 10.5 m. The sports hall does not have any openings, but the tent is semi-transparent and thus lets enough daylight in. No HVAC systems are installed in the structure. The dimensions of the curved tent are 24 × 43 × 10.5 m. The floor plan, cross section, and hall appearance are presented in Figure 5.

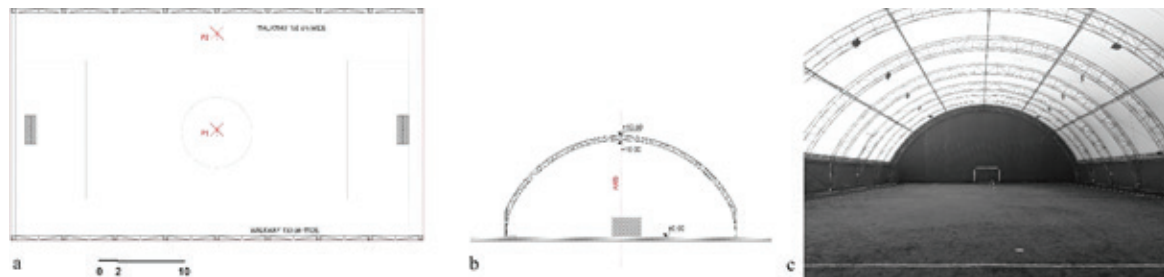


Figure 5. Sports hall in Sutjeska primary school in Podgorica, Montenegro (a - hall plan with the position of measuring instruments; b - hall cross section; c - free standing soccer curved tent with a steel construction positioned in the school yard)

It also shows the position of the measurement instruments used. Measurements were carried out along one receiver line at the height of 1.5 m above the floor at the central axes of the room in the case when there were no activities and 4 m from the walls and partitions, also in the central axes during sports activities. During measurements the outdoor micro-climate conditions were as follows: temperature (t) range from 19°C to 20°C, relative humidity (Rv) ranged from 24% to 23%, wind speed was 11-17 km/h and direction (V) was N/a, air pressure (P) was 1015.0 mb. The exact time of measurement is given in the graphs in Figure 6. During measurements, the interior temperature was 5°C–6°C higher than the outdoor temperature, which was caused by the semi-transparent tent material and the lack of openings and a ventilation system.

Figure 6 shows two typical situations: the hall without activities (Figure 6a) and the hall during activities (Figure 6b). Figure 6 shows that the noise equivalent was 50.6 dB (Figure 6a) before class up to 69.5 dB (Figure 6b) during class with 16 students. Students were exposed to a noise equivalent of 65.8 dB (Figure 6b) up to 99.5 dB (Figure 6b) during class. The measured noise level was above 77 dB (B) during 3.3% of the measuring time. Although the noise impact on the tent from the environment was higher than in cases 1 and 2, the four times higher dimension of the hall, the curved tent shape and the tent absorbing characteristics (like curtains), as well as the artificial grass on the hall floor, completely reduced the noise impact in this type of sports hall. In contrast to the poor thermal conditions, the acoustic conditions were far better than in traditional sports halls.

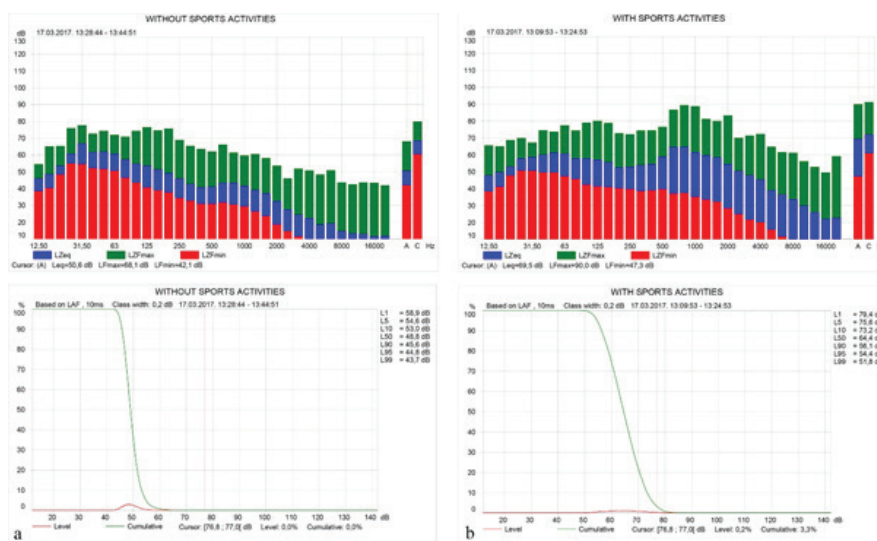


Figure 6. a - Noise level in the tent hall without activities; b - Noise level in the tent hall during activities

Discussion

The noise equivalent level for large sports halls during sports activities during the period of research was between 69.5–87.5 dB. The lowest level was measured in the tent sports hall (Sutjeska primary school) due to the large space, area and cubature and because of the artificial grass floor covering and pvc roof covering which are good absorbers of noise. The highest level of noise was measured in Sports Hall 2 (Milorad-Musa Burzan primary school), where the hall is integrated into the school building, and because it was in a stone building. This sound value is high, and it has an adverse impact on the nervous systems of both students and teachers. Additionally, in Milorad Musa Burzan primary school, it was detected that the noise from the sports hall could have an impact on classes, because the noise equivalent was 64.1 dB. This value is within the acceptable healthy limits (noise period), but it is not acceptable in terms of the classrooms (calmness standard), which is 35 (A) dB. In the Maksim Gorki primary school, the noise equivalent of 84.9 dB is high for educational activities, and being exposed to it for a more extended period could create health problems, especially for teachers.

Recommendations for resolving noise

The measuring results have shown that the existing halls do not have any adequate acoustical features. A series of architectural solutions can be applied to the halls in terms of hall design retrofitting, in order to provide better acoustical design, as well as noise protection, based on sound diffusors, noise barriers, and sound reflectors. School hall noise problems can be solved by a system of sound-absorbing units or new surface materials. Solutions range from retrofitting of primary building elements: the construction, the floor, the wall (openings) and the ceiling, the way of applying an insulating material, or in the form of plaster and the absorber installed inside the sports hall volume. Materials and construction elements that shape the finished spaces determine how sound will be perceived in that space (Cavanaugh, Tocci, & Wilkes, 2010).

Sound absorption coefficients of the floor, wall and ceiling materials and openings of the hall should be at the 125–4000 Hz frequency range in 1/1 octave band (Mezzo Stüdyo Co. Ltd., 2014). Ceilings and walls are more convenient for the installation of sound absorbers. The problem may arise if the hall

dimensions are tight, or if the ceiling is too low. In that case, reducing the hall volume should be avoided.

The possibilities among physical variable acoustic elements to be considered as physical-adjustable elements for the ceiling, wall, floor and openings, such as:

- Acoustic baffles and banners from a suspended ceiling system or mounted on the wall. Banners are usually free hanging and can be retracted through slots or folded into well-sealed boxes (Barron, 2010);
- Movable reflecting panels with different acoustical characteristics of different surfaces;
- Variable scattering elements could be mounted on horizontal ceiling surfaces that could be transformed into a coffered surface with slats lowered through slots from above. "Free-standing scattering elements could also be lowered to introduce scattering. A change in degree of scattering of a surface carries less impact than change in absorption or orientation" (Barron, 2010);
- Sound absorption modules and materials that can be applied on the wall or ceiling. Possible options range from acoustic fiberglass, acoustic foam, acoustic partitions, acoustic cotton, hanging baffles, Echo elimination, cellulose panels, multi-layer sound absorption panels, wool panels covered with acoustically transparent fabric, etc.;
- Sound diffusors that reduce the intensity of sound by scattering it over an expanded area (Quadra pyramid diffusors, pyramidal diffusors, double duty diffusors, quadratic diffusors etc.);
- Fabric covering or fabric wrapped panels as sound-absorbing curtain modules in front of tribune's rear wall, side walls, front walls and at the openings between the service and sports areas (Ulusoy, 2014);
- Replacement of existing windows with acoustical window inserts;
- Replacement of floor surfaces with different sound absorption characteristics etc.

The budget needed for satisfactory remediation has been estimated to vary in the range from 4.5% to 6.9% of the overall construction cost. The results also pointed out the critical concerns of acoustical design, particularly for sports halls (Ulusoy, 2014). Continuous development of materials and technology are meeting the needs for resolving noise pollution in school sports halls.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

The Mediation Effect of Corporate Image and Corporate Attitude on the Relationship between the Social Responsibility Activity of Sports Enterprises and the Loyalty of Customers

Kyongmin Lee¹, YongKoo Noh² and Kang-Won You³

¹Dankook University, Department of Sport Management, Cheonan, Korea, ²Korea Institute of Sport Science, Department of Policy Development, Seoul, Korea, ³Jeonju University, Department of Soccer, Jeonju, Korea

Abstract

The direct causal relationship between Corporate Social Responsibility activity and customer loyalty has been dealt with in many research studies, but there is a lack of discussion on the parameters that may affect the relationship between the two variables. Thus, this research selected corporate image and corporate attitude as parameters that could affect the relationship between the social responsibility activity of sports enterprises and customer loyalty and empirically investigated the relationship of each variable. For this research, the survey targeted 300 students of a four-year university located in the Gyeonggi-do, Chungcheong-do, and Jeolla-do regions of the Republic of Korea using a convenience sampling method. The main results of the hierarchical multiple regression analysis based on the mediation effect analysis method proposed by Baron and Kennedy are as follows: First, the social responsibility activity of sports enterprises was found to have a positive impact on the following factors: 1) corporate loyalty, 2) corporate image, 3) corporate attitude. Second, the corporate image was found to have a positive impact on customer loyalty. Third, the corporate attitude was found to have a positive impact on customer loyalty. Fourth, the social responsibility activity of sports enterprises was found to have a positive impact on customer loyalty through the corporate attitude and corporate image.

Keywords: corporate attitude, corporate image, customer loyalty, social responsibility activity of sports enterprises

Introduction

Necessity & purpose of the research

It is a deniable fact that private enterprise has contributed much to the material affluence of society. However, as the primary purpose of an enterprise gradually degenerates as profit-seeking, it receives continuous criticism for neglecting many social issues, such as the environment and income inequality (Seong & Seo, 2010). In the sense that society has given legal personhood to corporations, it can be said that companies are

not the property of a particular group, but rather the property of society. Accordingly, there has been a growing global demand for the implementation of CSR (Corporate Social Responsibility) requiring corporations to be actively involved in solving social problems in the process of generating profits (Zu & Song, 2009).

According to the advent of a hyper-connected society characterized by openness, cooperation, and connectivity, various stakeholders are involved in the corporate management pro-



Correspondence:

Y. Noh

Korea Institute of Sport Science, Department of Policy Development, 727 Hwarang-ro, Nowon-gu, Seoul, Korea

E-mail: ynoh@kspo.or.kr

cess, and their voices are growing (Anggusti, 2018). Therefore, the involvement of enterprises in solving social problems, such as solving employment problems in communities that are of interest to corporate stakeholders, improving the welfare of employees, and eco-friendly management for the global environment, is not only a required condition to create a sustainable enterprise but also an important management strategy for enterprise growth.

Under these trends, studies on the impact of CSR activity on corporate performance have been actively performed in various fields. For example, the research of Hsu (2018) showed that the social responsibility activity of mobile communication corporations has a positive effect on consumer satisfaction, corporate image, and customer loyalty and that CSR has a positive effect on corporate image and customer loyalty by mediating consumer satisfaction. In the fields of sports, it has been proven that CSR activity can be utilized as an essential marketing tool in securing loyal customers. A study by Oh (2016) on the relationship between the social responsibility and the customer loyalty of the professional basketball team found that ethical responsibility among the CSR activity types had a positive effect on the repurchase intention and oral effects and that ethical and economic responsibilities had a positive effect on the corporate preferences and the formation of low price sensitivity. These research results show that CSR activity can not only have a positive effect on consumer belief and belief for its products and services, emotional evaluation and purchasing behaviour, but also help maintain amicable relationships with existing customers over the long-term.

The fact that CSR activity is an essential determinant of customer loyalty and that competition between companies or products is intensified provides significant marketing implications: because there is a tendency that customers who have high loyalty prefer products and services of a particular company even in the situation of inter-company competition (Han, Y. Kim, & E.K. Kim, 2011). Thus, through CSR activity, the corporation enables existing customers to continue to be immersed psychologically or emotionally for the corporation, which will contribute ultimately to profit creation (Yusof, Manan, N.A. Kassim, & N.A.M. Kassim, 2015).

However, as mentioned by Martinez and Bosque (2013), most research on the relationship between CSR and customer loyalty has identified a direct causal relationship between the two variables. Also, empirical discussion on the parameters between the two variables was insufficient. Thus, efforts for defining the theoretical model by finding the existing parameters between the two variables will be helpful to understand the CSR effects in the relationship between CSR activity and customer loyalty from a multi-dimensional view and establish an efficient marketing strategy for improving the customer loyalty.

Based on the prior research, corporate image and corporate attitude were selected as parameters that could affect the relationship between CSR and customer loyalty in this research. CSR activity contributes to the formation of positive corporate image (Hsu, 2018), and the corporate image is identified as critical leading variables in the formation of customer loyalty (Choo & Kim, 2012). In addition, CSR activity affects the attitudes of customers toward the corporation (Distefano & Pisano, 2016), and the corporate attitude is reported as a cause of direct influence on customer loyalty (Doorn, Onrust, Verhoef, & Bügel, 2017). Therefore, the purpose of this re-

search is to empirically analyse the effect corporate image and corporate activity have on the relationship between the social responsibility activity of sports enterprises and customer loyalty.

Research hypothesis

CSR activity is known to play a critical role in securing and maintaining customers who have high loyalty. In a study that Martinez and Bosque (2013) performed for hotel customers, the social responsibility activity of a hotel was found to have a positive effect on customer loyalty by mediating reliability, consumer-business identification and satisfaction. A study of Pérez and Bosque (2015) for customers of a bank also found that the social responsibility activity of a bank had a positive effect on customer satisfaction, word-of-mouth effectiveness and repurchasing intention. Therefore, based on these theoretical grounds, the hypothesis was established as follows:

Hypothesis 1. The social responsibility activity of sports enterprises will have a positive effect on customer loyalty.

In a society in which competition between companies or products is intensifying, and competition is based on non-price factors rather than price, consumers consider the company image in making their purchase decisions (Jeong, Kim, & Park, 2012). In light of a prior research of the relationship between CSR and corporate image, the research results of Lee, Kim, and Jin (2015) showed that there was a positive definition relationship between CSR and the corporate image and that relative influence of marketing communication CSR activity was greater than other CSR types. Therefore, based on this theoretical ground, the next hypothesis was established:

Hypothesis 2. The social responsibility activity of sports enterprises will have a positive effect on the corporate image.

In light of the prior research on CSR activity and corporate attitude, Pino, Amatuli, De Angelis, and Peluso (2015) found that the higher the consumer awareness of corporate charitable and legal social responsibility, the higher the favourable attitude toward the enterprise; Doorn, Onrust, Verhoef, and Bügel (2017) also found that CSR had a positive effect of consumers toward corporate attitudes. Therefore, based on these theoretical grounds, the next hypothesis was established:

Hypothesis 3. The social response activity of sports enterprises will have a positive effect on the corporate attitude of consumers.

Corporate image is known to be a critical variable for maintaining and raising customer loyalty. In light of research on the relationship between company image and customer loyalty, Kim and Lee's (2010) research on a Korean mobile communication company showed that corporate image is a critical leading variable for the formation of customer loyalty; Choo and Kim (2012) also found that the better the image of a restaurant franchise chain, the higher the customer loyalty. Therefore, based on these theoretical grounds, the next hypothesis was established:

Hypothesis 4. The corporate image will have a positive effect on customer loyalty.

Given that the customer attitude toward the enterprises formed through information, and that experience affects the loyalty toward the enterprises (Y.M. Kim & S.Y. Kim, 2011), forming a positive belief and favourable feeling of customers toward enterprises, can be seen as a prerequisite for raising customer loyalty. In the research of Hasbullah (2015), attitude was found to have a high positive correction of 0.867 with loyalty intention. Thus, based on these theoretical grounds, the

next hypothesis was established:

Hypothesis 5. The corporate attitude will have a positive effect on customer loyalty.

Meanwhile, corporate attitude and corporate image are found to be mediated between the CSR and customer loyalty. In the research of Urandelger, Bae, and Lee (2014) on the relationship between the corporate social responsibility, customer satisfaction, and customer loyalty, the CSR activity of enterprises was found to have a positive effect on customer satisfaction through the corporate image. Thus, based on this theoretical ground, the next hypothesis was established as follows:

Hypothesis 6. The social responsibility activity of sports enterprises will have a positive effect on customer loyalty through the corporate image and corporate attitude.

Methods

Participants

The population of this research was configured as university students who are aware of the social responsibility activity of sports enterprises, and a survey was performed using a convenient sampling method with four-year university students as a sample located in the Gyeonggi-do, Chungcheong-do, and Jeolla-do regions in the Republic of Korea. A total of 350 questionnaires were distributed, and the retrieved 300 questionnaires, excluding insincere responses, were used for final analysis.

Measures

To measure the social responsibility of sports enterprises, a questionnaire used by Jung and Kim (2012) was modified for the present study. It was a single factor questionnaire composed of four questions. Its reliability was found to have an internal consistency of $\alpha=.977$. To measure the corporate image, the questionnaire used by Wang and Han (2017) was

modified for the present study. The corporate image was a single factor, consisting of three total questions. The reliability of the questionnaire was found to have an internal consistency of $\alpha=.907$. To measure the corporate attitude, the questionnaire used by Oh and Cha (2017) was modified. The corporate attitude was a single factor, consisting of three total questions. The reliability of the questionnaire was found to have an internal consistency of $\alpha=.819$. To measure customer loyalty, a questionnaire used by Yoon and Ryu (2014) was modified for the present study. Customer loyalty was a single factor, consisting of four questions. The reliability of the questionnaire was found to have an internal consistency of $\alpha=.927$. The questionnaires used in this research, except for the general characteristics of the research participants, were measured as five points of a Likert scale.

Data analysis

The collected data in this research were analysed using SPSS 23.0. Reliability analysis and correlations analysis were performed to identify the reliability of the measurement items and the correlations among the measurement variables respectively. Next, to verify whether corporate image and corporate attitude act as parameters in the relationship between CSR and customer loyalty of sports enterprises, a hierarchical multiple regression analysis was performed using the mediation effect analysis method proposed by Baron and Kenny (1986).

Results

Correlations results

As shown in Table 1, significant positive correlations at $p<.01$ level were found, among the social responsibility activity of sports enterprises, corporate image, corporate attitude, and customer loyalty.

Table 1. Correlations between Social Responsibility of Sports Enterprises, Corporate Image, Corporate Attitude, and Customer Loyalty (N=300)

Variable	M	SD	1	2	3	4
CSR	3.59	0.49	1			
Corporate Image	3.82	0.50	0.490**	1		
Corporate Attitude	3.80	0.48	0.424**	0.411**	1	
Customer Loyalty	3.93	0.55	0.481**	0.389**	0.459**	1

** $p<.01$

Hypothesis testing

As shown in Table 2, in Step 1, the CSR activity was found to have a significant impact on the corporate image ($\beta=.490$, $p<.001$); in Step 2, the effects of CSR activity on customer loyalty were also found to be significant ($\beta=.481$, $p<.001$). In addition, in Step 3, the corporate image was found to have a significant impact on customer loyalty

($\beta=.202$, $p<.001$). In conclusion, since the regression coefficient ($\beta=.481$) of CSR activity derived from Step 2 is greater than the regression coefficient ($\beta=.382$) of CSR activity derived from Step 3, the mediation effect of corporate image was identified as being significant in the relationship between the social responsibility activity of sports enterprises' activity and customer loyalty.

Table 2. Corporate Image's Mediating Effect on the Relationship between Social Responsibility Activity of Sports Enterprises and Customer Loyalty (N=300)

Step	Variable	B	SEB	β	F	R ²
1	CSR activity→Corporate Image	.499	.052	.490***	93.920***	.240
2	CSR activity→Customer Loyalty	.544	.057	.481***	89.693***	.231
3	CSR activity→Customer Loyalty	.432	.065	.382***	52.784***	.262
	Corporate Image →Customer Loyalty	.223	.063	.202***		

*** $p<.001$

As shown in Table 3, in Step 1, the CSR activity was found to have a significant impact on the corporate attitude ($\beta=.424$, $p<.001$); in Step 2, the effects of CSR activity on customer loyalty were found to be significant ($\beta=.481$, $p<.001$). In addition, in Step 3, the corporate attitude was also found to have a significant impact on customer loyalty ($\beta=.359$, $p<.001$). In con-

clusion, since the regression coefficient ($\beta=.481$) of CSR activity derived from Step 2 is greater than the regression coefficient ($\beta=.349$) of CSR activity derived from Step 3, the mediation effect of corporate attitude was identified to be significant in the relationship between the social responsibility activity of sports enterprises and the customer loyalty.

Table 3. Corporate Attitude's Mediating Effect on the Relationship between Social Responsibility Activity of Sports Enterprises and Customer Loyalty (N=300)

Step	Variable	B	SE B	β	F	R ²
1	CSR activity→Corporate Attitude	.415	.051	.424***	65.201***	.180
2	CSR activity→Customer Loyalty	.544	.057	.481***	89.693***	.231
3	CSR activity→Customer Loyalty	.395	.060	.349***	66.946***	.311
	Corporate Attitude →Customer Loyalty	.359	.061	.311***		

***p <.001

Discussion

First, the CSR activity was found to have a positive effect on the customer loyalty of university students. The enterprise performing social responsibility activity is recognized by consumers as a corporation performing the right roles and functions that society expects (Vahdati, Mousavi, & Tajik, 2015). Consumers have a favourable attitude toward corporates participating in social responsibility activity and tend to trust and prefer their products and services (Oh, 2016). Accordingly, sports enterprises need to establish a CSR strategy to prepare the policies and procedures that integrate social, environmental, ethical, human rights or consumer interests into the business operation and core strategy to raise the customer loyalty.

Second, the CSR activity was found to have a positive effect on the corporate image of university students toward sports enterprises. The reason that CSR activity has a positive effect on the evaluation and attitude for customers is because the focus of such activity is set in a direction balancing the vision and goal of the enterprises and the interests and welfare of society, rather than the pursuit of the interests of enterprises (Heikkurinen & Ketola, 2012). Through CSR activity, an enterprise can create an image of a good corporate citizen that aims for social value, such as managing an ethical responsibility, protecting human rights and preparing protective guards for the environment, rather than merely pursuing the material goal of profit creation through the provision of products and services (Seong, 2017). Thus, to improve the corporate image of consumers toward sports enterprises, the sports enterprises need to participate actively in social issues, such as job problems in the community, improvement of employee welfare, protection of the global environment, protection of human rights, and opposition to animal testing.

Third, the CSR activity was found to have a positive effect on the attitude of university students toward sports enterprises. This result is in line with the studies (Distefano & Pisano, 2016; Pino et al., 2015) that insisted that CSR activity has a positive effect on the response and attitude of customer toward the enterprises. Thus, providing the public with information that the purpose of the existence of enterprises is not just to pursue profit but to strive to create a better world for those who have difficulties; CSR activity can bring positive changes in the consumer's cognitive, emotional and behavioural attitudes toward enterprises (Distefano & Pisano, 2016).

Fourth, the image of sports enterprises was found to have

a positive effect on the loyalty of university student customers. The key role of corporate image is to bring a positive attitude of consumer toward the products and services provided by the enterprises (Stoyanov, 2017). The image of consumers toward sports enterprises can be formed by the quality level, the service level of salespersons (Agyei & Kilika, 2014), the philosophy and vision of the enterprises (Dowling, 1986), and the marketing activities deployed by the enterprise (Barich & Kotler, 1991). The image of sports enterprises formed by these corporate image determinants affects the formulation and change of the attitude on products and services provided by the sports enterprises, and the attitude is ultimately shown as a psychological driver affecting the behavioural intention. Therefore, to raise the loyalty of consumers, sports enterprises need to endeavour to form a positive corporate image.

Fifth, the attitude of university student consumers toward sports enterprises was found to have a positive effect on the loyalty of university student customers. It is consistent with the result of Y. M Kim and S. Y. Kim's study (2011) that reported that the more favourable attitude of the consumer toward the enterprises, the higher the customer loyalty toward the products and services of corresponding enterprises. Thus, sports enterprises need to endeavour to have a favourable attitude toward their own enterprises to raise the loyalty of customers.

Sixth, the corporate image and the corporate attitude was found to be mediated in the relationship between the CSR activity and the customer loyalty. These results show that the social responsibility activity of sports enterprises contributes to the formation of a favourable image and attitude of university student consumers toward the corresponding enterprise, and that these positive corporate images and corporate attitudes play an essential role in the improvement of customer loyalty. Thus, it seems that sports enterprises need to deploy the CSR activity on various social issues in which the public is interested in improving customer loyalty and that the strategic plans are necessary to form positive corporate image and corporate attitude.

The results of this research show that the CSR activity of sports enterprises not only has a positive effect on the image and attitude of customers toward enterprises but also contributes much to the improvement of customer loyalty. However, this study has the following limitations. First, as the survey target of this research is limited to university students in some regions of Korea, the results cannot be generalised to consumers of all ages in other countries. Second, in this research, the

corporate image and corporate attitude were selected as parameters of CSR activity and customer loyalty based on prior research. In further research, it seems necessary to explore

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

A Study on the Development Strategy for Marine Leisure Tourism: Using the Importance Performance Analysis (IPA) Method

Dahye Jang¹, Woojeong Cho¹ and Kyongmin Lee²

¹Korea Maritime & Ocean University, Department of Ocean Physical Education, Pusan, Korea, ²Korea Institute of Sport Science, Department of Policy Development, Seoul, Korea

Abstract

Although research on marine leisure tourism is steadily increasing, there has been a gap between the South Korean government's supply-centred policies and the demands of the public as potential consumers. Thus, the purpose of this study was to investigate the marketing needs of marine leisure tourism consumers to suggest a plan for the development of it. For this purpose, a total of 412 visitors to the Busan International Boat Show were surveyed in order to understand better the marketing needs of marine leisure tourism consumers, and the results were analysed for the magnitude of satisfaction centred around the 4Ps of marketing to suggest marketing elements that should be reflected first in the policy of the government as supplier. Quadrant I in the IPA Matrix included facility convenience, programme diversity, programme safety, and programme speciality. Quadrant II included equipment purchase/rental cost, ease of accessibility, and programme use prices. Quadrant III included food and beverage cost, convenience facility fees, and programme differentiation. Quadrant IV contained include mass media promotion, providing amenities and facilities, social media promotion, linkage with tourist attractions in neighbouring areas, and promotional events, materials, and brochures. These results may provide a foundation for comprehensive development plans for marine leisure tourism.

Keywords: *marine industry, marine leisure tourism, marketing mix, importance-performance analysis*

Introduction

Marine tourism, among other maritime industries, greatly contributes to the economy of the nations that are bordered by the ocean, and many countries are creating added value with it. Demand for marine tourism grew steadily from 25 million consumers in 1950 to 187 million in 2013, unlike other industries that have been affected by the rapidly changing global economy over the past six decades (Organization for Economic Cooperation and Development (OECD), 2016).

The marine tourism industry grew at an annual average

rate of 7% over the four years from 2010 to 2013 (United Nations Conference on Trade and Development (UNCTAD), 2014), and half of the more than one billion international tourists in 2012 reported participating in marine tourism (United Nations World Tourism Organization (UNWTO), 2012). As of 2010, marine tourism accounted for 26% of the marine industry, following marine petroleum and natural gas (34%), and marine tourism is expected to become the largest marine industry by 2030 (26%; OECD, 2016).

The marine industry in the United States accounts for 1.8% of total industrial GDP and 2.3% of job creation, while



Correspondence:

K. Lee

Korea Institute of Sport Science, Department of Policy Development, 727 Hwarang-ro Nowon-gu, Seoul, Korea

E-mail: dsukmlee@naver.com

marine tourism boasts 72% employment and a 36% economic contribution to the marine industry (National Oceanic and Atmospheric Administration (NOAA), 2017). The UK marine tourism industry is worth more than three billion euros and more than 3.2 million people, or 6.5% of the total population, participate in marine tourism activities. In addition, marine tourism in Australia is the largest contributor to the marine industry (\$28 billion), while marine tourism-related leisure fishing (\$2.16 billion), leisure boat manufacturing and repair (\$1.26 billion), and marina and boat infrastructure (US\$700 million) also contribute to the industry (Austrian Institute of Marine Science (AIMS), 2016).

In advanced countries, the activities of marine tourism, which have been attracting attention as a key part of the marine industry, include underwater leisure activities, such as scuba diving and snorkelling, as well as other marine leisure activities like yachting, motorboating, canoeing and kayaking in tourist programmes (Busan Development Institute (BDI), 2016). The global marine leisure market is worth \$45 billion, and the underwater leisure tourism market is estimated to be worth more than \$6 billion.

In South Korea, the marine tourism market is expanding from traditional marine tourism activities such as marine landscape appreciation, sea bathing, and enjoying seafood to more active and adventurous marine leisure activities. According to a study conducted by the Korea Maritime Institute (2018), there has been a steady increase in demand for marine fishing, cruise tourism, and marine leisure activities.

The interest and investment of the Korean government and municipalities in marine leisure tourism is continuously increasing. The Ministry of Oceans and Fisheries of Korea (2018) designated “marine leisure tourism” as a future growth engine of the country and established a new “marine leisure tourism department” to enhance the competitiveness of the industry. Furthermore, local governments are stepping up efforts to develop and promote marine leisure tourism programmes in connection with the government’s mid- and long-term marine tourism and marine leisure tourism development policies in anticipation of the revitalization of the local economy and the effects of urban marketing.

With continuing interest and investment in marine leisure tourism by central and local governments, academic research is also focusing on various aspects of the industry. According to the analysis of experts in the industry, marine leisure tourism research can be divided into demand-side and supply-side research. For demand-side research, Kim and Hwang-bo (2016) surveyed marine tourism activity preferences considering consumer characteristics to suggest plans for increasing marine leisure tourism, and the Busan Development Institute (2016) used the contingent valuation method (CVM) to assess the economic value of marine sports to suggest consumer-centred plans. Kim, Lee, and Jang (2017) analysed the socio-demographic characteristics of marine leisure tourism event users and conducted a study

to investigate the effect of event image and satisfaction of visitors on their intentions to revisit and recommend events to others.

As for supply-side research to suggest policy measures to increase marine leisure tourism, Hong (2014) has pointed out the problems of domestic marine leisure tourism policy and has suggested water-friendly cultural projects to promote marine leisure. Kim (2014) also suggested development plans of marine leisure tourism in Gangwon Province based on the conclusions drawn from the analysis of domestic and international cases and conditions, while Kwon and Mun (2015) conducted a study to determine a legal basis for legislation to encourage marine leisure tourism and to investigate current legislation that presents obstacles to increasing marine leisure tourism.

The results of these studies are significant in that they yielded marketing strategies for appealing to consumers of marine leisure tourism and provided the basic data necessary for the formulation of marine leisure tourism policy at a national level. However, despite the fact that the central government and municipalities have been pursuing multi-pronged policies for the establishment of infrastructure, and the popularization and advancement of marine leisure tourism for more than a decade, the marine leisure population, based on which the market size can be estimated, remains below the level of other developed countries. The policies of the government and municipalities have been focused on supply-centred activation plans. The policies also partly reflect the attitude and intention of the government to expand the related market strategically, but they cannot be exempt from the criticism that they did not adequately address demands and needs of the public as potential consumers of marine leisure services and products.

In other words, there has been a gap between the government’s supply-centred policies and the demands of the public as potential consumers. At the same time, government plans to promote marine leisure tourism have failed to reflect fully the preferences and needs of potential consumers. For example, government programmes mostly focused on yachting, but analysis of the marketing needs of consumers showed the public prefers more affordable and accessible activities, like canoeing or kayaking, which are also popular in most countries with advanced marine tourism industries (BDI, 2016).

Against this backdrop, this study aims to re-examine the development strategies for revitalizing marine leisure tourism pursued by the central and local governments of South Korea and to scientifically analyse the marketing needs of marine leisure tourism consumers and effectively reflect them in the supply-centred marine leisure policies of the government. For this purpose, this study presents the strategy of developing marine leisure tourism through the Importance Performance Analysis (IPA) of factors constituting the marketing mix of marine leisure tourism for the consumers.

and satisfaction level of the factors derived from the marketing mix through the panel discussion. A total of 412 questionnaires were collected directly at the site. Of the collected questionnaires, 25 were excluded, as they had unanswered questions or incomplete responses; the remaining 387 were analysed. Table 1 shows the general characteristics of the consumers.

Methods

Participants

This study selected the visitors of the Busan International Boat Show, between 26 and 29 April 2018, as a population from which to extract samples using convenience sampling out of non-probability sampling methods to ascertain the importance

Table 1. Demographic Details of the Participants

Characteristic		Frequency	Percentage
Gender	Male	237	61.2
	Female	150	38.8
Age	Under 20	19	4.9
	20 to 29	225	58.1
	30 to 39	63	16.3
	40 to 49	49	12.7
	50 and over	31	8
Education	HS graduate or less	54	14
	Some college	305	78.8
	College graduate	28	7.2
Income	Under \$12,000	185	47.8
	\$12,000 to \$23,999	54	14
	\$24,000 to \$35,999	58	15
	\$36,000 to \$47,999	33	8.5
	\$48,000 and over	57	14.8

Research tool

The questionnaire used in this study was drafted based on the preceding studies and preliminary investigations, and questionnaires were created through the verification of content validity by a group of marine leisure tourism experts.

The questionnaires were drafted based on the factors sug-

gested in the previous studies, such as marine leisure or marine tourism, to accommodate the purpose of this research before conducting preliminary investigations. In the preliminary study, the suitability and applicability of the contents were examined, revised, and supplemented before being used. The main components and contents of the questionnaire are listed in Table 2.

Table 2. Questionnaire Configuration

Factor	Item	Number of Items
Product	Programme safety	4
	Programme diversity	
	Programme speciality	
	Programme differentiation	
Price	Programme use prices	4
	Food and beverage cost	
	Convenience facility fees	
	Equipment purchase/rental cost	
Place	Facility convenience	4
	Ease of accessibility	
	Linkage with tourist attractions in neighbouring areas	
	Providing amenities & facilities	
Promotion	Social media promotion	4
	Promotional materials & brochures	
	Mass media promotion	
	Promotional events	

The questionnaire consisted of six general questions, eight questions about consumption behaviour, and 16 IPA assessment questions pertaining to the marine leisure tourism marketing mix. The questionnaire items were measured with a nominal scale and a five-point Likert Scale.

Validity test

A factor analysis was conducted to guarantee the validity

and the marketing factors of marine leisure tourism were applied to the Importance Performance Analysis (IPA). As shown in Table 3, the questionnaire about the importance of marketing factors consisted of four factors: promotion, price, product, and place. The factors accounted for about 64% of the total variance, and the reliability coefficients of the questionnaire were all over .7 ($\alpha = .759-.856$), thus providing reliability.

Table 3. Factor Analysis of the Importance of Marketing Factors Questions

	Item	Factor 1	Factor 2	Factor 3	Factor 4
Promotion	MMP	.817			
	PE	.812			
	PMB	.802			
	SMP	.748			
Price	CFF		.837		
	FBC		.830		
	EPRC		.703		
	PUP		.693		
Product	PSP			.796	
	PDIV			.781	
	PDIF			.699	
	PSA			.631	
Place	EA				.800
	FC				.774
	PAF				.620
	LTN				.557
	Eigenvalue	2.910	2.528	2.423	2.335
	% of Variance	18.185	15.797	15.141	14.595
	Cumulative %	18.185	33.982	49.124	63.718
	Cronbach's α	.761	.803	.759	.856

Legend: MMP - Mass media promotion; PE - Promotional events; PMB - Promotional materials & brochures; CFF - Convenience facility fees; FBC - Food & beverage cost; EPRC - Equipment purchase/rental cost; PUP - Programme use prices; PSP - Programme specialty; PDIV - Programme diversity; PDIF - Programme differentiation; PSA - Programme safety; EA - Ease of accessibility; FC - Facility convenience; PAF - Providing amenities & facilities; LTN - Linkage with tourist attractions in neighbouring areas

As shown in Table 4, the questionnaire about the satisfaction of marketing factors consisted of four factors: promotion, price, product, and place. The factors accounted for about 70%

of the total variance, and the reliability coefficients of the questionnaire were all over .7 ($\alpha = .825-.876$), thus demonstrating internal consistency.

Table 4. Factor Analysis of the Satisfaction of Marketing Factors Questions

	Item	Factor 1	Factor 2	Factor 3	Factor 4
Promotion	MMP	.818			
	PE	.794			
	PMB	.774			
	SMP	.715			
Price	CFF		.826		
	FBC		.784		
	EPRC		.779		
	PUP		.678		
Product	PSP			.781	
	PDIV			.775	
	PDIF			.774	
	PSA			.631	
Place	EA				.732
	FC				.725
	PAF				.686
	LTN				.622

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Item	Factor 1	Factor 2	Factor 3	Factor 4
Eigenvalue	3.012	2.911	2.727	2.582
% of Variance	18.826	18.197	17.031	16.140
Cumulative %	18.826	37.023	54.053	70.193
Cronbach's α	.842	.867	.825	.876

Data processing

The collected data were subjected to a frequency analysis and IPA after excluding unsuitable data through coding and data cleaning. First, a frequency analysis was conducted to examine the demographic characteristics of the subjects. Second, an Exploratory Factor Analysis was conducted to verify the validity of marine leisure tourism products, prices, places, and promotional factors. The reliability of the data was then verified through Cronbach's α coefficients, which measure internal consistency between the items. Third, an IPA was

conducted for 4Ps based on marine leisure tourism consumers using SPSS 23.0.

Results

Figure 1 is the IPA matrix of all the items selected from the marketing mix of marine leisure tourism. It is a matrix of the average values of importance and satisfaction for each factor for all items. The centre of the matrix is the same as in the Likert 5-point scale, with an average of importance (3.90) and an average of satisfaction (3.30).

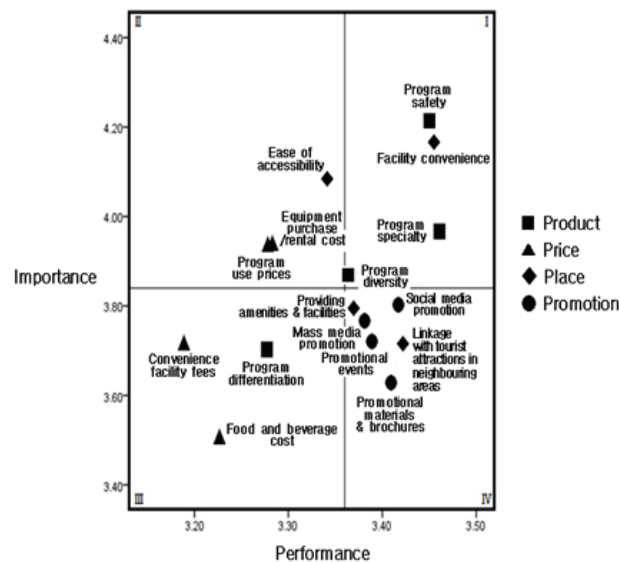


Figure 1. IPA Matrix of Marine leisure tourism marketing mix based on tourism consumers

The attributes of quadrant I, “keep up good work”, have both high importance and satisfaction, which means that continuous maintenance and management are necessary to stay relatively superior. These factors include facility convenience, programme diversity, programme safety, and programme speciality.

The attributes of quadrant II, “concentrate here”, are considered underperforming and, as such, represent the product's major weaknesses and threats to its competitiveness. These attributes have the highest priority in terms of efforts to enhance the level of satisfaction. These factors include equipment purchase/rental cost, ease of accessibility, and programme use prices.

The attributes of quadrant III, “low priority”, are considered low both in importance and satisfaction and include food and beverage cost, convenience facility fees, and programme differentiation. These attributes do not require further efforts, and it is considered unimportant to devote additional resources to them.

Quadrant IV, “possible overkill”, contains attributes of low importance to customers, which are performing strongly, indicating a possible waste of limited resources. These factors include mass media promotion, providing amenities and facilities, social media promotion, linkage with tourist attractions in neighbouring areas, and promotional events, materials, and brochures.

Discussion

Based on the results of the analysis of importance-satisfaction (IPA) of the customer-based marine leisure tourism marketing mix, the marketing strategies to develop marine leisure tourism are suggested as follows.

Product strategy

This research is in agreement with the study of Roh and Kim (2014) in placing “programme differentiation” in quadrant III. It was revealed that differentiation of tourism products is important to attract tourists to the destination and it is necessary to accommodate the different needs of consumers by market segment because they show different preferences according to gender and age (Yeo & Kim, 2014; Choi, 2010; Jeon, 2012).

Jeon (2012) argues that younger consumers are more likely to be interested in the equipment and learning skills of marine leisure tourism and should be provided with differentiated programmes to obtain new knowledge regularly. Therefore, consumers in their twenties and thirties should be given programmes by level, based on learning how to use equipment, while more static and non-active tourist programmes like un-

derwater landscape appreciation need to be provided for those in their forties to sixties.

According to the analysis of consumption patterns of the marine leisure tourism consumers surveyed for this research, most consumers have had experiences with power-type marine leisure activities, such as motorboat and rubber boat riding, followed by towed sport-type activities, such as banana boat riding and water-skiing. However, for most of them, the experience was no more than a one-time experiential activity, and measures should be prepared to encourage consumers to participate in these types of activities more frequently and regularly. For example, a package tour product could be developed and provided for those in their twenties and thirties, as that demographic is more likely to enjoy these activities. According to the National Survey on Marine and Fisheries, middle-aged people (in their forties to sixties) prefer enjoying scenery (Korea Maritime Institute, 2018). To reach this group of consumers, the marine leisure tourism industry should consider developing marine landscape appreciation programmes using power-type marine leisure vehicles.

Price strategy

According to the trend analysis of the Korea Maritime Institute (2018), one of the major obstacles to promoting domestic marine tourism is its high price. In previous studies by Choi, Han, and Lee (2013), Kang and Kim (2012), and Jeon (2012), as well as in this research, the price of marine leisure tourism ranks at a high level of importance but reveals a low level of satisfaction. It is expected that a decrease in price will encourage consumers to keep participating and specific measures, such as membership programs, mileage rewards programs, and birthday or anniversary discounts, were suggested to ease the price burden on consumers.

Consumers in their twenties and thirties are sensitive to the price of tourist products, and it is important to offer a variety of discount programmes to attract those young consumers. In fact, many studies have confirmed that most participants of marine leisure tourism activities are in their twenties and thirties and that this demographic considers KRW 10,000 to 50,000 (USD 10 to 50) per use the appropriate cost for marine leisure tourism activities. However, most marine leisure tourism programmes are beyond a price that consumers can afford, while discount programmes through promotional events are insufficient. It is necessary to establish and implement a wide range of price strategies to accommodate various consumer groups and to lure price-sensitive young consumers to marine leisure tourism programs.

According to the consumption pattern analysis of this research, consumers of marine leisure tourism tend to use these services with friends or family members rather than alone and gather information about programmes from friends or acquaintances in addition to the Internet; therefore, it is a good strategy to attract consumers by offering various discount programmes such as friends and family discounts and couple discounts.

Location strategy

The criteria for selecting marinas, one of the key infrastructure facilities of marine leisure tourism, include accessibility to a large market and accessibility and convenience via various modes of transportation (Ministry of Oceans and Fisheries of Korea, 2010). In this research, accessibility is positioned in quadrant II, which indicates that it is considered

more important than other factors but is underperforming.

As for accessibility, this research is not in agreement with the study of Choi et al. (2013), who placed it in quadrant I, where importance and satisfaction are both high. However, Moon (2010), Kang and Kim (2012), and Jeon (2012) showed that the location of marine leisure tourist destinations significantly influences consumer participation.

Given that consumers mostly use a car or bus to participate in marine leisure tourism activities, in order to appeal to a majority of customers, most of whom are in their twenties and do not have a high income, offering a programme combining a city tour and a car rental/car sharing application, such as SoCar, would be a good strategy.

Promotional strategy

Promotion showed a relatively higher level of satisfaction, but it was still not sufficiently high compared to what was shown by the preceding studies in terms of mass media promotion, promotional events, and promotion items. It is, therefore, important to establish and pursue continuous and effective promotional strategies to encourage marine leisure tourism.

As a primary promotional strategy, TV programmes might seem a viable strategy. However, most marine leisure tourism agencies have limited access to mass media, including TV. Considering that most marine leisure tourism providers are small and have limited financial resources to spend on promotion and marketing, the government should intervene and provide financial support to build a business platform for small marine leisure tourism companies to co-operate in co-marketing. At the same time, word-of-mouth marketing through social media such as Instagram and Facebook is considered effective to target marine leisure tourism consumers in their twenties and thirties.

This research has examined the importance and satisfaction of the marketing factors of marine leisure tourism using the IPA method. First, the objective of this research was to make an integrated analysis of the demand-side and supply-side factors for the development of marine leisure tourism and to suggest marine leisure tourism development strategies on a macroscopic level. However, the analysis of the demand side marketing mix was based on the survey conducted in Busan Metropolitan City and may be too limited to generalize the results as the global attitude of consumers to the marine leisure tourism marketing mix. To increase the external validity of data, a survey needs to be conducted on a national level and for a sufficiently long period to analyse the importance and satisfaction consumers perceive regarding the marine leisure tourism factors in the survey.

Additionally, marine leisure tourism is a promising sector of the marine industry that most coastal nations are strategically developing. However, different nations have different priorities depending on the maritime environment, the conditions of front- and rear-facing industries related to marine leisure tourism, and government policies. Therefore, it is necessary to continue research in which development factors are derived in ways that reflect differences in the macroscopic and microscopic socio-economic environments and can be scientifically verified, which would provide a firm basis for the establishment of the practical and customizable marine leisure tourism development strategies.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Does the Exercise and Self-Esteem Model Work on Wheelchair Basketball Players?

Samir H. Qasim¹, Yaser Telfah¹, Yazan Haddad¹ and Mohammad F. AbuMoh'd¹

¹Yarmouk University, Faculty of Physical Education, Irbid, Jordan

Abstract

This study aimed to investigate exercise self-efficacy, physical self-worth, and global self-esteem levels of athletes with physical disabilities. To examine the exercise and self-esteem model on athletes with disabilities, we explored the hierarchical relationship between self-efficacy, physical self-worth, and global self-esteem. Forty-one (N=41) basketball players who participated in the West Asian Championship answered the following three questionnaires: Exercise Self-Efficacy Scale, Physical Self-Description Questionnaire, and Rosenberg Self-Esteem Inventory. Descriptive statistics and the Pearson correlation coefficient were used for data analysis. Study participants achieved relatively high scores in all three variables: exercise self-efficacy (7.67 ± 2.263), physical self-worth ($4.41 \pm .953$), and global self-esteem ($3.13 \pm .516$). As a significant correlation was found between exercise self-efficacy and physical self-worth but not between physical self-worth and global self-esteem, the exercise and self-esteem model concept was not supported in the present study.

Keywords: physical disability, exercise self-efficacy, physical self-worth, global self-esteem, EXSEM

Introduction

Among all the theories present in the literature that aimed to explain the models behind self-esteem improvement due to physical activity, it seems that the exercise and self-esteem model (EXSEM), developed by Sonstroem and Morgan (1989), has been the most

acceptable model among researchers either in its original or adapted forms (Fox & Wison, 2008). This model suggests that exercise engagement enhances exercise self-efficacy, which leads to better physical self-worth. As a result of the physical self-worth improvement, global self-esteem is also likely to be improved (Figure 1).

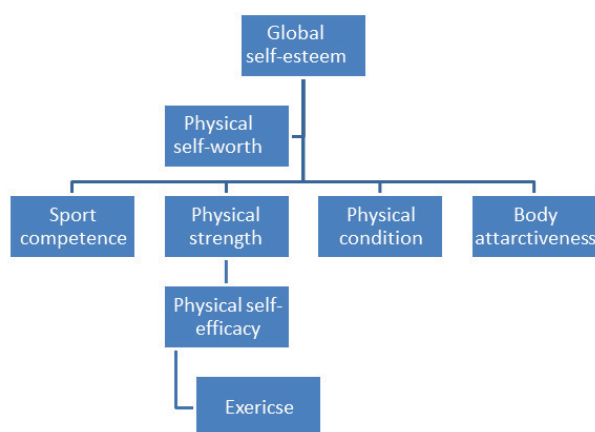


Figure 1. The EXSEM (Sonstroem, Harlow, & Josephs, 1994)



Correspondence:

S. Qasim
Yarmouk University, Faculty of Physical Education, Defense Street, Swimming Pool Building (AA3), 21163, Irbid, Jordan
E-mail: samir.qasim@yu.edu.jo

According to the EXSEM, increased exercise self-efficacy, which is assumed to be improved by constant exercising, is a fundamental component for global self-esteem improvement. Self-efficacy has been described as a person's belief about what (s)he can do under different sets of conditions regardless of the skills (s)he possesses (Bandura, 1997); Bandura further argued that different people with similar skills could have different beliefs about their abilities, and people may perceive their abilities differently within various conditions. In addition, self-efficacy has been found to be a significant instigating force in forming intentions to exercise and in maintaining the practice for an extended time (McAuley, 1993). According to the EXSEM, a physically active person will increase his/her exercise self-efficacy. This belief in the ability to exercise for an extended period leads to better physical self-worth. Physical self-worth may be described as a multidimensional hierarchical subjective perception and affective evaluation of people's various physical traits. It describes appearance, attributes, abilities and provides a substantive interface between the individual and the outside world. Interestingly, the EXSEM focuses only on the physical self-worth, and not other self domains, which has been assumed as the best predictor of global self-esteem (Harter, 2012). Global self-esteem, however, is an overall statement of the degree to which an individual perceives himself or herself to be an "OK person", dependent on whatever criteria that individual uses to determine the meaning of "OK" (Fox, 1997).

As a model that explains self-esteem changes due to exercise, the EXSEM has been considered as a potential help for researchers to understand the relationships between exercise engagement and self-esteem (McAuley et al., 2005) and has been widely accepted in the literature. For example, Elavsky (2010) examined the EXSEM in middle-aged women (N=143) over a two-year period following a randomized control trial. He found that increased physical activity increases exercise self-efficacy, reduces body mass index (BMI), improves physical self-worth and global self-esteem. Also, Moore, Mitchell, Bibeau, and Bartholomew (2011) aimed to determine whether changes in response to resistance training of college students follow the hierarchical structure of the EXSEM. Since the results appeared to support the EXSEM, the authors strongly recommended that EXSEM be examined with different population groups.

Although more similarity than difference has been reported between athletes with disabilities and athletes without disabilities on psychological measurements (DePauw & Gavron, 2005), limited research has focused on examining the EXSEM on people with disabilities. For instance, Qasim, Ravenscroft, and Sproule (2014) investigated the effect of karate practice on the self-esteem of young adults with visual impairment following the EXSEM. Improvement in exercise self-efficacy, physical self-worth, and global self-esteem was reported, but a correlation between these three variables was not examined. In addition, Shapiro and Martin (2010) found a positive relationship between physical self-worth and global self-esteem in athletes with physical impairments but not between physical self-worth and physical activity participation. Importantly, they reported neither exercise self-efficacy nor global self-esteem levels of their participants. This study, therefore, investigated the exercise self-efficacy, physical self-worth, and global self-esteem of athletes with physical disabilities. The second aim was to examine the hierarchical relationship between self-efficacy, physical self and global self-esteem.

Methods

Participants

After obtaining approval from the internal committee at the faculty of physical education at Yarmouk University for conducting this study, basketball coaches of four national teams that participated in the West Asian Championship were contacted. Information and consent sheets were distributed to the participants. All the players were happy to be involved in the study. Participants recruited for this study were 41 players (N=41) from four wheelchair basketball teams. All players were male (age=31±6.6 years) players for their national teams. Participants' disabilities included cerebral palsy (N=18), spina bifida (N=13), leg length difference (N=6), and four (4) participants whose disability was not diagnosed.

Measurements

Exercise Self-Efficacy: The Exercise Self-Efficacy Scale (EXSE) was developed by McAuley (1993). The scale was developed for sedentary middle-aged adults and consists of eight questions in which participants have to rate their confidence to participate in moderate physical activity three times for more than 40 minutes during the next week, the next two weeks; and so forth until the eighth week. The following is an example of the first item of the EXSE: "I am able to continue to exercise three times per week at moderate intensity, for 40+minutes without quitting for the next week". Also, this scale captures variation in mode of activity rather than focusing solely on aerobic activity (Elavsky et al., 2005).

Furthermore, when athletes answer this questionnaire, they should take into account the challenges that are expected during a specific period. Such a form of questionnaire supports Bandura's view to self-efficacy which could be described as persons' belief in their ability to handle specific challenges that helps them to feel satisfied with their abilities (Bandura, 1977). The items on the EXSE scale were ranked on the basis of a 100-point percentage scale composed of 10-point increments, ranging from 0% (not at all confident) to 100% (highly confident). The scale has been used with people with disability as well (Motl, McAuley, & Snook, 2007; Qasim et al., 2014). Motl et al. (2007) reported internal consistency based on coefficient alpha for the EXSE .99.

Physical Self-Worth: Physical self-description questionnaire (PSDQ) (Marsh et al., 1994) and Richards Physical Self-Concept Scale (Richards, 1988) are similar to the Physical Self-Perception Profile (PSP) (Fox & Corbin, 1989) and were designed for the same purposes. Concerning all measurements that have been developed for measuring physical self-worth, Sabiston, Whitehead, and Eklund (2012) reported that the PSP and PSDQ are the best measures for physical self-perception. However, we decided to apply the PSDQ that have been widely used in the literature and has shown high internal reliability (Marsh, Asci, & Tomas, 2002) and median test-retest correlation (Marsh, Papaioannou, & Theodorakis, 2006). Additionally, the PSDQ has been used in the Arabic language. Furthermore, Shapiro & Martin (2010) used the PSDQ with athletes with physical disabilities. The PSDQ is a 70-item questionnaire that measures physical self-perception across nine domains. The questionnaires were distributed and returned before the competitions began. This was done to avoid possible impact of the games results on any of the examined variables.

Global Self-Esteem: Rosenberg Self-Esteem Inventory (SEI), developed by Rosenberg (1965), was used for self-esteem

measurement. The measure is a well-validated 10-item assessment of one's overall evaluation of self-worth. This unidimensional scale is a content-free measurement that assesses only global self-esteem and not self-esteem domains. It has been widely used in different self-esteem research fields, including physical activity (Fox, 1997). All items are answered using a four-point Likert scale format ranging from strongly agree to strongly disagree. The following is an example of the first item of the SEI: "On the whole, I am satisfied with myself".

Analysis

For descriptive statistics, we used means and standard de-

viations. Pearson correlation coefficient was applied to measure correlations physical self domains (including physical self-worth) and exercise self-efficacy and global self-esteem using SPSS version 22.

Results

We found that participants from the current study had relatively high exercise self-efficacy (Mean=7.67±2.263 out of 10), physical self-worth (Mean=4.41±.953 out of 6), and global self-esteem (Mean=3.13±.816 out of 4) (Table 1). In addition, it appears that global self-esteem achieved the highest mean followed by exercise self-efficacy and physical self-worth.

Table 1. Descriptive Statistics (N=41)

Variables	Minimum	Maximum	Mean±SD
exercise self-efficacy	3	10	7.67±2.263
physical self-worth	2	6	4.41±.953
global self-esteem	1	4	3.13±.816

Furthermore (Table 2), exercise self-efficacy is significantly related to physical self-worth but not to global self-esteem. In addition, exercise self-efficacy was significantly (at the 0.01 level) related to most of the physical self- domains, except

health, body fat, and physical appearance. No significant relationship was found between physical self-worth and global self-esteem. Only the health domain was significantly correlated to global self-esteem.

Table 2. Analysis of correlation between exercise self-efficacy, physical domains, physical self-worth and global self-esteem (N=41)

Variables	Correlation	exercise self-efficacy	global self-esteem
Health	Pearson Correlation	.279	.372(*)
	Sig. (2-tailed)	.077	.017
Coordination	Pearson Correlation	.554(**)	.050
	Sig. (2-tailed)	.000	.758
Physical activity	Pearson Correlation	.720(**)	.075
	Sig. (2-tailed)	.000	.642
Body fat	Pearson Correlation	.118	.140
	Sig. (2-tailed)	.464	.384
Sports competence	Pearson Correlation	.634(**)	.164
	Sig. (2-tailed)	.000	.307
Physical appearance	Pearson Correlation	.259	-.005
	Sig. (2-tailed)	.102	.976
Strength	Pearson Correlation	.408(**)	-.119
	Sig. (2-tailed)	.008	.459
Flexibility	Pearson Correlation	.579(**)	-.036
	Sig. (2-tailed)	.000	.822
Endurance	Pearson Correlation	.516(**)	.015
	Sig. (2-tailed)	.001	.925
physical self-worth	Pearson Correlation	.552(**)	.075
	Sig. (2-tailed)	.000	.642
global self-esteem	Pearson Correlation	0.133	
	Sig. (2-tailed)	0.405	

Legend: ** Correlation is significant at the 0.01 level

Discussion

This study investigated exercise self-efficacy, physical self-worth, and global self-esteem levels of wheelchair basketball players. Results of this study show that the participants

achieved relatively high scores in all three domains. While most sport psychology researchers have typically focused on performance self-efficacy (Martin, 2008), very few researchers have examined self-efficacy with wheelchair athletes (Martin,

2002). Considering that this study was conducted on elite athletes, it is not surprising to find that exercise self-efficacy and physical self-worth were high. As this study was conducted on athletes who regularly participate in competitions it is expected to find that they feel able to continue exercising for a specified period. In addition, past success in training and competitions are essential antecedents of self-efficacy (Bandura, 1997). It appears that participants from our study achieved higher scores in physical self-worth compared to the scores of athletes from the previous study (Ferreira & Fox, 2008). We suggest that athletes from our study were physically prepared as they were supposed to play in the regional championship which could have had impact on their physical self. This means that they felt physically prepared for the competitions. This finding has been supported by Cocquyt and Sigmund (2011) who found a positive relationship between sport participation and increased self-perception among people with physical disabilities. Additionally, Scarpa (2011) found that adolescents and young adults with physical disabilities who regularly exercise achieved higher scores in global self-esteem and physical self-worth than their peers who did not exercise regularly. Therefore, relatively high scores of physical self-worth and global self-esteem become clearer.

Furthermore, results from the current study show that the participants had relatively high levels of global self-esteem although it has been believed that people with physical disabilities have low self-esteem due to their disability (Rumsey & Harcourt, 2004). Global self-esteem of young athletes with physical disabilities was found in a previous study (Sherrill, Hinson, Gench, Kennedy, & Low, 1990). The overall score of global self-esteem in the current study was 3.32 out of 4 compared to 3.1 in young athletes with physical disabilities. However, in the study of Ferreira and Fox (2008), wheelchair basketball players had medium levels of global self-esteem. This disagreement in the results could be due to the regional championship that was organized during data collection for the current study. Although this study did not investigate the effect of exercise on global self-esteem, the participants' relatively high level of self-esteem may be explained by the fact that they were athletes. It has been claimed by Buckworth, Dishman, O'Connor, and Tomporowski (2013) that sport participation is related to improved self-esteem of people with disabilities.

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Conflict of Interest

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The second aim of this study was to investigate a correlation among exercise self-efficacy, physical self-worth (including its subdomains) and global self-esteem. We found a significant correlation between exercise self-efficacy and most physical self-domains (including physical self-worth). A significant correlation did not appear only between exercise self-efficacy and each of health, body fat, and physical appearance. This result is concurrent with previous findings that demonstrated that physical self-worth subdomains influence exercise self-efficacy (Sonstroem et al., 1994). Moreover, significant correlations between physical self-worth subdomains and exercise self-efficacy suggest that physical activity participation leads to better perception of exercise abilities and consequently improves physical self-worth. A correlation between regular exercise habits, as EXSE measures, and increased self-efficacy has been reported (Bandura, 1997). However, no significant correlation has been found between exercise self-efficacy and global self-esteem.

A significant and unexpected result is that no significant correlation existed between global self-esteem and physical self-worth. Only one physical subdomain, health, was found to be correlated to global self-esteem. This result does not support previous findings and consequently disagrees with the EXSEM concept. It also may suggest that participants from the current study did not consider physical self-worth as an essential domain of their lives as it has been reported that only domains of high personal importance exert a substantial effect on global self-esteem while evaluations in the domains of low personal importance do not (Brown & Marshall, 2006). This means that only those self-esteem domains that are perceived to be relevant may affect, either positively or negatively, global self-esteem while unimportant domains do not impact global self-esteem.

Although this study revealed that wheelchair basketball players have relatively high exercise self-efficacy, physical self-worth, and global self-esteem, it does not support the EXSEM. A significant correlation between exercise self-efficacy and physical self-worth was found but not between physical self-worth and global self-esteem. The present study did not investigate the importance of the physical self-domain, and therefore we recommend future research to include instruments that measure the importance of the physical self.

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ORIGINAL SCIENTIFIC PAPER

Deep Tissue Massage and Soft Tissue Release in the Management of Chronic Ankle Injury

Bernadetta Maria Wara Kushartanti¹ and Rachmah Laksmi Ambardini¹

¹Yogyakarta State University, Faculty of Sport Sciences, Yogyakarta, Indonesia

Abstract

Deep Tissue Massage and Soft Tissue Release have been widely applied for injury rehabilitation. Both types of massage aim to eliminate the muscle tension that precedes or follows an injury. It is not known how effective each method is, and whether a difference between the two exists in achieving a desirable outcome of injuries, especially ankle injuries, which often occur. With this rationale, this study will examine the effectiveness and the differences of the massage approaches in managing ankle injuries. An experimental method was used in this study, involving 40 research subjects with chronic ankle injuries. Convenience sampling was used to recruit subjects, following which informed consent was signed following sufficient explanation about the experiment. Before and after the treatment approaches were carried out, the degree of pain perceived by the subjects was assessed with the Visual Analog Scale (VAS), and the level of ankle function was measured with Adapted Foot and Ankle Ability Measurement (FAAM). Ordinal collected data were analysed with non-parametric Wilcoxon sign rank test to determine the effectiveness of each method, and the U Mann Whitney to estimate the differences between the two methods. The results showed that Deep Tissue Massage and Soft Tissue Release massage decreased pain and increased ankle function significantly ($p=0.001$), with the effectiveness of 67.5% and 61.1%, respectively, for decreasing pain and 21% and 24.7%, respectively, for increasing ankle function. There was no significant difference in effectiveness between Deep Tissue Massage and Soft Tissue Release in the management of chronic ankle injuries.

Keywords: *deep tissue massage, soft tissue release, ankle injury*

Introduction

Ankle injury often occurs during physical activities and sports. It is more frequently found in athletes who more extensively use the lower extremities. Furthermore, ankle injury is the most common repeated injury because it is followed by mechanical or functional instability (Prentice, 2008; Kisner & Colby, 2007). Functional disorders in ankle injuries occur because of insufficiencies in motor-sensory function consisting of proprioceptive, postural control, neuromuscular control, reflexes disturbance in inversion reactions, and muscle strength. Motor sensory deficits occur because of a decrease in motor recruitment and non-ac-

tivation of the Golgi body (Weerapong, Hume, & Kolt, 2005). It is well known that the ankle joints are arranged by the distal tibia, fibula, and superior thallus, which are bound by elastic ligaments as passive stabilization of the ankle and foot joints. The frequently injured ligaments are lateral complex ligaments, consisting of anterior talofibular ligaments that function to resist plantar flexion; posterior talofibular ligaments, which function to withstand inversion movements; calcaneocuboid ligaments, which hold back plantar flexion movements; talocalcaneal ligaments, which function to resist flexed plantar ligaments; and posterior talofibular ligaments, which function to



Correspondence:

B.M.W. Kushartanti

Yogyakarta State University, Faculty of Sport Sciences, Jl. Colombo No.1, Karang Malang, Caturtunggal, Kec. Depok, Kabupaten Sleman, Daerah Istimewa Yogyakarta 55281, Indonesia

E-mail: bm_warakushartanti@uny.ac.id

resist inversion. The three most important ligaments are the anterior talofibular ligament (ATFL), the calcaneofibular ligament (CFL), and the posterior talofibular ligament (PTFL), which are lateral ligaments (Small, 2009; Golano, Vega, Peter, & de Leeuw, 2010).

Not only ligaments, but tendons are also often injured, especially the peroneus longus and brevis tendons that function for leg eversion (Farquhar, 2013). The prevalence of ankle sprain is most common among soccer players. As indicated by Walls et al. (2016), ankle injuries constitute one third of cases of lower limb ceedra. During the 2004 Athens Olympics, ankle injuries were more common in soccer than other sports (Badekas et al., 2009). Furthermore, Junge and Dvorak (2014) noted that at the Futsal World Cup in 2000, 2004, and 2008 ankle sprain occurred in 10% of cases. In Indonesia, Abdurahman (2015) noted that in the Taekwondo Pre PON Competition, there were 37 cases of injuries, and 18% of them were ankle injuries. Kamal (2016) identified 41 cases of injury in football and found ankle injuries in 29.26% of cases. Thus, ankle injuries often occur mainly in soccer athletes; furthermore, Elliott, Ellis, Combs, and Hunt Long (2015) revealed that most soccer players undergo the process of rehabilitation and therapy poorly, resulting in chronic injury.

Massage in injury management has been done for a long time, including to deal with ankle injuries (Anderson, 2011). Deep Tissue Massage and Soft Tissue Release are two massage methods that are often used with the primary objective of myofascial release. Deep Tissue Massage will release soft tissue with a direct emphasis on the trigger point for 8-20 seconds followed by effleurage, petrissage, or friction using fingers, palms, knuckles, and elbows (Fernandez, 2016). Soft Tissue Release will release soft tissue by locking, followed by stretching. Locking will eliminate shortened muscle fibres and adhesion between muscle groups while stretching (both passive and active) will help stiff muscles become relaxed (Sanderson & Odell, 2013). Manipulation on Deep Tissue Massage requires oil and the therapist's hands must touch the skin directly, so it requires a dedicated room or space. This is manipulation will make the patient comfortable, even though it requires a lot of energy for the therapist (Johnson, 2011).

In Soft Tissue Release, there is no need for oil, and patients do not need to undress, so it can be done on the field without special equipment or space. The patient is involved in stretching while the therapist maintains pressure. This reduces patient comfort but is safer because it does not exceed the pain and ROM (Range of Motion) tolerance of the patient, and for the therapist, it will save energy (Pattanshetty & Raikar, 2015).

Myofascial release produced by the two methods will reduce pain and allow realignments of joints and tendons,

thereby increasing ankle function. Given the advantages and disadvantages of Deep Tissue Massage and Soft Tissue Release, this study will examine the effectiveness of both in the management of chronic ankle injuries with indicators of success in decreasing pain and increasing ankle function.

Methods

This study was experimental research with two-group pretest and posttest design. The research subjects were 40 people (based on a quota sampling scheme), consisting of 20 women and 20 men, with equal gender distribution in the Deep Tissue Massage and Soft Tissue Release groups. The average age, height, and weight of the study subjects were 33.4 years, 163.28 cm, and 61.8 kg, respectively. All recruited subjects, both athletes or non-athletes, were with engaged with physical activities at the Yogyakarta Public University Sport Center. The levels of subject activity were classified: 24 people in the mild category (60%), 12 people in the moderate category (30%), and 8 persons in the heavy category (10%). The average duration of injury was 7 weeks.

A total of 40 subjects fulfilled inclusion criteria: older than 20 years, with a chronic ankle injury (more than 6 weeks), and agreed to participate in the study (signing informed consent). Exclusion criteria were ankle injury accompanied by fracture, total ligament tore (post-operative), and those taking painkillers and anti-inflammatory medications. Men were separated from women; subjects with odd numbers of registration were assigned to Deep Tissue Massage, while those with even numbers were treated with Soft Tissue Release. Data were collected as pretest and posttest, consisting of pain measurement with Visual Analog Scale (VAS), and ankle functions rated with Foot and Ankle Ability Measurement (FAAM). Data collection and intervention procedures were done in the Exercise Therapy Laboratory, Sport Sciences Faculty, Universitas Negeri Yogyakarta (Yogyakarta Public University). Deep Tissue Massage and Soft Tissue Release were applied to the lower extremities with an average duration of 15 minutes. Data descriptions included gender, age, duration of injury, level of physical activity. Changes in pain level and ankle function for the two treatment groups were described as the percentage of change of the pretest level, compared using the Wilcoxon sign rank test. Differences in the effectiveness of the two treatments were statistically tested using the Mann Whitney U test.

Results

The result from this research was presented consecutively to show the influence of Deep Tissue Massage and Soft Tissue Release on the pain or ankle injuries through (1) pain scale, (2) ankle function, and (3) level of pain and ankle function before and after treatment.

Table 1. Pain scale (N=20)

Method	N	Pretest	Posttest	Mean	%
Deep Tissue Massage	20	4.40	1.43	2.97	67.5
Soft Tissue Release	20	4.75	1.85	2.90	61.1

Data in Table 1 indicated that those with Deep Tissue Massage group experienced higher average decreases in pain level compared to those with Soft Tissue Release

(67.5% vs 61.1%).

Ankle function before and after treatment is shown in Table 2.

Table 2. Ankle function

Method	N	Pretest	Posttest	Mean	%
Deep Tissue Massage	20	73.72	89.23	15.5	21
Soft Tissue Release	20	70.15	87.45	17.3	24.7

The table above shows that Soft Tissue Release was a better method to improve the ankle function with 24.7% against 21% for Deep Tissue Massage

Differences before and after treatment tested with the Wilcoxon Signed Rank Test are shown in Table 3.

Table 3. The level of pain and ankle function before and after treatment

Method	Variable	Pretest	Posttest	Z	p
Deep Tissue Massage	Pain	4.4	1.43	3.84	0.001
	Function	73.72	89.23	3.83	0.001
Soft Tissue Release	Pain	4.75	1.85	3.93	0.001
	Function	70.15	87.45	3.928	0.001

Both Deep Tissue Massage and Soft Tissue Release significantly decreased pain and increased ankle function ($p=0.001$).

Differences between Deep Tissue Massage and Soft Tissue Release methods were tested with the Mann Whitney U Test, as shown in Table 4.

Table 4. The difference in pain and ankle function between Deep Tissue Massage and Soft Tissue Release Method.

Method	Variable	Posttest	p
Deep Tissue Massage	Pain	2.97	0.195
Soft Tissue Release		2.90	
Deep Tissue Massage	Function	15.5	0.521
Soft Tissue Release		17.3	

The results from the table above showed that Deep Tissue Massage has a positive influence on decreasing pain and healing injuries, but Soft Tissue Release also has a benefit in improving patient health. However, there is no significant difference between Deep Tissue Massage and Soft Tissue Release in increasing the patient health status (0.195 & 0.521) > 0.05 . In general, both methods are effective in solving the pain and injuries of both athletes and non-athletes.

Discussion

Pain is a negative sensory and emotional experience associated with actual or potential tissue damage (Anderson & Parr, 2011). In an ankle sprain, the stretching and tearing of the complex lateral ligaments result from the inversion and plantar flexion force that bursts when the foot rests imperfectly on an uneven floor or ground (Kisner & Colby, 2012). Inflammatory processes that occur due to tearing will cause pain and decreased the function of the ankle. In subacute or chronic injury, there will be a crunch in the muscles making it difficult to stretch. Manipulative therapy, especially Deep Tissue Massage and Soft Tissue Release, will target specific regions of muscle tension, including muscles that are difficult to stretch actively (e.g., fibularis or peroneal muscle groups) and isolate muscle groups that usually stretch together, such as the vastus lateralis from quadriceps muscles (Johnson, 2009). At the time of suppression, gripping, and squeezing, blood flow to the area is blocked, but at the time of release, small blood vessels are no longer compressed, so fresh blood will flood the area. Thus, the massage will work as a pump (Johnson, 2011).

Massage is one method for relieving pain and related symptoms. Mechanical pressure in muscle tissue can improve local microcirculation of blood and lymph flow, which can fur-

ther reduce swelling, ischemia, or build-up of substances that directly or indirectly cause pain (Vegar, 2013). The benefits of therapeutic massage against muscles include relieving muscle tone and stiffness, accelerating healing of muscle strains and sprains by reducing muscle pain and restoring range of motion (ROM). Massage is known to stimulate cutaneous receptors so that it can potentially cause local lateral inhibition of pain feedback of the spinal cord. Lin, Hiller, and de Bie (2010) said that exercise therapy may reduce the occurrence of recurrent ankle sprains and may be effective in managing chronic ankle instability. After surgical fixation for ankle fracture, an early introduction of activity, administered via early weight-bearing or exercise during the immobilization period, may lead to better outcomes.

The pull and strength applied to muscle fibres from various massage techniques also activate the Golgi tendon and nerve organs. Their afferents have large diameters. Activation of large nerve fibres capable of sending nerve impulses quickly can partially block smaller and slower nerve fibres so as to reduce pain.

The Soft Tissue Release method involves stretching the fascia and releasing bonds between the fascia and skin, muscles, and bones with the aim of relieving pain, improving ROM and body balance (Namvar, Olyaei, Moghadam, & Hosseinifar, 2016). If the pain declines and the ROM rises, the function will increase. The results of the study of Pattanshetty and Raikar (2015), which examined the effects of three types of soft tissue manipulations, showed that the myofascial release technique could reduce pain and improve ROM in plantar fasciitis cases. Park et al. (2017) explained that massage is a systematic manual manipulation of the body by movements such as rubbing, kneading, pressing, rolling, slapping, and tapping for thera-

peutic purposes. These movements promote the circulation of the blood and lymph, relaxation of muscles, relief from pain, and restoration of metabolic balance

Field (2018) said that there are at least three mechanisms that underlie the effects of massage therapy on chronic pain: increasing vagal activity, reducing the inflammatory process, and reducing substances. Stimulation of pressure receptors will increase vagal activity and in patients with chronic pain lower vagal-mediated heart rate variability is indicated by increased vagal activity.

The principle of handling with the Soft Tissue Release method was emphasized on trigger points, then stretched. The aim of Soft Tissue Release is to free fascia and maintain network functions. This technique is used to relieve pressure in connective tissue. Careful myofascial stretching and maintaining a certain amount of time are believed to free the bond, softening and extending the fascia. Freeing the fascia where the nerves and blood vessels are located helps increase the transmission of the circulatory and nervous system. This technique is widely used in chronic conditions to help change the basic viscosity of the substance to a more fluid

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Conflict of Interest

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state, which eliminates the fascia pressure on the pain-sensitive structure and restores proper alignment (Pattanshetty & Raikar, 2015).

The advantage of the Soft Tissue Release method is the involvement of patients; in other words, patients actively participate in therapy. Methods by involving patient activity are seen as safer, and therapists should attempt to use them. This method is felt to relieve the therapist because patients actively participate in treatment procedures. In addition, lotions or lubricants are not needed so the method can be more practically applied in the field setting. The effect of relaxation is longer, although the onset of therapy is slower, and patient comfort during the treatment is somehow lacking.

Deep Tissue Massage and the Soft Tissue Release Method are effective in decreasing pain and increasing the function of the ankle. The effectiveness of Deep Tissue Massage and Soft Tissue Release were 67.5% and 61.1% for decreasing pain, and 21% and 24.7% for increasing ankle function, respectively. There was no significant difference between Deep Tissue Massage and Soft Tissue Release in decreasing pain and increasing ankle function.

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ORIGINAL SCIENTIFIC PAPER

Differences in the Isokinetic Strength of Thigh Muscles between Track and Field and Karate Athletes

Amel Mekic¹, Safet Kapo¹, Haris Alic¹, Izet Bajramovic¹, Slavenko Likic¹, Damir Besirevic¹ and Nedim Covic¹

¹University of Sarajevo, Faculty of Sport and Physical Education, Sarajevo, Bosnia and Herzegovina

Abstract

This research aimed to determine the isokinetic strength differences between two groups of athletes (karate and track-and-field athletics) and to analyse factors that possibly contribute to the differences. We examined possible differences in peak power output and power ratio between agonist and antagonist thigh muscles of the knee. The sample consisted of 20 respondents: karate athletes (n=10; age 19 ± 2.4) and track-and-field athletes (n=10; age 18 ± 2.6). For this study, a valid test ($CV < 5\%$) of the isokinetic strength output of the knee extensors and flexors, was used at the angular velocity of $60^\circ/s$. Isokinetic variables: Peak torque in extension for both legs (Nm); Peak torque in flexion for both legs (Nm); Total work for both legs (J); Strength deficit involved/uninvolved leg and agonist/antagonist ratio for involved and uninvolved leg. A t-test for independent samples was used to determine the differences. Statistical significance was set at the conventional 95%. In the sample of examined variables, the first tested group of athletes (karate) achieved higher power output values with the dominant leg, except in the case of the peak torque extensors. In the second tested group of athletes (track-and-field athletics), a higher power output values are registered with dominant leg, except in the case of the total work flexor with almost identical value of dominant and non-dominant leg. In the variables of the peak torque of the dominant leg ($p=0.002$) and the peak torque of the non-dominant leg ($p=0.019$), statistically significant differences were noted between two tested groups of athletes ($p < 0.01$, $p < 0.05$). The unilateral relationship of the dominant leg ($p=.003$) significantly differentiates two groups of athletes ($p < 0.01$). The better performance of track-and-field athletes is probably the result of the specificity of the structure of their motor movement and greater muscular work in training and competition. In contrast, the lower results of peak torque and total work in karate athletes compared to track athletes do not necessarily mean situational inferiority. Evaluation and assessment of knee dynamic stabilizers' isokinetic profile can lead to the optimal selection of training operators, during the construction of the overall training program for athletes. Results of different outputs of force and strength may indicate a differently shaped approach to training.

Keywords: knee dynamic stabilizers, flexor and extensor, training specificity, evaluation

Introduction

According to the International Association of Athletics Federations (IAAF), the athletics track disciplines are sprint (100 m, 200 m and 400 m), middle and long distances (800 m, 1500 m, 5000 m, 10000 m and 3000 m steeplechase);

hurdles (men: 110 m and 400 m; 100 women 100 m and 400 m) and road running (marathon and half-marathon), as well as Relay (4x100 m; 4x400 m); cross country running; mountain running and ultra-running disciplines. Sprint disciplines and sprinting ability is based on lower extrem-



Correspondence:

S. Likic

University of Sarajevo, Faculty for Sport and Physical Education, Patriotske lige 41, 71 000 Sarajevo, Bosnia and Herzegovina

E-mail: slikic@fasto.unsa.ba

ities strength capacity. The long-term training process can initiate different effects in leg strength balance, as well as the unilateral and bilateral strength ratio. Sprinters are faster at 20 m and have more speed at block when their take-off leg is dominant (Vagenas & Hoshizaki, 1986). Asymmetry of dynamic leg strength is key factor for successful start (Vagenas & Hoshizaki, 1986; Exell, Irwin, Gittoes, & Kerwin, 2017). Most of the strength asymmetry is registered in the ankle and upper leg muscles (Exell et al., 2017); however, there is no correlation between leg strength asymmetry and running velocity. Also, because of the training structure and motor movements, sprint produces constant sudden shifting between maximal voluntary eccentric and concentric contraction, which significantly influences strength development, especially in hamstring muscles (Jonhagen, Nemeth, & Eriksson, 1994).

Karate is different from other martial arts in that its basic goal, which is symbolic destruction of the opponent, is achieved by simulated or strictly controlled blows of the arms and legs (Sertić, 2004). Generally, punches account for 89.09% of the movements, leg kicks 8.36%, while cleaning and throwing with pointing account for 2.55% (Koropanovski, Dopsaj, & Jovanovic, 2008). The dynamics of movement in karate are particularly emphasized, while static situations most often occur when maintaining postures. Upper and lower body strength and maximum dynamic strength variables were positively correlated to punch acceleration in all conditions (Loturco, Artioli, Kobal, Gil, & Franchini, 2014). Also, in karate, reaction time is a key element, because high performance is based on explosive techniques, while karate performance relies more on muscle strength at lower versus higher loads (Chaabène, Hachana, Franchini, Mkaouer, & Chamari, 2012). Karate shows a specific sport adaptation when measuring power with an isokinetic dynamometer (Probst, Fletcher, & Seeliger, 2007).

The skeleton and joints are the dynamically inactive part while the muscles are the active part of the locomotors system, which ensures the movement of the body by its contractions. The symmetry of muscle strength for each joint and each direction of movement should be balanced so that the body remains upright or performs the desired movements. If the force-to-muscle ratio is exceeded, then injuries such as ligament or muscle fractures, cartilage damage in the joint, chronic inflammatory reactions, pain, and permanent joint damage occur (Hadžović-Džuvo & Kapur, 2011). Greater asymmetries are noticeable in non-athletes (Siqueira, Pelegrini, Fontana, & Greve, 2002).

Isokinetic testing provides detailed and exact insight into the strength of individual muscle groups, the ratio of muscle strength of agonists and antagonists, bilateral comparison of the same muscle groups, information on the amount of work performed, information on the moment of expression of maximum muscle strength during a particular motor task, and information on fatigue index (Desnica-Bakrač, 2003). The aim of many previous studies was to evaluate muscle performance, primarily for the purpose of objectively documenting and reviewing the effectiveness of certain therapeutic procedures for the rehabilitation of injuries to the locomotors system, as well as for determining deficiencies in muscle strength and determining the relative strength of antagonistic muscle groups due to the influ-

ence of dominance (Siqueira et al., 2002).

This research aimed to determine the isokinetic strength differences between two groups of athletes (karate and track-and-field athletics) and to analyse factors that possibly contribute to those differences.

Methods

Inclusion criteria featured male athletes 16-21 years of age. For this study, a valid test ($CV < 5\%$) of the isokinetic strength output of the knee extensor's and flexor's, was used at the angular velocity of $60^\circ/s$. Age and morphological characteristics (height and body mass) of the first tested group of athletes (karate): $n=10$, 19 ± 2.4 , 184 ± 7 cm, 77.8 ± 11.5 kg; and second tested group of athletes (track-and-field athletics): $n=10$, 18 ± 2.6 , 182 ± 5.4 cm, 76.1 ± 4.5 kg.

Isokinetic variables (Biodex System): Peak torque dominant leg Extensor (Nm), Peak torque non-dominant leg Extensor (Nm), Peak torque dominant leg Flexor (Nm), Peak torque non-dominant leg Flexor (Nm), Total work dominant Extensor (J), Total work non-dominant Extensor (J), Total work dominant Flexor (J), Total work non-dominant Flexor (J), Unilateral ratio dominant leg, Unilateral ratio non-dominant leg.

A t-test for independent samples was used to determine the differences. Statistical significance was set at the conventional 95%.

All subjects were completely healthy, with no recorded knee joint injuries, and at their discretion participated in the study and isokinetic testing procedure. All tested athletes did this isokinetic testing from 2012 to 2017. The measurement protocol involved a standard warm-up procedure after which the subject performed five maximal voluntary contractions at an angular velocity of $60^\circ/s$. An 80° range of motion was set for each subject. The rotation axis of the knee joint is aligned with the axis of rotation of the isokinetic dynamometer. The gravity correction was performed at an angle of 30° with respect to the vertically positioned isokinetic dynamometer. Each subject was in a specific position: sitting on an isokinetic chair.

Statistical programs SPSS and EXCEL were used for data processing. All result values are presented as arithmetic mean and standard deviation. Differences in outcome values between the two groups of athletes were determined using the two-sided t-test. Statistical significance was set at the conventional 95%.

Results

The karate athletes achieved better results with their dominant leg in all variables, except for the Peak torque Extensor variable which indicates a better result achieved with the non-dominant leg (Table 1). The skewness values indicate that all variables have a positive sign, of which seven results have slightly more pronounced asymmetry values. This means that most of the results are poorly grouped; that is, there are one or several extremely high values in karate athletes. The total work non-dominant Flexor and Unilateral ratio dominant leg variables are closest to ideal symmetry. The values of kurtosis indicate that most of the results in karate athletes have a mesokurtic distribution, and the closest to the ideal distribution is variables Peak Torque dominant leg Extensor and Total work dominant Extensor. The tendency toward platykurtic distribution is noticeable

in the variable Unilateral ratio dominant leg. Variables that analyse the unilateral ratio of power output between flexors

and extensors, based on the values of arithmetic means, may suggest a better-quality relationship with the dominant leg.

Table 1. Descriptive isokinetic parameters of karate athletes

Variables	Minimum	Maximum	Mean±SD	Skewness	Kurtosis
Peak torque dominant leg Extensor	202.10	289.30	230.91±28.88	.93	.16
Peak torque non-dominant leg Extensor	199.60	309.90	236.10±35.34	.90	.62
Peak torque dominant leg flexor	114.50	180.10	138.13±21.44	1.03	.40
Peak torque non - dominant leg flexor	99.40	180.60	129.15±24.56	.86	.97
Total work dominant Extensor	793.70	1362.10	995.33±187.18	.93	.12
Total work non - dominant Extensor	763.10	1231.90	968.35±143.95	.60	-.32
Total work dominant Flexor	491.10	878.50	637.17±139.69	.97	-.36
Total work non-dominant Flexor	437.40	734.60	582.55±97.72	.13	-.94
Unilateral ratio dominant leg	55.40	64.90	59.71±3.79	.18	-1.91
Unilateral ratio non-dominant leg	48.90	63.90	54.58±4.91	.46	-.37

Track-and-field athletes also achieved better results with their dominant leg (Table 2). The only exception is the variable Total work dominant Flexor, in which a nearly identical result was recorded with dominant and non-dominant leg. Regardless of the positive or negative sign, skewness values indicate that all but one result is within the allowed distribution. An exception is the extreme negative asymmetry of results in the Peak torque dominant leg Extensor variable in track-and-field athletes. This suggests grouping better results than the arithmetic mean, that is, the presence of one or several ex-

tremely lower values. Peak torque non-dominant leg Extensor and Unilateral ratio non-dominant leg are close to ideal symmetry of 0. Most kurtosis results indicate mesokurtic or a slight platykurtic tendency. The result of the Peak torque dominant leg Extensor suggests a leptokurtic distribution of results, that is, the accumulation of most results around the centre of distribution. The unilateral ratio of power output between flexors and extensors in track-and-field athletes, based on the values of arithmetic means, suggest an equal ratio for both legs, which is lower than the recommended value of 61 (Biodex System).

Table 2. Descriptive isokinetic parameters of track-and-field athletes

Variables	Minimum	Maximum	Mean±SD	Skewness	Kurtosis
Peak torque dominant leg Extensor	197.10	330.60	283.91±35.80	-1.59	3.95
Peak torque non-dominant leg Extensor	211.70	343.80	280.45±41.62	.05	-.92
Peak torque dominant leg flexor	113.60	169.70	148.07±19.03	-.52	-.91
Peak torque non-dominant leg flexor	112.30	166.50	143.68±19.57	-.31	-1.10
Total work dominant Extensor	892.90	1354.30	1142.37±139.69	-.21	-.45
Total work non-dominant Extensor	936.50	1347.00	1092.06±127.56	.87	.18
Total work dominant Flexor	533.50	744.40	652.48±74.02	-.60	-.87
Total work non-dominant Flexor	521.80	830.10	652.65±102.74	.34	-1.00
Unilateral ratio dominant leg	45.30	60.40	52.43±5.56	.18	-1.47
Unilateral ratio non-dominant leg	40.60	64.40	52.01±7.88	.07	-.75

Comparing the result of arithmetic means between two tested groups of athletes, it is evident that the variable Peak torque dominant leg Extensor in karate athletes has a lower value by 53 Nm compared to the value measured in track-and-field athletes, or by 44.4 Nm in the variable Peak torque non-dominant leg Extensor. The peak torque dominant leg Flexor is slightly higher for track-and-field athletes by 9.9 Nm or 14.5 Nm for Peak torque non-dominant leg Flexor. The total work of dominant and non-dominant legs in extensors is higher in track-and-field athletes than in karate athletes (147 Nm and 123.7 Nm). The total work of the dominant and non-dominant legs in flexors measured in track-and-field athletes is also higher than measured values of karate athletes (15.3 Nm and 70.1 Nm). The unilateral ratio of the dominant

leg is higher for track-and-field athletes compared to karate athletes by 7.3 Nm, and by 2.6 Nm in the case of the unilateral ratio of non-dominant leg.

Statistically significant differences between the two tested groups of athletes are evident in the following variables (Table 3): Peak torque dominant leg Extensor ($p=0.002$), Peak torque non-dominant leg Extensor ($p=0.019$) and Unilateral ratio dominant leg ($p=.003$). A negative sign of the t-test in the variables Peak torque dominant leg Extensor and Peak torque non-dominant leg Extensor indicates a better power output values of the track-and-field athletes. On the other hand, a positive sign of the t-test in the variable Unilateral ratio dominant leg indicates a better power output ratio in the case of karate athletes.

Table 3. Independent t-test results between karate and track-and-field athletes

Variables	t	Df	Sig.
Peak torque dominant leg Extensor	-3.644	18	.002*
Peak torque non-dominant leg Extensor	-2.569	18	.019*
Peak torque dominant leg flexor	-1.096	18	.287
Peak torque non-dominant leg flexor	-1.463	18	.161
Total work dominant Extensor	-1.991	18	.062
Total work non-dominant Extensor	-2.034	18	.057
Total work dominant Flexor	-.306	18	.763
Total work non-dominant Flexor	-1.563	18	.135
Unilateral ratio dominant leg	3.423	18	.003*
Unilateral ratio non-dominant leg	.875	18	.393

Legend: * - $p < 0.05$

Discussion

By analysing the track and field athlete's training structure, it is possible to assume the reason for their dominance in relation to karate athletes. Track-and-field athletes' training is characterized by various motor movements that develop the entire musculature. The specificity of training and competitions in karate is likely to make more impact with a dominant leg. The dominance of one leg may cause asymmetry between muscle groups and develop a predisposition for injury (Zakas, 2006). Different resistance training programs should consider the specific neuromuscular demands of each sport (F.B.D. Oliveira, A.S.C. Oliveira, Rizzato, & Denadai, 2013). Training programs are linked to different athlete profiles, models and requirements of a particular sport, which requires the correct selection of exercises. The load distribution of exercises needs to be carefully selected, depending on the sport as well as the individual in the sport.

The results obtained with the isokinetic protocol in the treated groups of karate and track and field athletes are within the optimal values. Track and field athlete's better test-results are probably the result of the specificity of the structure of their motor movement and greater muscular work in training and competition. In track and field athlete's training, the mechanical work of the lower extremities is particularly pronounced, which involves performing high-speed and explosive movements, as well as very high engagement of the muscles of the upper leg (m. quadriceps femoris, m. biceps femoris, m. semitendinosus and m. semimembranosus). This is especially pronounced in the track and field sprint disciplines. Greater muscular strength is strongly associated with improved force-time characteristics that contribute to an athlete's overall performance (Suchomel, Nimphius, & Stone, 2016). The results of this study indicate the presence of a low tendency for muscular asymmetry on both legs in track-and-field athletes. Similar results were obtained in the study of Siqueira et al. (2002). The training of track-and-field athletes abound in various movements, like sprints, jumps, and throws that optimally develop the muscles of the entire body. Specifically, concentric and eccentric contraction predominates in muscles at high levels of dynamic loading, whereby activities are performed under conditions of overcoming and ease up force muscle work. The result of such high-intensity loads is an improvement in the increase in muscle force and muscle strength. In contrast, it is necessary to make an optimal distribution of training load in order to avoid harmful consequences.

Karate is full of various motor movements, such as walking, running, sprints, jumps, changes of movement direction, and duels. The decisive actions of karate depend essentially on the explosive power of the muscles in the upper and lower extremities (Chaabène et al., 2012). However, karate athletes achieve better results with their dominant leg, probably because of its more frequent use in training and competition. Andrzejewski and Elbaum (2005) state that, in karate, the kinematics of impact with non-dominant extremities is quite similar to the dominant side, but lower angular and linear impact velocities have also been reported. Karate training can produce agonist-antagonistic muscle asymmetries that can predispose these athletes to knee joint injuries (Scattoni-Silva, Lessi, Lobato, & Serrão, 2012). Kovač, Kovačević, Abazović, and Alić (2013) emphasize the importance of preventive training primarily aimed at improving power, strength and muscular endurance, and reducing bilateral and reciprocal muscle group deficits.

However, lower values in Peak torque and Total work of karate athletes in relation to track-and-field athletes do not necessarily mean their situational inferiority. The treated groups of athletes, according to the periodization of sports development, belong to the stage of adolescence, and their performance is close to elite sports performance. However, chronological age is not the most appropriate method for analysing biological data in adolescents (Bjelica, 2013). Creating a training program, in contrast, is directly linked to the athlete profiles, models and requirements of a particular sport. This indicates in practice that the selection of exercises and the distribution of exercise load should be carefully chosen in relation to sport and also in accordance with the individual approach to athletes. The evaluation of the isokinetic profile of dynamic knee stabilizers can guide the optimal selection of training operators as well as the creation of the overall athlete training program. Results on different outputs of muscle force and muscle strength may indicate a differently shaped approach to training. In addition to isokinetic testing procedures, the use of basic and specific tests is the first recommendation, both in karate and track-and-field athletics practice. Also, the disadvantage of isokinetic measurement is its realization under open kinetic chain conditions, whereas in real sports situations, the moments of the open and closed kinetic chain are most often exchanged. Hence, functional training is a form of the fastest and most effective action to increase strength and build muscles (Thomee, Augustsson, Wernbom, Augustsson, & Karlsson, 2008).

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Effects of Visual, Verbal, Visual + Verbal Feedback on Learning of Dribbling and Lay-up Skill

Yasin Akinci¹ and Sadettin Kirazci¹

¹Middle East Technical University, Faculty of Education, Physical Education and Sports Department, Ankara, Turkey

Abstract

The purpose of this study is to examine how different feedback conditions affect learning skills. Two-task dribbling, continuous skill, and lay-up discrete skill of basketball were selected, and participants were randomly grouped and assigned to verbal, visual + verbal, and visual feedback groups. Two experts evaluated the performances of the participants. First, a pre-test was applied to form the groups, then a day later subjects performed both task 15 times (5 trials, 3 sets) and received feedback after every 5 trials for three consecutive days; 72 hours later, a retention test was applied to test learning. A 3×2 (Group \times Condition) ANOVA was used to calculate the differences between the groups in the pre-test and post-test conditions. The results indicated no significant difference between the groups for the two skills in the pre-test, but the post-test results indicated significant difference among the verbal to visual + verbal group, visual to visual + verbal group and verbal and visual group. The total difference scores of the groups were also significant; the visual + verbal condition indicated the greatest improvement, whereas the visual condition indicated the least improvement in skills. The study indicated that the verbal feedback for novice group caused better improvement and retention of the dribbling and lay-up basketball skills compared to the visual feedback group.

Keywords: skill learning, basketball, videotape feedback, verbal feedback

Introduction

Coaches, physical education teachers, trainers, and athletes are seeking methods to facilitate skills learning and performance development. Motor learning specialists are also interested in the same topic with the mechanisms that affect performance and learning. Feedback is regarded as an essential part of this teaching process (Rink, 2002). Feedback from an external source that influences performance is called “augmented feedback”, which has motivational and informational functions (Coker et al., 2006; Smith, 2006). The motor learning field has been interested in the informational function of feedback, which indicates the role of providing knowledge about the student’s performance concerning the task target. In this context, researchers have indicated methodological subjects, for example, the frequency, timing and accuracy of feedback (Salmoni, Schmidt, & Walter, 1984; Williams, & Hodges,

2004; Schmidt & Lee, 2005). The way in which the feedback was used depends on the nature of the task and learner for reducing the feedback dependency. To explain the dependency-producing role of feedback, researchers presented the guidance hypothesis, which states that feedback is a mean to guide performers’ actions with a both positive and negative “side effects” (Salmoni et al., 1984; Schmidt, 1991; Schmidt & Wrisberg, 2000). Learners can correct errors and develop consequent trials performance by using knowledge about the results of a movement. Using frequent augmented feedback is also because of over-reliance on the guiding properties of the feedback; it thus plays a critical role between trial information processing involving coding storage and retrieval operations that is important for learning dimension (Bjork, 1988; Schmidt & Lee, 1999; Schmidt & Wrisberg 2000).

According to Bandura (1997), motor skills are also learned



Correspondence:

Y. Akinci

Middle East Technical University, Faculty of Education, Physical Education and Sports Department, 06800 Ankara, Turkey,

E-mail: yasakinci@hotmail.com

through observation. Bandura suggests that when a learner views a performer, s/he will keep essential knowledge about skill than it is used as a cognitive illustration, for trying to replicate the skill. Learning through observation was the concern of feedback studies, which were videotape and computer analysis, and were frequently used as a source of information both in education and sport setting. Videotape feedback (VTFB), contains high-intensity information, provides the clarity and time needed for useful instructions in the realization of the successful movement learning process (Hubwieser, 2007; Niegemann et al., 2013). With this, VTFB allows for the explanation of movements or partial elements that may be difficult to identify at first (Schön & Ebner, 2013). It is supposed that viewing learners' motion with VTFB stimulated corrections and consequently improves performance. In the cognitive perspective, a person crosschecks on the video display to a criterion, detect errors and build corrections on the following performances. In general, researchers (Miller, & Gabbard, 1988; Haguenaue et al., 2005; Jennings, Reaburn, & Rynne, 2013) suggest that using video as a form of performance feedback can be a beneficial tool to improve motor skill learning and performance (Razali, Suwarganda, & Zawaki 2012; Barzouka, Sotiropoulos, & Kioumourtzoglou, 2015; Giannousi, Mountaki, & Kioumourtzoglou, 2017). However, research regarding VTFB is inconsistent (Tzetzis et al., 1999; Ram & McCullagh, 2003; Clark & Ste-Marie, 2007), and the impact of this seems to be related to the characteristics of the learners, with increased benefits from those more skilled in the task, or more practice with VTFB. In brief, learners gain information about the performance or experience seeing VTFB; they are adjusted at selecting information, error detection, and correction, and using this information (Darden, 1999).

The level of performer, type of skill or movement, instructor-provided feedback, and frequency of viewing and other variables should be considered when using VTFB to increase motor skill learning.

Therefore, the purpose of this study was to examine the effect of investigate the differences in the learning of two fundamental skills of basketball (dribbling and lay-up skills) with verbal, visual + verbal, and visual feedback and verbal feedback condition, visual + verbal, feedback condition and visual feedback condition processing from the pre to post-test phases.

Accordingly, it was hypothesized that there was significant difference both in the scores of the three feedback conditions in the post-test results indicating learning effect and in the total difference scores of the feedback groups indicating an improvement from pre to post-test.

Methods

Subjects

Twenty-four male and twenty-one female third-grade primary school students with no prior experience in basketball were selected as subjects of the study. The average age of the students was $M=9.2\pm0.2$, were randomly assigned to three feedback groups which are visual feedback, verbal feedback, visual + verbal feedback group.

Permission to conduct the study was received both from Middle East Technical University Ethics Committee. The researcher highlighted that it was not compulsory to take part and that all information gathered would be treated as confidential. Participants were given an informed consent form to be signed by their parents.

Apparatus and Task

The experts used a basketball dribbling and lay-up skill evaluation checklist that had an "A" class basketball-coaching certificate. The goal of the dribbling skill was to dribble the ball around cones 10 metres apart with the dominant hand using the correct technique. The goal of the lay-up task was to perform the correct lay-up technique from 7 metres from the right or left side of the court according to preference.

Before the subjects had started to perform the task, the instructor demonstrated the correct technique and explained the essential parts of the skills. Experts evaluated the participants while they were performing the skills and subjects received feedbacks according to the expert's evaluation. The instructor verbally gave the performer the most important four-feedback title from the skill evaluation checklist.

The reliability and validity of the checklist were done by Çamur (2001). The study was done in a FIBA dimensions basketball court and rim heights. Participants performed both tasks with No: 5-size basketball ball.

A digital camera connected to a 55-cm screen TV was used to recorded and watched visual and visual + verbal feedback group subject's performance. Both two experts and cameraman had the full vision of participants' performance during the whole experiment.

Procedure and Design

In this study, three groups receiving verbal, visual + verbal, and visual knowledge of performance feedback practised the lay-up and dribbling skill of basketball. The study was conducted on eight days for all three-feedback groups. The schematic design of the study was given in Table 1.

On the first day, participants performed two tasks with five trials as pre-test and experts evaluated them with three scores for tasks and sub titles of tasks. Subjects were assigned to the feedback groups randomly. On the second day, participants were on a 24-hour rest interval. On the third, fourth, and fifth days, the subjects performed the training (acquisition).

In the acquisition phase, subjects were first separated into three groups, with five participants for every feedback group. The first five subjects performed the task five times then received feedback. While the first five subjects were receiving the feedback, the second five started to the task. When the first five finished to receiving feedback, waited for a little for second five students to finish the task and went to receive feedback. This process applied during the three-acquisition day.

After 72 hours, a retention test was applied on the eighth day. Subjects completed a total of 15 trials for retention post-test. During the retention test, no subjects received any feedback.

Statistical Design

To test the hypothesis and to calculate the group differences in pre-test and post-test, data were analysed with a 3×2 (Group \times Condition) analysis of variance (ANOVA). A significance level of $p<.05$ was set for all statistical tests. Tukey's honestly significant difference (HSD) procedure was adopted for all follow-up comparisons when appropriate.

Reliability of experts

Before the data collection of study, Covariance matrix and correlation matrix was used for the reliability of the experts over 15 subjects independently. The estimated reliability of

Table 1. Overall Study Design

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
Groups	Pre-test	24h Rest	Acquisition Phase			72h Retention		Post-test
Verbal Feedback	5dribbling 5 Lay-up trial	No Relevant Activity	15 Lay-up & dribbling 5 Trial × 3 set × 3 day			No Relevant Activity		5 dribbling 5 Lay-up trial
Visual Feedback								
Visual+Verbal Feedback								

Legend: N=15 for the three groups

the scale was 0.79, and the unbiased estimate of reliability was 0.78. Both the R-values are higher than 0.70, so these results indicate that the experts were highly reliable between and within.

Results

Preliminary analyses

The mean and standard deviation of three feedback groups on dribbling and lay-up skill of students are shown in Table 2. The pre-test analysis aimed to compare the baseline scores for each feedback group before training intervention. Thus, one-way ANOVA was used to analyse to test the difference in visual, verbal, and visual +verbal feedback condition on the pre-test values. The results revealed that there were no statistically significant differences between the three feedback groups in the pre-test in dribbling performance scores $F(2,42)=0.357$

$p<0.05$, nor in the lay-up performance scores $F(2,42) = 0.195$ $p<0.05$.

Main analyses

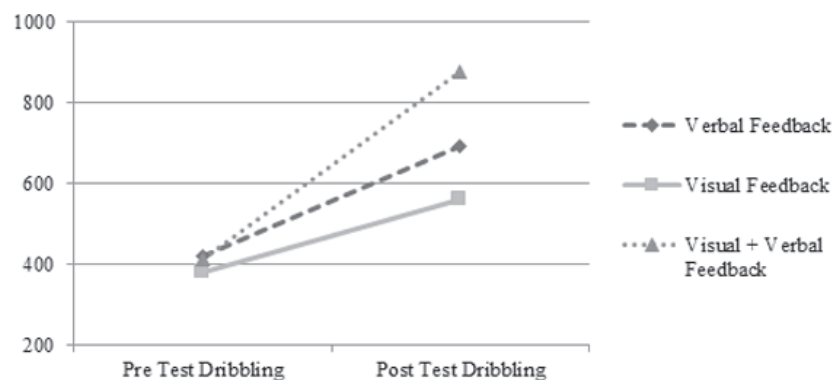
The ANOVA results for the dribbling post-test revealed a significant main effect for three feedback conditions, $F(2,42)=14.01$ $p<0.05$, and for the lay-up $F(2,42)=20.66$ $p<0.05$. Tukey's HSD follow up for the dribbling performance revealed statistically significant differences among the scores of verbal condition ($M=690.66$; $SD=207.44$) to both visual conditions ($M=559.33$; $SD=156.94$), and visual + verbal condition ($M=875.06$; $SD=114.57$). Tukey's HSD follow up for the lay-up performance revealed statistically significant differences among the scores of verbal condition ($M=851.66$; $SD=258.11$) to both visual conditions ($M=710.01$; $SD=210.01$), and visual + verbal condition ($M=1231.01$; $SD=217.45$).

Table 2. Descriptive Statistics for Feedback Groups for Dribbling and Lay-up Tasks

Groups		Dribbling		Lay-up	
		Pre-test	Post-test	Pre-test	Post-test
Verbal Feedback	M	420.33	690.66	496.33	851.66
	SD	192.57	207.44	223.62	258.11
Visual Feedback	M	381.33	559.33	474.66	710.01
	SD	156.49	156.94	208.49	210.01
Visual + Verbal Feedback	M	410.33	875.06	547.33	1231.01
	SD	181.45	114.57	286.34	217.45

Legend: M - mean score; SD - standard deviation.

Figure 1 shows the dribbling mean scores of the three feedback conditions from pre-test to post-test.

**Figure 1.** Dribbling Mean Scores of the groups During Pre-test and Post-test

The ANOVA results for the total difference revealed a statistically significant main effect for the conditions of dribbling performance, $F(2,42)=46.18$ $p<0.05$ and lay-up

performance, $F(2,42)=100.47$ $p<0.05$. Tukey's HSD follow up for dribbling performance revealed statistically significant differences among the scores of verbal con-

dition ($M=270.33$ $SD=54.72$) to both visual conditions ($M=178.00$; $SD=36.73$), and visual + verbal condition ($M=464.73$; $SD=128.57$). These results showed that visual + verbal feedback condition has the largest improvement test

scores, but the visual condition has the least improvement in dribbling skill.

The lay up mean scores of the three feedback conditions from pre-test to post-test were shown in Figure 2.

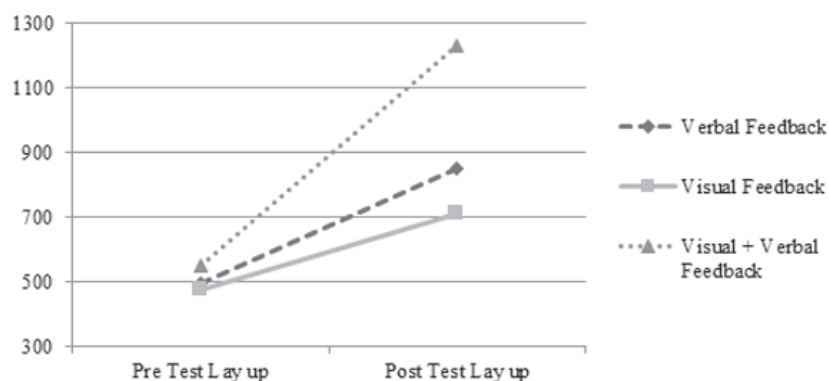


Figure 2. Lay-up Mean Scores of the groups During Pre-test and Post-test

Tukey's HSD follow up for lay-up performance revealed statistically significant differences among the scores of verbal condition ($M=355.33$; $SD=66.12$) to both visual conditions ($M=235.33$; $SD=67.94$), and visual + verbal condition ($M=683.66$; $SD=123.03$). These results showed that the vi-

sual + verbal feedback condition has the most substantial improvement in test scores, but the visual condition has the least improvement in lay-up skill. Figure 3 shows the total difference scores of the three feedback conditions as improvement scores.

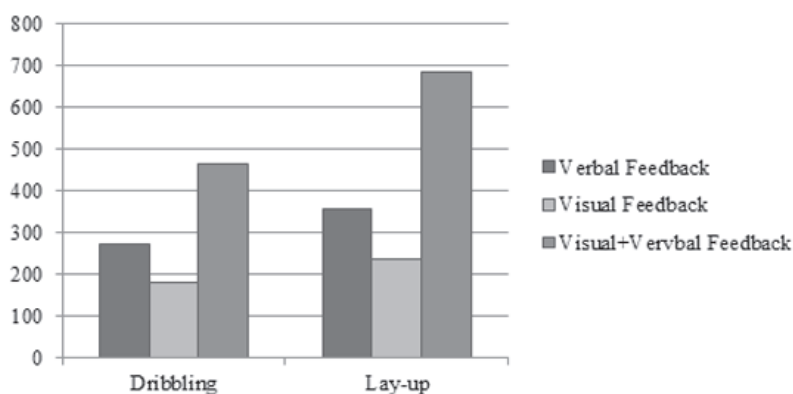


Figure 3. Dribbling and Lay-up Total Difference Scores of the Three Feedback Groups

Discussion

This study examined the effect of different feedback conditions on the dribbling and lay-up skills in basketball. The results of the study revealed that there was a significant difference in the post-test scores of verbal, visual + verbal, and visual feedback groups. This difference was caused by the verbal feedback group and the visual + verbal feedback group over the visual feedback group.

Baundry, Leroy, and Chollet (2006) examined the effect of visual feedback to the learning double leg circle on the pomel horse of gymnastic skills for 16 subjects at the age of 14.3 with a minimum of six years of experience. The subjects were set in groups of eight, and they practised ten sequences of six circles for four days. The results demonstrated that subjects in the visual group who had the chance to watch their performance exhibited considerable improvement. The results indicate that visual feedback enhances the error detection capability of the learner and analysis of the specific parts of the

intricate movement patterns.

Zetou, Tzetzis, Vernadakis, and Kioumourtoglou (2002) examined the effect of different feedback conditions on the performance and learning of serving and setting skills of volleyball for 116 elementary school children at the average age of 11.7. Subjects were randomly assigned to an expert modelling video feedback group and a self-modelling video feedback group. After the eight-week intervention, subjects in both groups improved their serving and setting skills but more in expert modelling video feedback group on acquisition and retention.

In conclusion, VTFB was appropriate for the tasks that serving and setting were simple, and the cognitive levels of the learners permit understanding the specific aspects of the skills. In the study Aiken, Fairbrother, and Post (2012), basketball set shot technique was investigated. Twenty-eight female subjects at the mean age of 26.4 were randomly assigned to a self-controlled video feedback group and yoked video feedback group. The results revealed that the self-controlled video feedback

group had significantly higher results during the transfer and acquisition phase. The amount and the type of feedback depend mainly on the cognitive level of learner and the characteristics of the skill. In this study, adults have a higher understanding, error detection, and error correction capability; therefore, VTFB has been more effective in learning.

In contrast, VTFB is not always beneficial. Ineffective use of VTFB for learning has been attributed to such variables as the level of performer, type of skill or movement, the instructor provided feedback, and frequency of viewing. These and the other variables should be considered when using VTFB to improve the learning of motor skills. In the studies of Whiting (1989) and Rusell (1993), VTFB was not as useful as the studies mentioned above.

Jennings et al. (2013) examined the effectiveness of videotape feedback on the cycling standing start performance of novice track cyclists. Nineteen subjects at the average age of 13.6 were assigned to traditional verbal feedback intervention group and video self-modelling feedback intervention group. The results failed to show a significant difference or interaction between the two groups on the performance. The evidence indicates that VTFB depends on learning process especially when the task was complex and learners were young or novice, seeing one's performance on video does not automatically accomplish the goals of feedback, it takes time and repetition for visual feedback to promote valuable cognitive effort.

Rusell (1993) examined the effect of traditional and videotape feedback method on the learning of hockey skills to the students at the age of 12. Subjects were separated into two groups of 15 students each. The results of the study demonstrated that there were significant differences between videotape and traditional feedback groups. The videotape feedback group had higher scores than traditional groups.

Boyce, Markos, Jenkins, and Loftus (1996) determined that teacher-provided verbal feedback was often the most effective for third graders, but for fifth graders VTFB was more effective than teacher-provided verbal feedback or peer feedback. Hebert, Landin and Menickelli (1998) also suggest that beginners and younger students might be more dependent on feedback and less able to process and use VTFB.

The ability to detect critical elements of the movement is vital for the proceeding "associative" stage of learning. VTFB must be supported via verbal and written clues to keep attention to those cues for better performance and learning. In this stage, learners may lose their motivation by focusing on the entire movement or result of the movement. In this case, instructors may quit VTFB, but the lowered motivation typifies early stages of learning, is temporary with appropriate experiences. The more successful they are in identifying and correcting errors, the higher the motivation and enthusiasm for students to use VTFB.

The hypotheses of the study were supported by the liter-

ature. The movement pattern scores of visual + verbal feedback scores were higher than the verbal feedback group, and verbal feedback groups scores were higher than the modelling feedback group. The reason for the low scores in visual feedback group is that; VTFB requires cognitive effort to comprehension (especially for the children). The study supported the second hypothesis that total difference scores of visual + verbal feedback scores were higher than verbal feedback group, and verbal feedback groups scores were higher than the visual feedback for both the dribbling and the lay-up tasks. Also, the literature, which was in agreement with this study, indicated that when the VTFB combined with the verbal cues or verbal feedback, the improvement in skill learning and performance became greater. Researches in these areas suggest that cognitive processes play an essential role during the early stages of skill acquisition.

In contrast, the learning of the dribbling is lower than the learning of the lay-up skill. The source of this difference is the nature of the skills. As is known, dribbling is a continuous skill and lay-up is a discreet skill. On the learning of lay-up skill, feedback is more concrete; for example, start with right foot, head and eyes looking at basket, land on two feet, etc. However, on the learning of dribbling skill, the feedback is more flexible, for example, knees make a slight forward angle, keep the centre of gravity in hip, push the ball through the floor in harmony starting from elbow to wrist, etc. For that reason, children showed considerable improvement in lay-up (discreet) skill.

The notion that motor skill learning occurs in stages is popular in pedagogical and motor-learning literature (Magill, 2001; Rink, 2002; Utley, Andrea & Astill 2018). Generally, the literature reveals that learners need to pass through "cognitive," "associative," and "autonomous" stages of motor learning to exhibit more consistency, show good ability to detect and correct errors, and well-defined motor programs (Magill, 1998). The transitions between the stages of the learning process need continuum and shifts gradually. The similar approach should be considered in the application of VTFB, and the learners' stage should be assessed carefully for enhancing motor skill learning. The particular elements of the movements, covers the instructional goals, should be given in the form of VTFB consistently immediate after practice until attaining mastery in specific sport skill.

Based on the findings of the study, the following recommendation might be considered in future studies. Firstly, verbal feedback for novice learners seems to be better than visual feedback. Secondly, VTFB and verbal feedback should be used together to get better learning and performance results. Thirdly, a control group can be added to the design of the study for assessing the practice only effect. Finally, visual-only feedback to an expert group can be given to assess the difference between the novice and the expert group.

Acknowledgements

There are no acknowledgements.

Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

The Effect of a Short-Term Training Period on Physiological Parameters and Running Performance in Recreationally Active Female Runners

Irena Auersperger¹, Iva Jurov¹, Klemen Laurencak¹, Bojan Leskosek¹ and Branko Skof¹

¹University of Ljubljana, Faculty of Sport, Ljubljana, Slovenia

Abstract

This paper aimed to analyse an individually set training programme in recreationally active female runners and its effects on endurance and performance. Nine female athletes (age 34.0 ± 5.4 years) went through eight weeks of polarized training based on a modified training impulse method. Their training zones were established individually based on their heart rate measured with an incremental running test. Their programme was polarized to elicit positive changes in aerobic capacity and running performance in a 2400 m test. Their physiological parameters ($VO_{2\max}$, HR, respiratory compensation threshold) ventilation were measured in an incremental running test. The participants attended most of the training sessions and showed great motivation in their individually set training regime. We observed positive changes in all measured parameters (final treadmill velocity, distance covered on the treadmill, $VO_{2\max}$, the velocity at RCT) in an incremental test and better performance on the 2400 m run. A modified TRIMP concept in an eight-week running programme is a valid method in prescribing training to recreationally active female runners. It elicits positive changes in performance and supports well-being and health.

Keywords: training periodization, TRIMP, $VO_{2\max}$, running, monitoring training load

Introduction

Endurance training is widely known to contribute to better health and well-being (Ainsworth et al., 2011; Haskell et al., 2007; Marti, 1991; Samitz, Egger, & Zwahlen, 2011). Running, in particular, is becoming increasingly popular as it is one of the most affordable forms of aerobic exercise that can produce results the fastest. The American College of Sports Medicine (Haskell et al., 2007) recommends moderate-intensity aerobic exercise for a minimum of 30 min, five days a week, or vigorous-intensity aerobic physical activity for a minimum of 20 min, three days a week, to all healthy adults aged 18–65 years. These guidelines emphasize training at an intensity close to the traditional lactate threshold (Haskell et al., 2007).

In recent years, training distribution has received attention,

as it could be a determinant of endurance training impact. A proposed training pattern termed ‘polarized endurance training’ (PET) (Esteve-Lanao, Foster, Seiler, & Lucia, 2007; Muñoz, Seiler, Bautista, España, & Esteve-Lanao, 2014; Seiler & Kjerland, 2006; Tønnessen et al., 2014) consists of two distinct intensity levels. About 80% of training volume is performed at a low-intensity level, and about 20% of training volume is high-intensity training (HIT), which is an intensity above the lactate threshold (LT). There are also other approaches to distributing intensity zones. A number of research studies have identified intensity zones based on ventilatory thresholds (VT) and their associated heart rate (HR) values identified during the incremental test. Three training zones are defined as zone 1, being low-intensity exercise performed below the first VT; zone 2, moderately high-intensity



Correspondence:

I. Jurov
University of Ljubljana, Faculty of Sports, Gortanova 22, 1000 Ljubljana, Slovenia
E-mail: iva.jurov@fsp.uni-lj.si

exercise in an intensity range between the VT and the respiratory compensation threshold (RCT); and zone 3, high-intensity aerobic exercise performed above the RCT (Muñoz et al., 2014). Taking into account both exercise volume and intensity into a single term, Banister et al. (Bannister, 1991) developed the concept of the training impulse (TRIMP). The original TRIMP method did not take into account the aforementioned intensity zones based on reference HR values. Foster et al. modified the original TRIMP concept by integrating total exercise volume and total intensity relative to three intensity zones (Foster et al., 2001; Foster, Rodriguez-Marroyo, & Koning, 2017).

There is substantial evidence supporting highly trained endurance athletes from a variety of sports using PET pattern. It is not, however, yet evident whether this is also beneficial for recreational athletes performing a much smaller volume (i.e., 3-5 hours per week) and whether intensity distribution is crucial at all. A study from Muñoz et al. (2014) suggested that PET training can stimulate greater training effects compared with a programme at threshold range intensities in male recreational runners. PET has also shown benefits in raising VO₂max compared to cross-fit endurance training in female runners (Carnes & Mahoney, 2019). A recent systematic review of middle- and long-distance runners compared PET to pyramidal training and threshold training (Kenneally, Casado, & Santos-Concejero, 2018). PET and pyramidal training appear to be more effective. However, only six intervention studies were suitable for the analysis, and other data were from three case studies and one review. Regarding these findings, further research is needed to support PET training advantages. Moreover, it would be beneficial to establish these recommendations in female recreational athletes.

Finally, using a running programme can be beneficial in delivering results in recreationally active individuals. Running related injuries are namely very common in recreational runners, especially in novice runners. They are an important factor of dropout from running. That is why running programmes can be effective not only in achieving greater performance but also in delivering greater health effects by achieving long term running participation (Kluitenberg et al., 2015).

The health benefits of exercise in recreationally active women are established (Marti, 1991), but little is known about improving performance and whether there are benefits of an individually determined training regime. The purpose of the study was to analyse the effectiveness of an eight-week individually set running intervention on the health and performance of nine female runners. The aim was to monitor and control the training load in order to ensure desired individually determined polarized endurance training.

Methods

Subjects

Nine healthy, active female recreational endurance runners were recruited to participate in the study. Prior to inclusion, all participants regularly had three to four regular running sessions per week, were non-smokers and were not taking any form of medication. The physical characteristics of the participants are shown in Table 1. Detailed history, physical examination, and laboratory analysis were performed before the study. All subjects were healthy at the start and during the research. The study protocol was approved by the National Ethical Committee of Slovenia. All participants gave written informed consent.

Table 1. Basic characteristics and body composition prior to training and post-study in the recovery phase

	Age	Body Height (cm)	Body Mass (kg)		BMI		% Fat		Fat Free Mass (kg)	
			pre	post	pre	post	pre	post	pre	post
M	34.0	171.3	60.3	60.0	20.5	20.6	18.3	17.8	50.3	50.0
SD	5.4	6.8	6.9	7.1	1.8	2.0	2.8	2.6	4.8	4.5

Study design

The study was completed during the intensified training phase (specific preparation), focusing on the 10 km (N=3) or the 21 km (N=6) run competition at the International Ljubljana Marathon in October 2008. The whole group completed a general preparation phase from April to August in that year. Before starting the specific training phase, all runners completed a two-week run-in period of low-intensity physical training to ensure familiarity with

experimental procedures and to have reached a non-fatigued state.

The physical training programme consisted of two three-week progressive overload periods (training loads Load1 and Load2), each followed by an easy week period (Easy Week 1 and Easy Week 2). After the second easy week, the runners participated in the race. This was followed by a recovery week. In the end, their physiological parameters were measured again. Table 2 shows the testing schedule for the study.

Table 2. Study protocol

General Preparation Period		Physical Training Program									
week2	week1	week 0	week 1	week 2	week 3	week 4	week 5	week 6	week 7	week 8	week 9
low-intensity physical training	anthropometry	Baseline Testing	Training Load 1			recovery week 1	Training Load 2			recovery week 2	Post Study Testing
		1. IT									2. IT
		1. RT	2. RT				3. RT			4. RT	5. RT
											anthropometry

Legend: IT-incremental test, RT-running test)

Experimental procedures

Running training

The participants had four training sessions per week in training load phases consisting of one short aerobic interval training (at 88–95% maximum HR (HRmax)), one long aerobic interval training (up to 100% HRmax), an easy run (at 70–87% HRmax) of 6–8 km and a long-distance run (at 70–87% HRmax) 12–18 km. Based on the runner's HRmax, which we determined during the incremental baseline test to exhaustion, we set each runner's training protocol to match the same training stimulus. The runners completed a 2400-m time trial (Cooper) on an outdoor 400 m tartan track before commencing training and then every two to three weeks during the testing period. The programme was divided into two four-week training blocks, each consisting of three weeks of increasing load and one recovery week (Table 2). In the recovery period, interval training was replaced with an easy run of 6–8 km. All training sessions were supervised by at least one qualified athlete coach and one member of the research group.

Incremental test and anthropometry

All runners completed an incremental test to exhaustion on a treadmill before the start and post-study. Each runner had previous experience with treadmill running and testing. After a six-min warm-up, an incremental protocol on a calibrated treadmill (Technogym, UK) with a 2% incline was performed. The starting velocity was 3 km/h with speed increments of 2 km/h every 2 min. The runners walked the first stage and then ran until volitional exhaustion. The last half or full stage that the subject could sustain (for either 1 min or 2 min) was defined as that individual's maximal speed. During recovery, the subjects walked at 5 km/h for 5 min. Respiratory parameters were assessed with a Cosmed K4b2 spirometry system (Rome, Italy) (McLaughlin, King, Howley, Bassett, & Ainsworth, 2001). HR was recorded continuously during the test using telemetric heart monitors (Polar Electro, Oulu, Finland).

Anthropometric measurements were made before the start and post-study. Bodyweight (kg) and height (cm) were measured to the nearest 0.1 kg and 0.5 cm, respectively, and body mass index (BMI) was calculated. Body fat percentage (%) and lean mass (kg) were assessed using the skinfold technique and calculated using Matiegka's method. Skinfold thicknesses at biceps, triceps, and subscapular were measured with GPM skinfold callipers (Siber Hegner & Co. Ltd., Zurich, Switzerland) with a precision of 0.2 mm.

Quantification of training load

Each participant wore a Polar 800 HR monitor during the process to record training, not including warm-up and cool-down intervals. The following parameters were measured: total time spent in each intensity zone (zone 1, HR below the VT; zone 2, HR between VT and RCT; zone 3, HR above RCT) and total load (TRIMP score). Previous research on trained endurance athletes has shown that HR values at VT and RCT determined during laboratory testing remain stable over the season despite significant improvements in the workload eliciting both thresholds (Lucía, Hoyos, Perez, & Chicharro JL., 2000).

We estimated the total exercise load (intensity \times volume) using an approach to calculating the TRIMP based on Foster et al. (2001). This method uses HR data during exercise to integrate both total volume and intensity relative to three intensity zones. The score for each zone is computed by multiplying the accumulated duration in this zone by an intensity-weighted multiplier (1 min in zone 1 is given a score of 1, 1 min in zone 2 is given a score of 2, and 1 min in zone 3 is given a score of 3). Total TRIMP load is then obtained by summing the three zone scores.

Data analysis

Statistical analysis was performed with SPSS version 22 (IBM, Armonk, NY, USA) and Microsoft Excel (2016, Seattle, USA). A paired samples t-test investigated significant differences between methods. Data are reported as mean \pm standard deviation or percentage unless specified otherwise and participant characteristics pre- and post-study were compared.

Results

Baseline and post-study laboratory parameters

One of ten subjects was excluded from analysis due to incomplete training-data recording. Baseline and post-study parameters of body composition did not change significantly (Table 1).

Quantification of training load

None of the nine participants included in the study was injured during the training period (Auersperger idr., 2012). All of them performed 94% of the scheduled training sessions over the eight-week programme. The cumulative total duration of running training session over the experimental period (week 1–8) was 23.71 ± 3.9 hours and 235.79 ± 39.16 km. Other characteristics are represented in Table 3.

Table 3. Average training load and physiological parameters measured at incremental test after the study

participant	number of sessions per week	duration of training (h/week)	running distance (km/week)	VO2max improvement	VRCT improvement	final treadmill velocity	distance covered on treadmill
1	30	2.7	34.3	5.51%	5.66%	4.76%	6.53%
2	24	2.8	31.0	6.77%	0.00%	1.79%	3.65%
3	18	3.4	35.1	6.76%	8.89%	7.02%	14.53%
4	29	2.9	30.9	5.20%	6.12%	-3.17%	0.03%
5	26	2.1	23.0	4.04%	-5.66%	3.64%	7.83%
6	28	3.3	38.0	2.83%	4.26%	10.91%	17.39%
7	26	2.9	31.0	9.33%	3.77%	-1.89%	-6.10%
8	27	3.1	37.4	7.31%	-2.13%	1.64%	2.78%
9	29	3.6	42.6	-0.56%	8.51%	0.00%	-0.11%
average	26.33	3.0	33.7	5.24%	3.27%	2.68%	5.11%

Legend: VRCT - velocity at respiratory compensation threshold

The realization of the training programme is presented with modified TRIMP score in Figure 1.

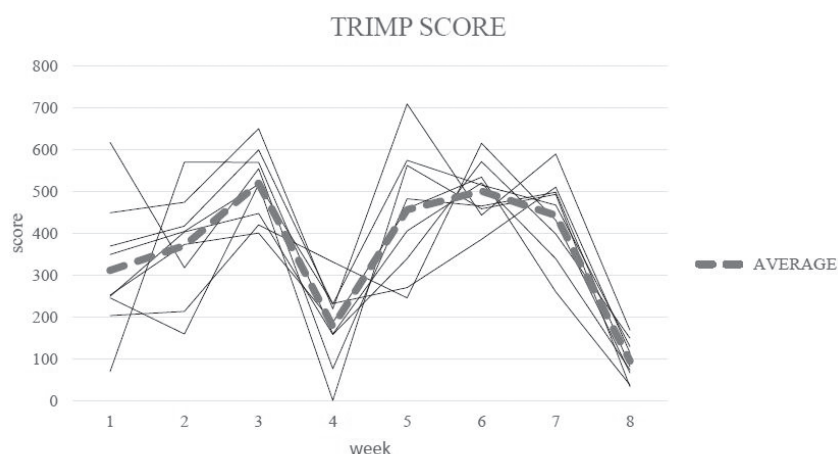


Figure 1. TRIMP score during 8-week training program

All but one runner improved their performance in the 2400 m test, as shown in Figure 2. We suspect her poorer per-

formance was due to the fact that she developed iron deficiency anaemia during the study (Auersperger idr., 2013).

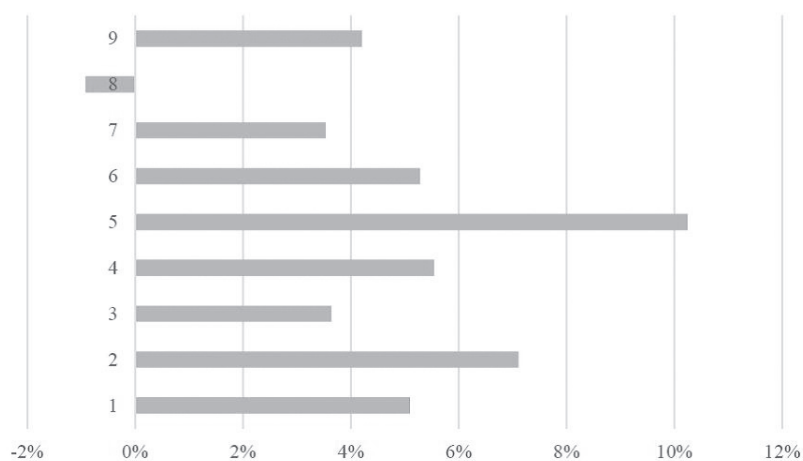


Figure 2. Individual performance improvement in 2400 m test conducted at week 9

Training intensity distribution (time spent in zones 1, 2 and 3) with training sessions per week for all athletes is presented in Figure 3. It shows how two taper periods were pres-

ent in the training protocol where the training load was mostly reduced by decreasing zone 3 and zone 2.

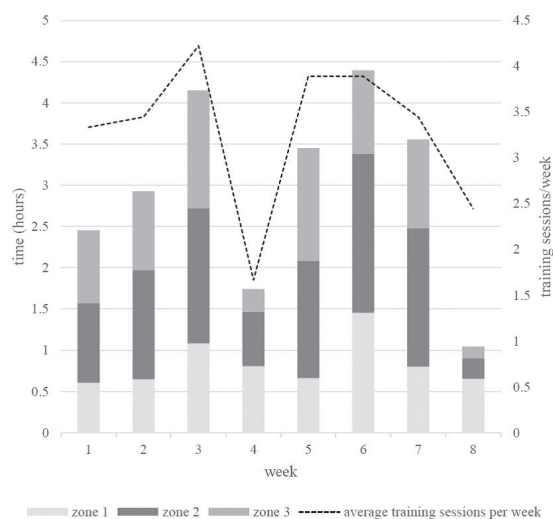


Figure 3. Exercise intensity and training unit distribution per week

All of the participants completed the majority of the prescribed training programme. Training volume of 3.0 ± 0.5 h per week (0.8 ± 0.3 h in zone 1, 1.2 ± 0.4 h in zone 2 and 0.9 ± 0.4 h in zone 3) including two taper periods in between elicited improvement not only in improvements of laboratory parameters but also of field test performance (Figure 2) was reported. We observed a tendency to improvement in running efficiency as the velocity at RCT increased on average by 3.27% ($t=1.94$, $p=0.088$). The sample size was not enough to prove statistically significant improvement, but the effect size is big (Cohen's $d=0.65$). Additionally, we can conclude that participants' aerobic capacity increased in this relatively short time period as we measured a 5.2% increase in $VO_{2\max}$ values ($t=5.40$, $p=0.001$) (Table 3).

Discussion

This article presents how an individually set training load influences the performance of recreationally active female runners. Eight weeks of prescribed and supervised training with two taper periods elicited significant positive changes in participants' aerobic capacity, running efficiency and running time in a 2400 m test. This is in accordance with a study (Manzi, Iellamo, Impellizzeri, D'Ottavio, & Castagna, 2009) conducted on recreationally active male long-distance runners where an individualized TRIMP concept was also used.

We expected an improvement in performance, as participants had been active before the study. On average, they performed running training two to three times weekly. This can also be shown also in their baseline $VO_{2\max}$ values which are above average for the general population (35-40 ml/min/kg for an average man (Guyton & Hall, 2011)). We expected progress as we increased their training load (and TRIMP score) in this programme with special attention to their individual abilities that enabled the programme to be defined well. This is what enabled good compliance as the programme was not too intense. A study on 1419 recreational male and female runners showed that their average weekly running mileage is 47.3 ± 17.5 km (García-Pinillos, Ramírez-Campillo, Roche-Seruendo, Soto-Hermoso, & Latorre-Román, 2019), which is above the average set for our participants. Our participants were females only, and we suggest that with average 33.7 weekly running distance the load on the runners was adequate and not too high.

Additionally, we expected better results as the programme had clearly defined sessions with supervision so that the runners were never alone in the process. The programme was set with the goal of improving $VO_{2\max}$ since our initial aim was to increase aerobic capacity and its related positive health consequences (Lackland & Voeks, 2014).

We used an incremental test to determine three intensity zones based on HR values. A study by Schumann et al. (Schumann, Botella, Karavirta, & Häkkinen, 2017) used another approach in individualizing training intensity in thirty recreationally endurance-trained males. They used the Polar Training Load Feature and, compared to standardized endurance training, they did not find any differences in HR-derived indices. In contrast, our approach enabled runners to perform a session in a set zone since their HR was fixed in advance. This individualization of the programme made it possible not only to ascertain good cooperation and better improvement in an individual, but it also ensured good periodization and precise control over TRIMP. Consequently, we had good con-

fidence that the TRIMP we set for our participants was also accomplished.

The programme was divided into two blocks of three weeks of higher load and one-week recovery. This is in accordance with a common knowledge used in endurance sports in which four-week mesocycles are regularly used since a ratio 3:1 between load and rest appeared to be efficient. Specifically, we planned extensive interval training in a way that every third run was performed uphill. This enabled the development of specific running power. Long aerobic interval training, which on average took 4-5 minutes, was also performed uphill in the last part of their entire training session. This was done with a goal of ensuring $VO_{2\max}$ values at the end of these sessions, as it is known this parameter can be influenced by intervals of 2-5 minutes (Daniels, 2005; Hill & Rowell, 1997). With long runs, we aimed to indirectly influence $VO_{2\max}$ with maintaining aerobic endurance intensity levels that resulted in a 5.1% longer distance achieved at the second incremental test (Table 3). We also observed a better running efficiency that resulted in a greater final treadmill velocity (Table 3). Short aerobic runs of 6-8 km were used for active recovery one to two days after the interval training session.

As observed from Figure 1, the TRIMP score did not reach its peak in Week 7 as expected in our programme. We observed fatigue in some participants that failed to complete all sessions in that week (hence 94% attendance instead of 100%). We suggest this is another reason that a running programme with supervision and expertise is beneficial in improving performance. This caused our average TRIMP score to be less than predicted. However, overreaching with its possible negative consequences on the second incremental test and second 2400 m run was prevented. Self-reported subjective measures should be taken into monitoring as they provide significant insight into athletes well-being (Saw, Main, & Gastin, 2016). Adjusting the programme to fatigue in these individuals also helped to avoid common running-related injuries (Hreljac, 2004). With regard to an improvement in all measured parameters, we can conclude that our goal of improving performance on the incremental test and the 2400 m running test was achieved. This indicates that an individualized running programme can be effective in running performance and well-being in recreationally active women. We also suggest this shows that our decision in not putting pressure on fatigued individuals to complete all sessions in Week 7 and mildly adjusting the programme could be the right decision.

After the training programme, the participants reported greater motivation than in their regular activities. Although this was not investigated with scientific methods or psychological questionnaires, we believe this contributed to a good attendance in determined sessions. This could be another advantage of a supervised running programme over a programme that is performed only by a runner alone.

We experienced some difficulties in controlling intensity in long-distance runs in which participants tended to run too fast (that is with an HR too high). We observed this when analysing HR values after their long-distance run sessions. If we perform this protocol again, we suggest monitoring HR values in real-time and adjusting their levels during the runs, if necessary. Secondly, as already emphasized, to ensure an ideal distribution of intensities in order to achieve a good anabolic and catabolic phase in our programme, Week 7 would need a greater TRIMP. This would be achieved if all prescribed ses-

sions would have been performed. However, our participants were females that were not professional athletes. Their activities at the workplace and in their social environments also affected fatigue that aroused in some individuals at the end of our programme. This is why adjusting the programme is probably very realistic also in everyday practice when working with non-professional athletes.

We can conclude that an individually set modified TRIMP concept was beneficial in recreationally active female runners in our eight-week programme. It positively affected aerobic capacity and endurance performance. It also successfully avoided running-related injuries and supported well-being

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There are no acknowledgements.

Conflict of Interest

The authors declare that there are no conflicts of interest.

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Limitations

Our study recruited only a moderate number of subjects; thus, we may not have been able to detect more subtle differences in measured parameters. Our results may not be applicable to men and should also be confirmed in elite athletes.

ORIGINAL SCIENTIFIC PAPER

Factors Associated with Physical Activity

Armend Kastrati¹ and Georgi Georgiev²

¹University of Pristina "Hasan Pristina", Pristina, Kosovo, ²Ss. Cyril and Methodius University, Faculty of Physical Education, Sport, and Health, Skopje, Republic of North Macedonia

Abstract

The purpose of this paper is to determine the association of demographic, psychological, and social factors with physical activity, and to determine whether indicators of physical activity differ in terms of gender among 974 young adults of Albanian nationality from 18 to 29 years of age. Students completed a questionnaire that examined their level of participation in physical activity and behaviours, along with several potential correlates. Hierarchical regression was used to explore the relationship between hypothesised factors and physical activity. On the basis of the obtained results, one can conclude that male students, unlike female students, show a significantly higher level of physical activity. The respondents of both genders who have a higher level of self-efficacy perceive greater benefits of physical activity, greater social support from friends, and come from families where a larger number of family members have higher levels of physical activity. The results of the research suggest the importance of the preparation of a national plan and programme to promote physical activity to help young people change unhealthy lifestyle habits and increase physical activity, thereby to improve their health.

Keywords: *physical activity, students, attitudes, IPAQ criteria*

Introduction

The influence of physical activity (PA) on human health has been proven in numerous studies but, unfortunately, a large part of the population remains insufficiently physically active (Hallal, Victora, Azevedo, & Wells, 2006; Bouchard, Blair, & Haskell, 2007; WHO, 2010). Diseases caused by hypokinesia constitute a significant problem in modern medicine. Sports and recreational physical activities are an indispensable means for compensating the lack of movement. For this reason, many developed countries around the world have created state-wide strategies to promote physical activity among their citizens, which is a priority in the attempt to reduce the massive healthcare costs in the long run.

In adolescents, the health benefits of physical activity include healthy growth and development of the bones as well as the muscular and cardio-respiratory system, maintenance of energy balance, avoiding risk factors for cardiovascular diseases, possibilities for social interaction, and positive mental well-being: higher self-esteem, lower anxiety, and lower stress

(Hillsdon & Foster, 2003; British Heart Foundation, 2004).

Given the fact that as age increases, physical activity decreases, adolescence is a critical period of intervention (Aaron et al., 1993). Adolescents are more likely to be physically active in adulthood if they establish habits to engage in physical activity in early adolescence (Telama & Yang, 2000). Physical activity is a complex behaviour that is affected by many internal and external factors, including socio-cultural factors, psychological-cognitive factors, and the physical and social environments that surround the individual.

The explanation regarding the influence of the factors on behaviour changes is crucial in designing interventions, strategies and educational programmes that will contribute to increasing the level of physical activity in young people (Sallis, Prochaska, & Taylor, 2000). Current guidelines recommend that all young people should participate in physical activity of at least moderate intensity for one hour per day.

The results of the previous research indicate that self-efficacy (confidence in one's abilities to perform a particular



Correspondence:

G. S. Georgiev
Ss. Cyril and Methodius University, Faculty of Physical Education, Sport, and Health, Str. Dimche Mirchev 3, 1000 Skopje, Republic of North Macedonia
E-mail: georgigeorgiev63@yahoo.com

behaviour in specific situations), the increase of the level of perceived benefits of physical activity, the reduction of the perceived barriers, the increase of social support from the closest persons in the environment (parents and peers/friends), the enjoyment in physical activity, and the access to equipment and facilities are factors associated with physical activity in the period of adolescence (Sallis et al., 2002; Sallis et al., 2000).

In the Republic of Kosovo, there is a small number of studies that investigated factors that affect physical activity in adolescents who have their own socio-cultural, religious, and other specific factors. In contrast, internationally this topic has been the subject of numerous studies in many countries and different geographical environments; however, the question arises of whether the results of these studies can be generalized to the population of Albanian adolescents (McKenzie et al., 2002; Schmitz et al., 2002). In response, this study has been conducted in order (a) to determine the association of demographic, psychological and social factors with physical activity, (b) to determine whether physical activity indicators differ in terms of gender, (c) and to provide recommendations for interventions aimed at promoting an active and healthy lifestyle in this population group.

Methods

Participants

The research was conducted on a sample of 974 randomly selected respondents from several faculties within the university. The sample consisted of 572 (58.7%) male respondents (male students) and 402 (41.3%) female respondents (female students). The average age of the respondents of both genders was 20.2 years. The respondents were treated according to the Declaration of Helsinki.

Measures

A questionnaire was used to identify (a) demographic factors, (b) the physical activity, (c) the factors associated with physical activity.

Demographic Factors

A ten-item investigator-developed questionnaire was used to collect demographic data. The following demographic data and participant characteristics were collected to describe the study sample: age, gender, residence, number of family members, education of the father, education of the mother, whether the father is active in sport and whether the mother is active in sport.

Physical Activity

The nine-item IPAQ-C records self-reported physical activity in the last seven days. Responses were converted to Metabolic Equivalent Task minutes per week (METmin/wk) according to the IPAQ scoring protocol: total minutes over previous seven days engaged in vigorous activity, moderate-intensity activity, and walking were multiplied by 8.0, 4.0, and 3.3, respectively, to create MET scores for each activity level. MET scores across the three sub-components were totalled to indicate overall physical activity.

Exercise Benefits/Barriers Scale

The original version of EBBS consisted of 43 items, 29 items under the construct of benefits, and 14 items under the construct of barriers. The benefit scales are composed of five subscales: life enhancement, physical performance, psychological outlook, social interaction, and preventative health.

The barrier scales are composed of four subscales: exercise milieu, time expenditure, physical exertion and family discouragement. The scales are designed based on a four-point Likert scale: strongly agree (4), agree (3), disagree (2), strongly disagree (1). When the barriers and benefits are added together for a total benefits/barriers score, the items of the barrier scale have an inversed score. The barrier items are not inversely scored if only the barrier items are used. The benefit subscales can have a score ranging from 29 to 116 and the barrier subscales can have a score ranging from 14 to 56. Altogether, they result in a total score between 43 and 172. In this scoring system, the higher score represents the greater perception of a subscale.

Exercise Self-Efficacy

Perceived exercise self-efficacy was assessed using the Children's Physical Activity Self-Efficacy Survey, an eight-item scale developed by Garcia, Pender, Antonakos, and Ronis (1998). Items included, for example, "I could exercise even if I were tired" and "I could exercise even if I were not very good at it". Responses ranged from "very true" to "not at all true" and a mean score, ranging from 1–5, was computed by averaging responses to the eight items.

Parental Support

Levels of paternal and maternal support for being active were measured using an adapted version of a scale from the Amherst Health and Activity Study (Sallis et al., 2002). Five items assessed different aspects of parental support, including encouragement, participation in joint activities, provision of transport, observation and praise. Responses ranged from "a lot" to "not at all". A mean score, ranging from 1–5, was computed by averaging responses to the five items.

Peer Support

Peer support for being active was measured using an abridged version of the parental support scales. Two items assessed how often friends provided encouragement to be active and how often they took part in joint activities. Responses ranged from "a lot" to "not at all". A mean score, ranging from 1–5, was computed by averaging responses to the five items. The question "How much do you enjoy doing physical activity?" was asked, as well as asking respondents about their enjoyment of physical education at school and how many of their friends are physically active (Inchley, Kirby, & Currie, 2008).

Enjoyment

The enjoyment of PA was assessed using the revised PACES, which was originally designed to measure positive effects associated with involvement in physical activities in college students (Kendzierski & DeCarlo, 1991). It has since demonstrated internal consistency in 12–16 year-old children, with coefficient $\alpha=.90$, and item-total correlations $=.38-.76$ (Crocker, Bailey, Faulkner, Kowalski, & McGrath 1997). The original PACES consisted of 18 bipolar statements on a seven-point continuum (I enjoy it–I hate it) which were totalled to produce a total enjoyment score. The revised PACES consists of 16 statements that begin with the stem "When I am physically active...". The items of the PACES questionnaire can be seen in Table 1. Motl, Dishman, Saunders, Dowda, and Pate (2007) modified the PACES for use with young adolescent females. In doing so, two items were removed and others rewritten to im-

prove comprehension and reduce redundancy, and a five-point Likert-type scale (1="Disagree a lot" to 5="Agree a lot") which was considered more comprehensible to younger children replaced the 7-item bipolar continuum (Motl et al., 2007). A score is computed by calculating the average of the 16 items.

Statistical Analysis

The data was processed using the statistical package SPSS for Windows Version 22.0. The normality of the distribution of the variables was checked with the Kolmogorov-Smirnov method, and log transformations were made when possible. The variables that met the normality criterion were analysed by using parametric statistical procedures, while the variables that did not meet the normality criterion were analysed by using nonparametric statistical procedures. Independent samples t-tests and Mann-Whitney U tests were used to compare differences in PA for gender. Comparison of means used a two-

tailed hypothesis with the alpha levels set at $p < .05$. Spearman's Rho correlation was used to analyse the relationship between PA and potential correlates. Factors associated with PA were entered into hierarchical regression models.

Results

To determine whether there are differences in physical activity and psychosocial factors between male and female respondents, a Mann-Whitney U test was applied. From the overview of Table 1, which presents the results of the applied analysis, it is observable that statistically significant differences were found between male and female respondents in the variables: vigorous physical activity ($p=0.000$), moderate physical activity ($p=0.000$), total physical activity ($p=0.000$), exercise self-efficacy ($p=0.000$), peer support ($p=0.001$), perceived barriers of physical activity ($p=0.003$), perceived benefits of physical activity ($p=0.004$), and enjoyment of physical activity ($p=0.001$).

Table 1. Means and standard deviations for study variables grouped by gender and Mann Whitney U tests

Variables	Males		Females		p
	Mean	SD	Mean	SD	
Vigorous	1731.39	2042.26	694.79	1435.47	0.000
Moderate	770.22	1040.54	496.46	902.83	0.000
Total FA	4194.65	3164.46	2907.50	2627.60	0.000
Self-Efficacy	3.01	0.77	2.81	0.72	0.000
Parent Support	3.20	1.13	3.14	1.12	0.334
Peer Support	3.73	1.07	3.47	1.19	0.001
Barriers	31.94	6.80	30.64	6.30	0.003
Benefits	92.32	11.66	90.49	10.73	0.004
Total (Benefit/Barrier)	130.48	14.40	129.88	13.54	0.477
Enjoyment	3.25	0.35	3.19	0.33	0.001

Table 2 shows the coefficients of correlation between physical activity and demographic, social, and psychological variables in respondents of both genders. The Table 2 overview indicates that there is a low statistically significant positive correlation (with values within the range from .15 to .23) between physical activity and the treated variables: whether the father is active in sport, exercise self-efficacy, parent support, peer support, perceived benefits of physical activity and

total score (Benefit/Barrier scale). For female respondents, there was a low and statistically significant positive correlation (with values within the range of .16 to .24) between physical activity and the variables: exercise self-efficacy, peer support, perceived benefits of physical activity and total score (benefit/barrier scale), while a low negative correlation was found between physical activity and the variable of perceived barriers of physical activity.

Table 2. Correlations between Physical Activity and various factors using Spearman's Rho

Variables	Males	Females
Number of Family Members	.056	.071
Education of the father	-.112	-.027
Education of the mother	-.114	-.067
Whether the father is dealing with sport	.151**	.006
Whether the mother is dealing with sport	0.05	.072
Self-Efficacy	.228**	.202**
Parent Support	.129**	.092
Peer Support	.151**	.162**
Barriers	-.084	-.152**
Benefits	.225**	.213**
Total (Benefit/Barrier)	.213**	.242**
Enjoyment	.096	.047

To determine the multivariate influence of the demographic, psychological, and social factors, a hierarchical regression analysis was applied. The results of the regression analysis are presented in Table 3. The first regression equation explains 8.4% ($p < 0.001$) of the total variability of the criterion variable, with statistically significant influence of predictor variables: gender, number of family members, father's education and whether the father was engaged in sports. By including the two social variables in the second step, the amount of the explained variance increases to 10.3% ($p < 0.001$), and the linear correlation coefficients in the equation for this system of 10 predictors with the physical activity level is $R = 0.321$ ($F = 10.30$, $p < 0.001$). Social support from friends ($\beta = 3.841$, $p < 0.001$) is a

significant determinant that has a significant statistical effect on the criterion variable physical activity. With the inclusion of the third block of psychological variables, the amount of the explained variable increases to 15.5% ($p < 0.001$). Of the entire predictive system, the variables of exercise self-efficacy ($\beta = 5.183$, $p < 0.001$) and total score (Benefit/Barrier scale), ($\beta = 4.350$, $p < 0.001$) have significant statistical effects. After including the third block of psychological variables, it is observable that the variable education of the father in the final regression equation becomes statistically insignificant. On the basis of the obtained results, it can be concluded that the education of the father is not directly related to the physical activity in this population group.

Table 3. Hierarchical regression analyses explaining PA

Variables	β	Partial r	β_1
Demographics	$R = 0.290$ $R^2 = 0.084^{***}$		
Age	-0.107	-0.003	-0.347
Gender	-7.091***	-0.223	-6.140***
Residence	-0.431	-0.014	-0.138
Number of Family Members	3.272***	0.105	3.517***
Education of the father	-2.279*	-0.073	-1.836
Education of the mother	-0.626	-0.020	-0.393
Whether the father is dealing with sport	3.223***	0.103	2.653**
Whether the mother is dealing with sport	1.855	0.060	1.541
Social	$R = 0.321$ $R^2 = 0.103^{***}$		
Parents support	0.934	0.030	-0.021
Peer support	3.841***	0.123	2.019*
Psychological	$R = 0.393$ $R^2 = 0.155^{***}$		
Self-Efficacy	5.183***	0.246	5.183***
Total (Benefit/Barrier)	4.350***	0.212	4.350***
Enjoyment	0.835	0.067	0.835

Legend: Partial r – coefficient of partial correlation; β – standardized partial regression coefficient; β_1 – the value of the β -coefficients follows the following equation of analysis; R – coefficient of multiple correlation; R^2 – change of the coefficient of determination; Significance, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Discussion

Several previous studies suggest a decline in physical activity during adolescence, with a further decline in early adulthood. However, less information is available regarding what constitutes these changes and patterns of determinants for population subgroups. The understanding of the factors that contribute to decreased physical activity in adolescents is essential for developing effective programmes and strategies to promote physical activity in this population group.

Most researches to date suggest that the level of physical activity of girls is lower than that of boys (Higgins, Gaul, Gibbons, & Van Gyn, 2003; Muntner et al., 2005; Wu & Jwo, 2005; Raudsepp, 2006; Shi et al., 2006; Sherrick-Escamilla, 2007). The results of our research also indicate that male students show higher levels of physical activity with high and medium intensity and overall physical activity compared to female students. Moreover, boys also perceive greater levels of self-efficacy, greater benefits of physical activity, more reduced barriers from physical activity, greater social support from friends, and more enjoyment in physical activity compared to girls.

The social environment where the physical activity takes place has a crucial impact on young people. Family members, friends, teachers and coaches can play a significant role in promoting adolescent physical activity. The social influence can function through a variety of mechanisms, including encouragement, activity modelling, common activity, and practical support. The results of our research have shown that social support from parents does not have a significant effect on physical activity in this sample of respondents. Nevertheless, previous research suggests that the role of parents in promoting physical activity in their children is particularly important; most probably, it is more significant in younger respondents.

Other family characteristics, such as the socioeconomic status and the education of parents, may affect physical activity in adolescents. The results of the studies on the impact of the socioeconomic status on physical activity in children and adolescents are contradictory. The research carried out within the Scottish Health Survey suggests that girls from families with lower socioeconomic status have higher levels of physical activity than girls from families with higher socioeconomic status do. In contrast, the results of the research within the Health

Behaviour of School-aged Children (HBSC) study suggest that adolescents from wealthier families are more physically active (Levin et al., 2007) and more likely to participate in vigorous exercise in their free time (Inchley et al., 2008).

In this study, a statistically significant association was identified between the number of family members and the sporting tradition in the family (the parent as a role model). The results from the Framingham Heart Study indicate that children of active parents are nearly six times more likely to be physically active than children of inactive parents (Moore et al. 1991).

Furthermore, social support from friends, and especially group activity (number of friends who exercise), is an important determinant that can help increase physical activity in young people. This has been confirmed in many previous studies conducted in children, preadolescents, and adolescents (Zakarian, Hovell, Hofstetter, Sallis, & Keating, 1994).

The belief in the benefit of physical activity is also a significant predictor of physical activity among respondents of both genders, which has been confirmed in several studies involving preadolescents and adolescents (Zakarian et al., 1994).

Self-efficacy is a belief in one's abilities in attempts to accomplish a task. Self-efficacy rests on the idea about the importance of the subjective experience of personal competence in the achievement of different goals, rather than real knowledge, abilities and skills. Self-efficacy is not estimated as a personality trait, but rather as a belief in one's abilities to coordinate knowledge and abilities to achieve the desired goal. Personal factors (cognitive, emotional, and biological), environmental factors and behaviour have an interactive influence on the model of reciprocal determinism (Bandura, 1997). The results of this study show that self-efficacy, which is a construct of the social cognitive theory, is positively related to physical activity in respondents of both genders. The results of other studies also show that self-efficacy, directly and indirectly, affects physical activity in children and adolescents (Wu, 1999; Neumark-Sztainer, Story, Hannan, Tharp, & Rex, 2003; Wu & Pender, 2003; Chang, 2004; Wu & Jwo, 2005; Jago, Baranowski, Baranowski, Cullen, & Thompson, 2007; Motl et al., 2007; Sherrick-Escamilla, 2007).

Based on all the above-mentioned factors, it can be concluded that a national plan and programme for promoting

physical activity need to be developed to help adolescents change unhealthy lifestyle habits and increase physical activity, and thus improve their health. These strategies, plans and programmes should be prepared by considering the specifics of the environment, the customs and the cultural characteristics of the region.

There is evidence that anyone who increases their level of physical activity can have health benefits even after a long period of inactivity, regardless of age.

Changes can be made through extensive modification in policy and practice, and in particular through an increase of the cross-sectoral cooperation and the adoption of new roles by different entities that are already proven and respected in their fields. Minor changes in policy and practice are needed, aimed to promote and increase physical activity among the young population.

Different approaches can be used: individual work, group work, workshops, counselling, among others. The primary promoter of these educational programs and strategies should be the school; however, it is necessary to involve more governmental and non-governmental organizations, the family as well as the local government and the country with a broad media campaign. Changes in the school should be directed towards changing the curricula that should include contents for physical activity and its importance, the inclusion of new forms of physical activity in the curriculum, improvement of the material base (facilities, devices, etc.).

Based on the obtained results, it can be concluded that boys show significantly higher levels of physical activity compared to girls. The respondents of both genders who have a higher level of self-efficacy perceive greater benefits of physical activity, greater social support from friends; they come from families in which more family members have higher levels of physical activity.

This study did not find a significant relation between the age of parents, the education of parents and physical activity. The sporting tradition in the family (the father as a role model) affects the physical activity of the respondents of both genders. The results of the research indicate the importance of the preparation of a national plan and programme to promote physical activity to help young people change unhealthy lifestyle habits and increase physical activity, thereby to improve their health.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

The Impact of Mass Sports Work in Educational Institution on the Formation of Cadets' Value Attitude Towards Physical Education

Serhii Romanchuk¹, Evhen Anokhin¹, Iryna Tychyna², Viktor Dobrovolskii³, Roman Pidleteichuk⁴, Serhiy Homanyuk⁵, Vitaliy Kirpenko⁵, Artur Oderov¹ and Volodymyr Klymovych¹

¹National Academy of the Army, Department of Physical Education, Special Physical Training and Sports, Lviv, Ukraine, ²Ivan Franko Zhytomyr State University, postgraduate student of the Pedagogy Department, Zhytomyr, Ukraine, ³Military Institute of Taras Shevchenko National University if Kyiv, Military Training Department, Kyiv, Ukraine, ⁴National University of Ukraine on Physical Education and Sport, Physical Education Theory and Methods Department, Kyiv, Ukraine, ⁵Kharkiv National University of the Air Force named after Ivan Kozhedub, Department of Physical Education, Special Physical Training and Sports, Kharkiv, Ukraine

Abstract

Within the functioning of the physical education system of higher educational institutions, a four-year pedagogical experiment was carried out regarding cadets' value attitude formation to physical education activity. According to the results of the research, a significant improvement in the formation of the cadets' value attitude to physical education activity was recorded: in 93.6% of cases, the cadets of the experimental group identified a personally significant sport; 96.7% of cadets will continue to play their favourite sports after graduation; 90.0% of cadets recognized the importance of substantial and procedural aspects of physical education activity "for themselves" as a subject; 83.3% "for themselves" as a specialist, and 100% "for themselves" as an officer. The results of the practical implementation of the author's program confirmed the effectiveness of the proposed pedagogical influences. The results obtained indicate an increase in objective and subjective indicators of the formation of a value relationship, which affected the level of sports and physical fitness ($p < 0.05$). The presence of productive experience in sports activities, the formed value attitude of the majority of graduates involved in the author's program, suggests that they can continue to exhibit high physical activity during their professional activities, which will help to reduce the time for adaptation and maintain the level of professional performance.

Keywords: *programme, cadet, value, attitude, sport*

Introduction

For some decades, there have been significant changes in all spheres and branches of public life in Ukraine. Abandoning the administrative-command system, Ukrainian society strives for democracy. The new system requires the updating of forms, means, and methods of management; therefore, the necessity of considering a person in his mental and physical integrity is becoming more acute.

Until recently, the efforts of educational specialists and scholars in physical education were mainly focused on the develop-

ment of physical qualities and motor skills, yet with insufficient attention to the "spiritual" aspect (values, motives, needs, interests, ambitions) of a particular personality. Under such circumstances, the efficiency of the physical education process of the younger generation has been significantly reduced. Moreover, the overwhelming majority of the population has not formed a positive value attitude to physical education and regular physical activity (Bolotin, Bakayev, & Vazhenin, 2016; Klymovych, Olkhovyi, & Romanchuk, 2016; Oderov et al., 2017).

These problems are inherent in military education sys-



Correspondence:

S.V. Romanchuk

National Academy of the Army, Department of Physical Education, Special Physical Training and Sports, Heroyiv Maydanu, 79012 Lviv, Ukraine

E-mail: asv-fpis@ukr.net

tems. The urgency of their resolution is derived from the low levels of physical preparedness and physical activity of the officers, and the inability of most officers to organize the process of self-improvement (Rolyuk et al., 2016). In this regard, one of the main prerequisites for achieving the goal of physical training in military educational institutions (the formation of a personal physical culture) is the advancing formation of cadets' motivational-value attitude to physical culture (Grankin & Kuznecova, 2017; Kamaiev et al., 2018).

Various authors (e.g., Costa et al., 2016) acknowledge that during the period of study at a higher educational institution a cadet does not develop a sense of personal interest in regular physical exercises, which means the value attitude to these activities is not formed. In this regard, a number of works have recently identified a tendency to study the motivational aspects of the cadets' activities at higher educational institutions (e.g., Pichugin, Griban, & Romanchuk, 2011) and, on this basis, to search for ways to optimize physical training in the interests of professional military activity have been started. However, an insignificant role in these studies is played by mass sports, which is currently reduced to the form of additional physical training classes, which, according to several authors (e.g., Pronenko et al., 2018) reduces the educational value of mass sport. Therefore, the determination of the possibilities for its use in forming a value-based attitude to physical education is relevant.

The purpose of the study is to determine the effectiveness of the program of formation of the value attitude of cadets to physical education activities and to confirm the feasibility of applying the proposed program and the need for further development of

the problem associated with value-oriented activity.

Methods

To determine the effectiveness of the programme of the cadets' value attitude formation to physical education activities, we conducted a pedagogical experiment on the basis of the National Academy of the Army from 2016 to 2019. The experiment was conducted in hours of mass sports work, which are defined by the guidance document on physical training in the Armed Forces of Ukraine (one hour twice on weekdays and three hours on Sunday).

Two study groups took part in the experiment, which made up the control group (CG=30) and the experimental group (EG=30). The cadets' lives were regulated by their daily routine. The cadets' initial levels of sports and physical fitness and physical development were reliably the same, which allows us to judge the clarity of the experiment ($p>0.05$).

The content of CG classes during the hours of mass sports mainly included exercises from the physical education curriculum at the first stage. Moreover, according to the objectively existing position of the prevalence of the normative approach, the emphasis in the activities of the unit commander was aimed at ensuring academic performance in discipline and at fulfilling subordinates of VSK norms and requirements.

Mass sports work in the EG was consistent with our programme. Its essence is to determine the stages of activity by the degree of regulation: Stage I (1-2 courses) is strictly regulated; Stage II (3rd and senior courses) is partially regulated. The model programme of the value attitude formation to physical education activities at the stages is presented in Table 1.

Table 1. A programme model of the cadets' value attitude formation to physical education activities

Numbers	Stages and Courses of Education	
	I Stage (1st-2nd courses)	II Stage (3rd course and senior)
Objectives:		
• tactical	1. Improving the level of physical preparedness. 2. Mastering sports and physical exercises element by element and in integrity. 3. Creation the attitude to the importance of sports for an officer, specialist and "for oneself".	1. Improving the development of physical qualities and motor skills. 2. Perfection in a chosen sport. 3. Achieving the optimal level of sports qualification. 4. Mastering the skills of self-improvement.
• strategical	1. Effective management of the comprehension of sports and physical exercises. 2. Ensuring the necessary emotional richness of classes.	1. The provision of practical assistance in self-improvement.
Sports and physical exercises	1. The prevalence of sports and physical exercises characterized by the categories "general" and "special".	1. The prevalence of sports and physical exercises, characterized by the categories of "single" and "special."
Leading mass sports activities	1. Cognitive 2. Pre-educational	1. Value-oriented
Characteristic of pedagogical interactions	1. Predominantly subject-objective. 2. Communication.	1. Predominantly subject-subjective. 2. Interaction.
Specific features of participation in the process of managing the value attitude formation	Scheme benefits "Teacher - commander - cadet"	Scheme benefits "Teacher - cadet" (in "special" and "single" sports) and "commander - cadet" (in "general" sports)
System of competitions characteristic	1. According to simplified rules. 2. The predominant level of mass competitions: "platoon - company - battalion" (and their equals). 3. Selectively: "higher educational institution and external competitions"	1. Preferred level: "faculty – higher educational institution - external competitions."
Physical training interconnection	Direct	Indirect

At the second stage, in accordance with the existing situation, the content and conduct of classes on mass sports work in the CG did not differ significantly from the first stage.

A specific feature of the organization and conduct of mass sports work in EG at the second stage was the freedom in choosing kinds of sports or physical exercises for further improvement and freedom in choosing activity forms (in sections or independently). The participation in competitions involving all the personnel ("general" sports and physical exercises) was obligatory.

A direct indicator of the value attitude formation was the results of a questionnaire among cadets about the need of physical activity "for themselves" as a subject, "for themselves" as a specific specialist in professional activity, "for themselves" as a future officer ("single", "special", "general"), as well as the severity of procedural motives and the inten-

tion to engage in a selected sports after graduation. We developed the questionnaire, and it was evaluated by 45 experts ($W=0.859$).

The result of the transformative type of mass sports activity was the indicators of cadets' sports qualifications, which were determined by analysing the competition protocols and physical fitness checklists, as well as indicators of cadets' physical fitness according to the results of physical exercises based on the conditions of the Physical Training Manual in the Armed Forces of Ukraine. To increase the reliability of the results obtained, the results of final exams and state exams were used (Olkhovyi, 2015).

Results

Based on the experiment result, the general positive dynamics of cadets' sports preparedness was revealed, both in the controlled and experimental groups (Table 2).

Table 2. Comparative characteristic of the experimental (EG=30) and controlled (CG=30) groups on the dynamics of sports qualification (%)

Groups	Research Stage	Candidate for Master of Sport	I grade (%)	II grade (%)	III grade (%)	Overall (%)
EG	Initial Level	-	10.0	10.0	6.7	16.7
	After the 1st Stage	-	10.0	30.0	20.0	60.0
	After the 2nd Stage	10.0	30.0	40.0	20.0	100
CG	Initial Level	-	3.3	6.7	10.0	20.0
	After the 1st Stage	-	3.3	13.3	26.7	43.3
	After the 2nd Stage	3.3	6.7	16.7	33.3	56.7

After the first stage in the experimental group, the general level of sports qualification is significantly higher than in the controlled group ($p<0.05$).

The data characterizing the level of CG cadets' sports qualification at the end of the second stage are congruent to some extent with the general state of mass sports work with traditional approaches to its organization and conduct (a low level of higher grades (10.0%) and the predominance of the third grade (33.3% among other grades). Also, due to the

ratio of the dynamics of sports readiness of a particular CG cadet, it was revealed that at the second stage some members of this group had a decrease in qualifications by the end of the training period. A similar study in the EG showed that the level of cadets' athletic preparedness mainly increased or remained the same; no decline was observed.

For a more complete description, we conducted an analysis of the amount of conducted sports grades by a particular cadet of the experimental and controlled groups.

Table 3. Comparative characteristic of sport grades number in experimental and controlled groups (%)

Groups	Number of sport grades (%)			
	one	two	three	four
EG	20.0	53.3	20.0	6.7
CG	76.4	17.7	5.9	-

As the data in Table 3 show, in the EG, 80.0% fulfilled the grades in two or more sports (physical exercises), while in the controlled group, this indicator is equal to 23.6% of the cadets' who fulfilled sports grades.

Another defining aspect of the differences between the cadets of the CG and the EG and the advantages of the developed and tested programme, accordingly, is the indicators of sports specialization (Table 4).

Sports grades in the CG were mainly fulfilled according to exercises directly related to the physical training programme (category "general"). In the experimental group, along with the same exercises, cadets achieved quite good results in other sports as well. At the same time, "general" sports also prevailed in the EG at the first stage, although cadets completing the second stage confirmed and increased the grade levels of the same types and exercises and were able to master the grade standards for other sports.

Table 4. Characteristic of sports specialization in the experimental (n=30) and controlled (n=30) groups

Numbers	CG		EG	
	After the I Stage (%)	After the II Stage (%)	After the I Stage (%)	After the II Stage (%)
Obtained Sports Qualification	43.3	56.7	60.0	100
Orienteering	-	3.3	-	40.0
Skiing	-	3.3	10.0	40.0
3 km Race	16.7	30.0	30.0	66.7
100 m Race	6.7	10.0	10.0	10.0
Overcoming Obstacles	10.0	10.0	16.7	20.0
Combat Sport	3.3	6.7	6.7	6.7
Weight-lifting	3.3	-	-	10.0
Officers' Triathlon	-	-	3.3	3.3
Sport Games	3.3	3.3	3.3	3.3

In our opinion, the participation of the CG and the EG cadets in the training process of combined teams is considered to be another indicator of the tested programme effectiveness in terms of increasing the level of sports preparedness by applying a personality-oriented approach. The results are presented in Table 5.

iveness in terms of increasing the level of sports preparedness by applying a personality-oriented approach. The results are presented in Table 5.

Table 5. Number of the experimental (n=30) and controlled (n=30) groups cadets participating in sports sections and higher educational institution combined teams

Groups		Types of Sport					Overall
		Sport Games	Combat Sport	Orienteering	Athletics	Power	
I Stage:	CG	3.3	3.3	-	3.3	-	10.0
	EG	6.7	-	-	3.3	-	10.0
II Stage:	CG	3.3	6.7	3.3	3.3	3.3	20.0
	EG	10.0	10.0	40.0	10	10.0	80.0

Before moving to the subjective characteristics of the tested programme effectiveness, it is necessary to mention that during the questioning of cadets the basic requirements for carrying out such procedures were strictly provided and observed in order to clarify the value attitude.

Discussion

While defining a favourite sport, attention is drawn to the differently expressed uncertainties in the answers to this question by the CG and the EG cadets. Only two respondents among the EG cadets had difficulty with this question, whereas more than half did in the CG (53.3%). The remaining part of the CG cadets named different kinds of sport games. This indicates that mainly the emotional form of the value attitude prevails (in this sense, sport games are self-sufficient) without the necessary value reflection among the CG cadets. Some cadets also added some types of martial arts, general physical training (as a kind of complex sport), and weight-lifting exercises.

The vast majority of the EG cadets define two and more types of sport for themselves. At the same time, the emotional aspect (sports games) and the semantic aspects of the value attitude are combined, highlighting the "special" sport and its component (running).

However, the definition of a favourite sport does not yet sufficiently characterize the value attitude to physical education activities. Therefore, the interest of our research was the question: "Will you be engaged in a selected sport (physical exercises) in future?"

According to the data in the tables, there is an insignificant degree of confidence in the CG that the person will be engaged in physical education activities, regardless of the conditions of

professional activity, domestic and other conditions, and 20% of the cadets of this group responded clearly negatively. In this regard, a considerably different point of view of the EG cadets, in which opinions about the necessity and value of physical education and the possibility of doing sports in future prevail.

However, it should be noted that the cadets involved in a "special" sport activity, orienteering, were aware that cultivating this sport in professional activities is highly dependent on external conditions; therefore 70% of them chose the second option in their answers. Thus, it must be recognized that this sport is more important and valuable for a cadet as a subject of the educational process. However, at the same time, an additional survey showed that even if there are no conditions for orienteering, cross-country running and acquired orienteering skills are valuable for them as components of orienteering.

Therefore, the substantive aspect, along with the procedural and resultant aspects of mass sports activities carried out according to the programme proposed, influenced the determination of the subjective significance of physical education activities.

As can be seen in the first stage, there are differences in the subjective characteristics of the controlled and experimental groups in relation to the substantive and procedural aspects of mass sports activities. At the same time, the positive attitude of cadets in both groups does not have significant differences in personal motives, in professional and duty motivations, which is probably objectively inherent in the first stage.

However, at the second stage, significant differences were revealed in the subjective significance of the substantive and procedural aspects of physical culture activity. In the EG, the indicators for "general", "special", and "single" increased (or

remained at the same level), whereas in the CG the same indicators decreased, according to the table, especially in terms of personal and professional significance. Furthermore, an additional survey showed that the need for physical activity “for oneself” as an officer in 73.3% of cases is connected with the duty motivations, the need to participate in final tests.

It should also be mentioned that the overwhelming number of EG cadets in the formation of a value-based attitude to physical education activities confirm the positive role of the teacher of the physical training and sports department and the unit commander (86.7% and 56.7%, respectively), while the CG cadets responded positively in 20% and 33.3%, respectively. These facts confirm our belief in the need for participation in mass sports activities, especially in terms of educational influences.

Thus, the objective indicators of sports preparedness and subjectively expressed indicators of the value attitude to physical education activities identified in the controlled and experimental groups indicate the effectiveness of the proposed programme for the formation of value attitude.

Higher indicators of the EG cadets in comparison with the CG were revealed even in the level of physical preparedness.

Also, due to the experiment results, the level of physical fitness increased in both controlled and experimental groups. The results are presented in Table 6.

It should be noted that the overall assessment of physical fitness at the initial level has such a low score due to the fact of the transition of subjects from an “entrant” to a “cadet” category. Therefore, the reason for the decline in results was new living conditions, changes in the form of clothing, changes in regulatory requirements according to the NFP, etc.

The data obtained indicate marked changes compared with the initial level in almost all indicators. However, if we compare them not with their basic level but with each other, then higher progress is noted after the first stage in the EG in the development of endurance quality ($p < 0.05$). Moreover, differences in the development of this quality become statistically significant after the second stage. Such a correlation with the same level of significance takes place in the integral assessment of physical fitness ($p < 0.05$).

Table 6. The results of the cadets' physical fitness level of experimental and controlled groups before and after the experiment

Numbers	Groups	Initial numbers	After the 1st Stage	At the end of the Experiment	p
Pull-ups (number)	EG	11.4 ± 0.8	14.5 ± 0.4	15.2 ± 0.5	-
	CG	11.8 ± 0.6	14.3 ± 0.5	15.0 ± 0.4	
100 m Race (c)	EG	15.4 ± 0.6	14.5 ± 0.5	13.9 ± 0.4	-
	CG	15.2 ± 0.7	14.6 ± 0.6	14.14 ± 0.3	
Dexterity Complex Exercise (c)	EG	10.1 ± 0.5	9.4 ± 0.4	9.38 ± 0.4	-
	CG	10.6 ± 0.5	9.57 ± 0.4	9.56 ± 0.3	
3 km Race (min., c)	EG	13.34 ± 0.15	12.34 ± 0.3	12.16 ± 0.4	0.05
	CG	13.39 ± 0.3	12.48 ± 0.2	12.41 ± 0.2	
Overall mark (average score)	EG	2.93 ± 0.3	4.4 ± 0.4	4.46 ± 0.16	0.05
	CG	2.84 ± 0.2	4.34 ± 0.3	4.16 ± 0.2	

The results obtained and the application of the principles of philosophy, pedagogy, pedagogical psychology, and cultural science made it possible to determine the conditions and substantiate the programme for the cadets' value attitude formation to physical education in the process of mass sports work.

The results of the practical implementation of the author's programme confirmed the effectiveness of the proposed pedagogical influences. The results obtained indicate an increase in objective and subjective indicators of the value attitude formation, which affected the level of sports and physical fitness ($p < 0.05$).

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Conflict of Interest

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The productive experience in mass sports work and the formed value attitude of the majority of graduates involved in the author's programme suggest that they can express prolonged high physical activity during their occupation, which will help to reduce the time for adaptation and maintain the level of professional performance.

The results of our research confirm the feasibility of using the proposed programme and confirm the need for further development of the problem associated with the value-oriented type of activity.

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ORIGINAL SCIENTIFIC PAPER

Do Body Composition and Physiological Parameters Measured in the Laboratory Have Predictive Value for Cycling Performance?

Iva Jurov¹, Radoje Milic¹ and Samo Rauter¹¹University of Ljubljana, Faculty of Sport, Ljubljana, Slovenia

Abstract

Physiological parameters measured in the laboratory are used in cycling for analysing changes in performance, adjusting training regimes, and helping with predicting future performance. Some parameters are known to have better predictive credibility than others. In this study, we aimed to find the parameters that influenced performance in the same cyclists in two consecutive years. We gathered the scoring results of 29 competitive young cyclists (18.45 ± 2.23 years old) in various age categories and their physiological parameters. The racing results were obtained from both the national and international levels. From measurements of change in peak power output, body composition and gas exchange, this study showed that the negative change in the percentage of body fat positively correlated with all-year scoring results in male cyclists of different ages. No other correlations were found. This research amplifies the importance of body composition in cycling and suggests further research is needed on the influence of body composition on cycling performance.

Keywords: cycling, performance, body composition, power output

Introduction

Cycling is an endurance sport discipline in which physiological parameters are often used for assessing performance (E.W. Faria, Parker, & I.E. Faria, 2005a; Impellizzeri, Marcora, Rampinini, Mogroni, & Sassi, 2005; Tanner, & Gore, 2013). Various protocols can be used in incremental testing for gathering performance-related parameters. Usually, intensity is increased between 10 and 30 W every 30-60 s (Amann, Subudhi, & Foster, 2004). Parameters measured during incremental test include maximal oxygen uptake (VO_{2max}), peak power output (PPO), lactate values, ventilation (VE), gas exchange (VO_2 and VCO_2) and heart rate (HR). Anthropometric measurements provide additional data widely used today for cycling performance assessment, such as PPO and VO_{2max} values expressed relative to body mass (W/kg and ml/min/kg).

This is because cyclists have to overcome gravitational forces in relatively long periods. Body mass (BM) is an essential parameter in cycling (Maciejczyk, Wiecek, Szymura, Szygula, & Brown, 2015), and it has long been known that a limit of > 6 W/kg can be used as an assessment tool for good racing outcomes (Palmer, Borghouts, Noakes, & Hawley, 1999). Another parameter PPO normalized to fat-free mass (PPO/FFM) has been introduced as having a more critical influence on PPO in cycling than PPO/BM has (Maciejczyk et al., 2015). BM increase resulting from increased body fat percentage (BF) has been shown to negatively affect PPO (Maciejczyk et al., 2015). Another parameter in cycling and other endurance disciplines known to be associated with aerobic capacity is VO_{2max}/BM . Elite cyclists exhibit values of 70-75 ml/kg/min (Lucia, Hoyos, Perez, Santalla, & Chicharro, 2002) whereas



Correspondence:

I. Jurov, University of Ljubljana, Faculty of Sport, Gortanova 22, 1000 Ljubljana, Slovenia
E-mail: iva.jurov@fsp.uni-lj.si

an average man can reach 35–40 ml/min/kg (Guyton & Hall, 2011). Although high $\text{VO}_{2\text{max}}/\text{BM}$ values can also be found amongst recreationally active cyclists, professionals have a greater cycling efficiency that enables them to perform better (Lucia et al., 2002).

Four parameters (PPO/BM, PPO/FFM, $\text{VO}_{2\text{max}}/\text{BM}$, BF) gathered with incremental cycling test and anthropometry were used in this study. We observed changes in these parameters in the same cyclists in two consecutive years (2015 and 2016) and compared these changes to the difference in the overall racing results in the two years. We hypothesized that an increase in PPO/BM, PPO/FFM and $\text{VO}_{2\text{max}}/\text{BM}$ would elicit an increase in points gathered and a decrease in BF would cause an increase in scoring results.

Methods

Twenty-nine (29) cyclists (18.45 ± 2.23 years old) participated in the study. They were measured twice in two consecutive years. For this study, data gathered before the competitive season were used (gathered from January to March). The study was approved by the institutional ethics committee.

Anthropometry

BM and body composition were assessed with bioelectrical impedance (Biospace InBody 720, Seoul, Korea). Body height was measured with an anthropometer (GPM, Siber Hegner & Co., Switzerland, 2007).

Incremental test

Cyclists performed an incremental test on a Cyclus 2 ergometer (RBM Electronics, Leipzig, Germany) using their own bicycles. Two different protocols were used according to the cyclists' ages. Those under 17 years old performed 60 + 15 W protocol (starting with 60 W in the first minute and adding 15 W every additional minute), and those of 17 years or older executed 100 + 20 W (100 W in the first minute and an increase in 20 W for every additional minute). During the test, a cadence of 60 or higher had to be maintained with a constant gear ratio. The incremental test is performed until exhaustion. Peak power had to be sustained for 60 s to be used. If only 30 s at peak power output were reached, one half of the performed power increment is added. Cyclists had to warm up 15 min before and rest 60 s before commencing the test.

Gas exchange

Ventilatory parameters were measured with V2 mask (Hans Rudolph, USA) of appropriate size and Quark CPET (Cosmed, Albano Laziale, Rome, Italy) with Quark 8.1. PC software support. Before commencing the test, we calibrated the machine (O_2 and CO_2 analyser and air-flow device).

Collecting data

In the first round of testing, 62 male road cyclists met the criteria of having all laboratory measurements in two consecutive years. We excluded all who did not compete in at least 15 competitions of national level and internationally accredited competitions under the UCI (Union Cycliste Internationale). Due to changes in the cyclists' physical condition in different periods across the season, we used only the data gathered in the pre-season (from January to March). Lastly, seven additional cyclists were excluded as they were no longer active in competitive cycling. We suggest that their racing scores in the measured years might be influenced by other unknown factors, such as psychological factors and other detrimental factors that can be present at the end of an athlete's career. A total of 29 cyclists met all criteria.

Racing points were gathered throughout the competitive season from national and international levels. There is no official comparison system that would enable comparing the two levels. Thus, an unofficial system was used in this study, which is also used by national cycling managers when selecting national teams. They add national points to international points multiplied by two as the latter are more difficult to obtain.

Data analysis

Microsoft Office software was used for processing data. The analysis was performed with SPSS (version 25.0; SPSS, Inc., Chicago, USA). Descriptive statistics (average \pm SD) are used for representing data. Parameters of relative increase were used to compare the differences in all parameters and scoring results in two different years. We calculated them by subtracting the values in the second year from values in the first year and making this difference relative to the value in the first year (PPO/BM_{rel}, PPO/FFM_{rel}, $\text{VO}_{2\text{max}}/\text{BM}_{rel}$, BF_{rel}, T_{rel}) (Figure 1).

$$T_{rel} = \frac{T_{2nd\ year} - T_{1st\ year}}{T_{1st\ year}}$$

Figure 1. The equation for calculating the parameter of relative increase for scoring results

Multiple regression was used. A normal distribution assumption was not met in T_{rel} so we used logarithmic transformation (by adding a constant to all of the data to make positive numbers). According to Berry (1993), we confirmed all assumptions.

Results

The main characteristics of cyclists are represented in Table 1. The descriptive data of the cyclists were gathered from testing in the 2nd year.

Table 1. Main characteristics of cyclists gathered in the second year: age, body composition, and physiological parameters

variable	Mean \pm SD
age	18.45 \pm 2.23
BM (kg)	70.68 \pm 6.66
BF (%)	9.2 \pm 2.4
$\text{VO}_{2\text{max}}/\text{kg}$ (ml/min/kg)	64.84 \pm 4.81
PPO/BM (W/kg)	6.19 \pm 0.42
PPO/FFM (W/kg)	3.2 \pm 0.23

For the study, we compared the differences in physiological parameters from the tests and scoring results in two

different years. The results of multiple regression are shown in Table 2.

Table 2. The results of multiple regression analysis

	Model	Unstandardized Coefficients		Standardized Coefficients
		B	Std. Error	Beta β
1	(Constant)	0.06	0.07	
	BF _{rel.}	-1.4	0.36	-.60*
2	(Constant)	0.12	0.13	
	BF _{rel.}	-1.38	0.43	-.59*
	VO _{2max} /BM _{rel.}	3.08	1.52	0.31
	PPO/BM _{rel.}	0.36	0.43	0.13
	PPO/FFM _{rel.}	-0.44	1.82	-0.05

The biggest correlation was found in BF_{rel.} (-0.597, $p < 0.001$), followed by PPO/FFM_{rel.} (0.353, $p < 0.05$) and VO_{2max}/BM_{rel.} (0.342, $p < 0.001$). Model 1, using just BF_{rel.} explained 35.7 % of

the variability of T_{rel.} whereas Model 2, using BF_{rel.}, W/kg_{rel.}, PPO/FFM_{rel.} and VO_{2max}/BM_{rel.} added only 9.9 % to the variability. The model summary is presented in Table 3.

Table 3. Model summary presented of the multiple regression analysis

Model	R	R Square	Adjusted R Square	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.597a	0.357	0.333	0.357	14.988	1	27	0.001	
2	.676b	0.456	0.366	0.099	1.462	3	24	0.250	1.859

Predictors: (Constant), BF_{rel.}; Predictors: (Constant), BF_{rel.}, PPO/BM_{rel.}, VO_{2max}/BM_{rel.}, PPO/FFM_{rel.}; Dependent Variable: LGT_{rel.}

Discussion

This study was carried out on young top-level cyclists. It compared changes in physiological markers and body composition in the same participants across two consecutive competitive years. It has shown that, of the measured parameters, only changes of BF had an important impact on racing result at the end of the year ($t(29) = -1.402$, $p < 0.01$). If the BF was lower, the result at the end of the year was better. These results suggest that in competitive cycling not only BM is important, but body composition also has a role. More importantly, in young top-level cyclists, reducing BF values could have a positive effect on performance. This is in accordance with a recent study that found a negative correlation between BF and PPO in cycling (Maciejczyk et al., 2015). The authors suggested avoiding a surplus of BF to improve cycling anaerobic power. However, a study also showed that increased BM diminished VO_{2max}/BM regardless of body composition (Maciejczyk et al., 2014). In this study, a change in VO_{2max}/BM did not correlate with changes in racing results. According to Faria et al. (Faria, Parker, & Faria, 2005b), VO_{2max} has limited predictive credibility when cyclists of homogenous aerobic capabilities are compared. This is consistent with our results, as our participants were homogenous in aerobic capacity (VO_{2max}/BM 64.84 ± 4.82 ml/min/kg). However, this is not in accordance with studies showing that relative VO_{2max} is an important performance predictor (MacRae, 2006; Novak & Dascombe, 2014; Pfeiffer, Harder, Landis, Barber, & Harper, 1993; Ramana, Surya, Sudhakar, & Balakrishna, 2014). This could imply that cyclists should not focus only on lowering BM or maintaining relatively low BM when trying to increase performance. What their BF is might also be important. Male athletes might reduce their BF to as low as 1% with no evident medical consequences

(Johnson, Powers, & Dick, 1999). However, values as low as these are questionable for having only good outcomes for all athletes and could have a negative impact on performance as suggested by research that has been done in body composition in leanness-demanding sports (Meyer et al., 2013).

In addition, the time needed to reduce BF is probably significant. Studies assessing low energy availability point out that cutting weight too quickly negatively affects performance (Mooses & Hackney, 2017; Tornberg et al., 2017) and that there should be a gradual BM change allowing the fat-free mass to be lowered as little as possible in this process. In this study, we did not assess ways of weight cycling in participants so we cannot suggest if the timing of cutting BF has any impact. However, from other research done in low energy availability, we know BF values can be much lower in male than in female athletes without evident health damage. Nevertheless, there is probably an individual threshold in men and women at which maintaining low BF values is not possible with sustaining optimal performance. This could suggest BF annual changes are also needed in competitive cycling, with BF values being the lowest in the racing period and slightly increased in recovery and preparation period for enabling good recovery and hormonal balance. Another problem could be a BF overshoot after drastic reductions, as seen in bodybuilders (Fagerberg, 2018). As suggested by Fagerberg, a more tempered approach to BF management could be more optimal for bodybuilders. We wonder if BF overshoot after drastic reductions in BF values is also present in cycling. This would certainly reduce performance. More research is needed, especially in younger cyclists for whom drastically low BF values could also have a negative impact on growth and development.

Finally, changes in PPO/BM and PPO/FFM did not sig-

nificantly influence racing results although there were significant changes in values across two years ($t=-3.69$, $p<0.001$ and $t=5.32$, $p<0.000$). There are some limitations to this study. According to the cyclists' ages, two different protocols were used in an incremental cycling test. PPO could be influenced by these two different approaches, as lower PPO is achieved in longer protocols (Bentley, Newell, & Bishop, 2007). This could interfere with our PPO/BM and PPO/FFM measurements.

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Conflict of Interest

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REVIEW PAPER

Ketogenic Diet and Sport Performance

Fiorenzo Moscatelli¹, Anna Valenzano¹, Rita Polito¹, Sessa Francesco¹, Angelo Montana², Monica Salerno², Antonietta Messina³, Marcellino Monda³, Giuseppe Cibelli¹, Vincenzo Monda^{1,3} and Giovanni Messina¹

¹University of Foggia, Department of Clinical and Experimental Medicine, Foggia, Italy, ²University of Catania, Department of Medical, Surgical and Advanced Technologies "G.F. Ingrassia", Catania, Italy, ³Università degli Studi della Campania Luigi Vanvitelli, Department of Experimental Medicine, Section of Human Physiology and Unit of Dietetic and Sport Medicine, Naples, Italy

Abstract

Many athletes are concerned about attaining or maintaining optimal body weight and composition for their sport. Athletes may want to reduce body weight to ensure optimal performance, to improve aesthetic appearance, or to compete in weight category sports. This leads to efforts to reduce body fat without losing muscle mass and often to nutritional practices that may have severe health consequences. A ketogenic diet is high in fat and low in carbohydrates (≤ 50 g d⁻¹) and fairly high in protein. There are numerous randomized controlled studies showing that ketogenic diets effectively reduce body fat without causing excessive loss of lean body tissue. The crucial question is whether these diets influence sports performance and, if so, how. Many nutrition-exercise combinations have been studied in an effort to increase rates of fatty acid oxidation and attenuate the rate of carbohydrate utilization, thus potentially augmenting exercise performance. The evidence suggests that increased fat availability transfers into higher rates of both whole-body and muscle lipid utilization during standardized submaximal aerobic exercise. However, despite greater rates of fat oxidation, these diets consistently fail to improve endurance performance compared with a carbohydrate-rich diet, and little is known about the effect of a ketogenic diet on strength performance.

Keywords: *ketogenic diet, physical exercise, endurance exercise, central fatigue, aerobic exercise*

Introduction

The ketogenic diet (KD) is a nutritional approach consisting of high-fat and adequate protein content but insufficient levels of carbohydrates for metabolic needs (<20 g d⁻¹ or 5% of total daily energy intake (Moscatelli et al., 2016; Paoli, Bianco, & Grimaldi, 2015; Phinney, Bistrian, Evans, Gervino, & Blackburn, 1983), thus forcing the body to use fat as a primary fuel source. The original KD was proposed as a 4:1 lipid:nonlipid ratio, with 80% of daily energy intake from fat, 15% protein, and 5% carbohydrate. Many modifications subsequently have been introduced to the original KD, for example, lowering the lipid: nonlipid ratio or no restrictions in daily energy (in kilojoules) intake with protein and fat. The majority of knowledge about the metabolic aspects of KD

comes from studies conducted at the end of the 1960s (Owen et al., 1967; Owen, Felig, Morgan, Wahren, & Cahill, 1969); it has been shown that fasting ingesting (i.e., no or minimal amounts of food and caloric beverages for periods that typically range from 12 h to 3 wk) (Paoli et al., 2015) induces a particular metabolic state called "ketosis" (Chieffi et al., 2017).

Ketosis, the metabolic response to an energy crisis, is a mechanism to sustain life by altering oxidative fuel selection. Often overlooked for its metabolic potential, ketosis is poorly understood outside of starvation or diabetic crisis. Ketone body metabolism is a survival trait conserved in higher organisms to prolong life during an energy deficit or metabolic crisis. The advantages of ketone body metabolism during starvation are clear; providing an oxidizable carbon source to



Correspondence:

G. Messina

University of Foggia, Department of Clinical and Experimental Medicine, Viale L. Pinto 1, 7122 Foggia, Italy

Email: giovanni.messina@unifg.it

conserve precious glucose/gluconeogenic reserves while simultaneously satisfying the specific fuel demands of the brain. Ketone bodies, when present, act not only as respiratory fuels to power oxidative phosphorylation but as signals regulating the preferential oxidation and mobilization of fuel substrates (Moscatelli et al., 2015).

Many athletes are concerned about attaining or maintaining an optimal body weight and body composition for their sport (Kiens & Astrup, 2015; Messina et al., 2015). Athletes may want to reduce body weight to ensure optimal performance, to improve aesthetic appearance, or to compete in weight category sports. This leads to efforts to reduce body fat without losing muscle mass and often to nutritional practices that may have severe health consequences. The KD can be used by athletes to produce weight loss without impairing performance, especially strength performance. There are numerous randomized controlled studies showing that KD effectively reduces body fat without causing excessive loss of lean body tissue (Gibson et al., 2015; Viggiano et al., 2016). The crucial question is whether these diets influence sports performance. Many nutrition-exercise combinations have been studied in an effort to increase rates of fatty acid oxidation and attenuate the rate of carbohydrate utilization, thus potentially augmenting exercise performance.

The interaction between exercise-induced responses and nutrient availability has long been recognized (Hawley & Burke, 2010). It seems that altering the substrate supply during exercise can modify a training impulse, but it has not been clearly determined to what extent. Skeletal muscle energy status exerts profound effects on resting metabolism and fuel use during exercise, exercise capacity, regulation of cell signalling and gene expression, as well as numerous processes involved in training adaptation. Some of the more recent studies on nutrition and exercise metabolism have attempted to examine scientific evidence for the hypothesis that endurance training undertaken with low carbohydrate availability promotes greater adaptive changes compared to high carbohydrate availability (Hawley & Burke, 2010; Lambert, Hawley, Goedecke, Noakes, & Dennis, 1997; Monda et al., 2017; Volek et al., 2009; Zajac et al., 2014).

For example, athletes in endurance sports lasting one hour or more are constantly searching for new nutrition strategies to enhance performance. Knowledge about energy metabolism has placed the focus on dietary carbohydrates in the past three to four decades, with most athletes undertaking carbohydrate loading for different periods of time before competitions (Zajac et al., 2014). High-carbohydrate diets increase muscle and liver glycogen stores, improving endurance performance, yet simultaneously increase the rate of carbohydrate utilization during exercise. Having this in mind, scientists and athletes have begun experimenting with dietary procedures that would decrease the rate of carbohydrate utilization, while increasing fat metabolism during prolonged physical work. It seems that such an alternative in exercise metabolism can be induced by a high-fat, low-carbohydrate diet. Very low carbohydrate ketogenic diets have been used for years in fighting obesity and different common and rare disease states (Gibson et al., 2015).

Ketogenic diet and Endurance Exercise

In an important study performed in endurance runners, KD promoted higher peak fat oxidation (Zajac et al., 2014).

This finding has been attributed to increased fat oxidation capacity. In another investigation, exhaustive cycling performance was improved by nutritional ketosis (Cox et al., 2016). This might be a limitation of the human study, and a well-designed *in vivo* or *in vitro* experiment may validate this result. It was reported that in an experiment that lasted for 762 days, muscle mitochondrial volume was increased by KD (Parry et al., 2018). Other authors show that a 12-week KD combined with daily treadmill exercise induced higher gene expression in markers of fatty acid oxidation, as compared with the control diet combined with exercise (Shimizu et al., 2018). It was also reported that ketolytic metabolism and lipolytic metabolism were remodelled by an eight-week KD in mice, thereby enhancing their endurance (Ma et al., 2018). These results explain the partial mechanisms by which keto-adaptation showed great potential in improving endurance exercise capacity. However, other researchers have reported that KD increased benefit in body composition and wellbeing but failed to enhance endurance capacity (Zinn, Wood, Williden, Chatterton, & Maunder, 2017).

Furthermore, a low-carbohydrate, high-fat diet impaired exercise economy and performance after intensified training in a group of elite race walkers (Burke et al., 2017). In an animal model, however, eight weeks of KD significantly enhanced the endurance capacity of C57/BL6 mice (Zinn et al., 2017); a correlation existed between body weight and running time until exhaustion with mice on heavier a KD running longer. This was attributed to keto-adaptation (Zinn et al., 2017). Since there was an inter-individual difference, the subjects possessing higher metabolic flexibility may prefer KD and reflect the weight change. After a two-month KD, the average weight of KD mice decreased by 30% compared with mice on a normal diet (Ma & Suzuki, 2019; Murtaza et al., 2019).

Effects on Anaerobic Exercise

Anaerobic exercise is a high intensity, low duration exercise that lasts less than 2 min. Energy demands are met by the phosphagen system and lactic acid system, which are highly dependent upon skeletal muscle glycogen. During anaerobic exercise, high contractile forces occur within the muscle, and muscle fibres become damaged. In addition to the replenishment of carbohydrates during the recovery period, adequate consumption of essential amino acids is necessary to support the protein synthesis required to repair and rebuild the muscle. In this regard, LC/KDs typically provide sufficient protein intake (~15% of daily calories) to avoid amino acid deficiency. However, due to the low carbohydrate intake, the increased reliance of amino acids toward gluconeogenesis and the impairment of glycogen-store restoration may adversely affect anaerobic performance. Several studies evaluated the effects of LC/KDs on anaerobic performance, primarily assessing power or strength parameters, in various populations, including endurance athletes (McSwiney et al., 2018), Cross-Fit participants (Wilson et al., 2017), gymnasts (Paoli et al., 2012), and powerlifters (Greene, Varley, Hartwig, Chapman, & Rigney, 2018). Dietary interventions ranged from 6 weeks to 12 weeks and included normal training regimens typical of the populations studied. In general, consumption of the LC/KD did not result in strength or power measures that were significantly different from the control groups (Harvey, Holcomb, & Kolwicz, 2019). One study reported a significant increase in relative power, but not absolute power, which was due to the decreased body

weight experienced by the subjects. In some studies, significant decreases in skeletal muscle thickness or lean body mass were noted. Moreover, muscle hypertrophy from resistance training may be blunted with the LC/KD (McSwiney et al., 2018). These studies demonstrate that the LC/KD diet is not an effective strategy to increase anaerobic performance in trained individuals or athletes, and it has the potential to negate the expected increases in lean body mass from anaerobic training (Harvey et al., 2019).

Effect on central fatigue

In addition to the aforementioned physiological changes in the muscle, the metabolic changes induced by long-term KD diets may also affect the central nervous system during exercise. The role of the central nervous system in the development of physical fatigue has long been recognized (Gandevia, 2001). Alterations in the metabolic fuel use during exercise after adaptation to an LCHF diet can affect cerebral amino-acid uptake, energy metabolism, and neurotransmission. The increased rate of fat oxidation during exercise after adaptation to a KD diet is likely to increase brain uptake of free tryptophan. This is the consequence of increased competition for binding to albumin by rising concentrations of non-esterified fatty acids (NEFA). Free tryptophan is the precursor of serotonin (5-hydroxytryptamine), a brain neurotransmitter associated with the feeling of lethargy and tiredness that may contribute to the loss of central drive and motivation (Davis & Bailey, 1997). Increased brain uptake of free tryptophan has been reported to favour cerebral serotonin synthesis and contribute to central fatigue (Chang, Borer, & Lin, 2017). The high protein content of KD diets also leads to elevated ammonia production during exercise (Chang et al., 2017). Ammonia is another factor that could induce central fatigue by altering cerebral energy metabolism and neurotransmission and also affect signalling pathways within the neural circuits (Secher, Seifert, & Van Lieshout, 2008). Subjects adapted to KD diets experienced higher plasma concentrations of NEFA and ammonia, two agents contributing to central fatigue, during exercise at various intensities (Ferreira et al., 2014). A pilot study with untrained adults consuming a hypocaloric KD diet for two weeks suggested that increased blood concentration of ketone bodies was associated with the feeling of fatigue and mood disturbance during submaximal exercise, which are indicators of central fatigue (Ferreira et al., 2014). There is currently a knowledge gap regarding the possible effect of long-term adaptation to LCHF diets on central fatigue in various types of exercise that is in need of additional research.

Conclusion

In modern sport nutrition, practitioners teach athletes to manipulate their eating practices to avoid unnecessary and excessive intakes of carbohydrates per se, to optimize training outcomes via modification of the timing, amount and type of carbohydrate-rich foods and drinks to balance periods of

low- and high-carbohydrate availability and to adopt proven competition strategies that provide appropriate carbohydrate availability according to the needs and opportunities provided by the event and individual experience (Burke, 2015). It is important to consider insights from research and athlete testimonials to identify different scenarios in which one approach might offer advantages over another or to explain divergent outcomes, rather than insist on a single “truth” or solution. Indeed, although there is a continual cry to rid sports nutrition of “dogma” (Brukner, 2013), it would seem counterproductive if new ideas were as dogmatic as the old beliefs they seek to replace. This author and others continue to undertake research to evolve and refine the understanding of conditions in which low carbohydrate availability can be tolerated or actually beneficial (Jeukendrup, 2017). However, we also recognize that the benefits of carbohydrate as a substrate for exercise across the full range of exercise intensities via separate pathways, the better economy of carbohydrate oxidation versus fat oxidation (ATP produced per L of oxygen combusted) (Cole, Coleman, Hopker, & Wiles, 2014), and the potential CNS benefits of mouth sensing of carbohydrate (Burke & Maughan, 2015) can contribute to optimal sporting performance and should not be shunned simply because of the lure of the size of body fat stores. In other words, there should not be a choice of one fuel source or the other, or “black versus white”, but rather a desire to integrate and individualize the various dietary factors that can contribute to optimal sports performance.

For endurance athletes, the literature supports LC/KDs as an effective strategy to reduce body weight and fat mass, particularly in a period of 3–12 weeks. Limited studies demonstrate a significant improvement in exercise performance at submaximal (~60%) intensities. However, exercise performance at higher intensities may actually be impaired. For athletes concerned with anaerobic power and strength, short-term consumption of LC/KDs does not negatively affect these performance parameters but may lead to unwelcome decreases in lean body mass or blunted skeletal muscle hypertrophy. Therefore, the literature does not support the use of LC/KD as an effective dietary strategy to increase athletic performance. Ketone body supplements, including KS and KE, are commercially available and gaining popularity in the exercise community. However, since supplements are not evaluated or approved by the Food and Drug Administration (FDA), consumers must pay careful attention to the components of the supplements. Compared to KS, KE supplements appear to be more effective at inducing ketosis; however, there are limited studies demonstrating improvements in the exercise performance of trained athletes. Moreover, the benefits of KE supplementation in non-athletes is unknown. Although recent research findings lend support to targeting ketone body metabolism for the treatment of cardiac dysfunction, obesity, diabetes, and exercise performance, further research is needed before dietary interventions or supplementation is implemented.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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SHORT REPORT

Objective and Subjective Assessments of the Psychological Gender of Female Athletes Practicing Martial Arts

Aleksander Yurevich Osipov^{1,2,3}, Viktor Nikolayevich Kovalev¹, Sergey Leonidovich Sadyrin¹, Roman Sergeevich Nagovitsyn⁴, Lyubov Vladimirovna Rubtsova⁵, Olga Yurievna Druzhinina⁵, Tatyana Vladimirovna Zhavner¹ and Anna Vladimirovna Vapaeva¹

¹Siberian Federal University, Department of Physical Culture, Krasnoyarsk, Russia, ²Krasnoyarsk State Medical University named after Professor V.F. Voyno-Yasenetsky, Department of Physical Culture, Krasnoyarsk, Russia, ³Siberian Law Institute of the MIA of Russia, Department of Physical Training, Krasnoyarsk, Russia, ⁴Glazov State Pedagogical Institute named after V.G. Korolenko, Department of Physical Culture and Safety Life, Glazov, Russia, ⁵Izhevsk State Agricultural Academy, Department of Physical Culture, Izhevsk, Russia

Abstract

Experts indicate the existence of a certain distorted assessment of gender in respect to female athletes practising martial arts. There is a lack of objective data regarding the determination of the predominant traits of the psychological gender of such female athletes. The purpose of the research is to compare objective and subjective data of the psychological gender of female athletes aged 18-26 practising boxing and kickboxing. The sample consisted of 58 female athletes practising boxing and kickboxing at elite and close-to-elite levels for at least five years. Psychological gender was determined using the Sandra L. Bem technique. Independent assessments of the psychological gender of female athletes and their personal trainers were also taken into account. Data analysis was performed using the Mann-Whitney U-test. The data show a significant ($p < 0.05$) predominance of individuals with traits of the androgynous psychological gender of the total number of female athletes. A significant ($p < 0.01$) difference was revealed between the data of an objective assessment and self-assessment of their psychological gender by female athletes. Some athletes with a masculine psychological gender endow themselves with excessive traits of androgyny. It was found that many trainers unreasonably endow their female athletes with excessive features of the masculine psychological gender.

Keywords: female boxing, psychological gender, androgyny, masculinity

Introduction

Comprehensive training of athletes practising martial arts needs high-quality scientific support for competitive activity (Osipov, Kudryavtsev, Iermakov, & Jagiello, 2019). Experts propose using the study of the characteristics of the psychological gender of athletes for an objective scientific assessment of martial arts practices (Channon & Jennings, 2014). Scientists studying the issues of sports psychology of women

practising martial arts indicate a lack of data in determining the psychological gender of women engaged in various types of martial arts (Kavoura, Ryba, & Kokkonen, 2012). Moreover, most of the research is dedicated to male athletes with regard to their psychological adaptation to sports activities (Pacesova, Smela, & Antala, 2019). Experts emphasize the presence of a certain warped judgement of gender in a number of sports (Alvariñas-Villaverde, López-Villar, Fernández-Villarino, &



Correspondence:

A. Osipov

Siberian Federal University, Department of Physical Culture, Avenue Free 79, 660041, Krasnoyarsk, Russia

E-mail: Ale44132272@ya.ru

Alvarez-Esteban, 2017).

Traditionally, most specialists associate various types of martial arts with masculinity, and the participation of female athletes causes some discussion (Kavoura, Kokkonen, Chroni, & Ryba, 2018). There is an opinion about the predominance of psychological masculinity practising different types of martial arts among female athletes (Burdzicka-Wolowik & Goral-Radziszewska, 2014). However, a number of scientists point to the predominance of individuals with the characteristics of the androgynous psychological gender during the self-identification of female athletes practising martial arts (Cardoso et al., 2016). McGannon, Schinke, Ge, and Blodgett (2019) indicate a lack of research in the study of the characteristics of the psychological gender and social gender structure of women boxers of an elite level (McGannon et al., 2019). It is known that various problems of the psychological identity of women practising martial arts, including boxing, have a significant impact on the athletic performance of female athletes (Schinke et al., 2019). Experts indicate that the athletic psychological identity of athletes is closely related to the motivation for engaging in sports activities and that this subject needs to be studied (Hagiwara, Kuroda, Oshita, Shimozone, & Matsuzaki, 2018).

Scientists recognize that the problems of the psychological identity of female athletes practising martial arts are not given due attention in Russia (Osipov et al., 2017). Some aspects of sports psychology, including the psychological gender of athletes, are not taken into account from the selection process for martial arts to the end of a sports career by the trainers (Kovalev, Osipov, Sadyrin, & Nagovitsyn, 2019). There is a need for quality psychological support for athletes maintaining their psychological health (Kuzmin, Larionova, & Murasheva, 2018) and the prevention of psychological stress (Nagovitsyn, Miroshnichenko, Merzlyakova, & Faizullina, 2018).

The objective of the research: to determine the characteristics of the psychological gender of female athletes aged 18–26 years old practising knock types of martial arts: boxing and kickboxing. The correlation has also been investigated between the objective data of the psychological gender and the self-awareness of their psychological identity of female athletes.

Methods

Study participants: women (n=58) who have been practising boxing and kickboxing for at least five years. Sports qualifications of women athletes: candidates for master of sports in boxing (n=35) who are close to the elite level; elite are masters of sports in boxing and kickboxing (n=23). Age of female athletes: from 18 to 26 years old. All athletes gave voluntary informed consent to participate in 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 Sandra L. Bem methodology was used to determine the psychological gender characteristics of female athletes. All participants were asked to answer 60 specially selected questions allowing to evaluate in points the development degree of particular personal qualities. The research participants took part in the survey twice two months apart, thereby increasing the reliability level of the obtained data. Specific questions were answered twice by persons who knew these women well (their relatives, friends and trainers). The average value was determined: the main index (IS) which was finally taken into account from the obtained answer options (each woman and a person familiar with this female) in points in the studies. Before the survey, female athletes were asked to indicate their psychological gender independently. The question about the psychological gender of female athletes was also answered by their trainers.

Statistical analysis: the results of the study were evaluated using the SPSS20 program. The reliability of the obtained data was determined using the Mann–Whitney U–test.

Results

The present study has shown that the most (n=27) female athletes have their signs of androgyny (IS=0.849). Signs of masculine psychological gender were identified among 25 female athletes (IS=-1.813). Also, signs of femininity prevail (IS=1.358) among six female athletes. In independent assessments of their psychological identity, most women (n=33) indicated a predominance of androgynous traits; 17 women attributed themselves to the masculine psychological gender. Eight female athletes classified themselves to the feminine psychological gender. The data revealed a significant ($p<0.05$) predominance of individuals with traits of the androgynous psychological gender in the total number of studied women athletes. A significant ($p<0.01$) difference was found between objective survey data and independent assessments of female athletes by the definition of androgyny and masculinity. There are also significant ($p<0.05$) discrepancies in the results of femininity assessment.

The vast majority (n=34) of female athletes are characterized by masculinity according to the estimates of the personal trainers of the research participants. The trainers of only three women athletes attributed them to the representatives of the feminine psychological gender. The trainers attributed the rest (n=21) of female athletes to the androgynous psychological gender. The main research results are presented in Figure 1.

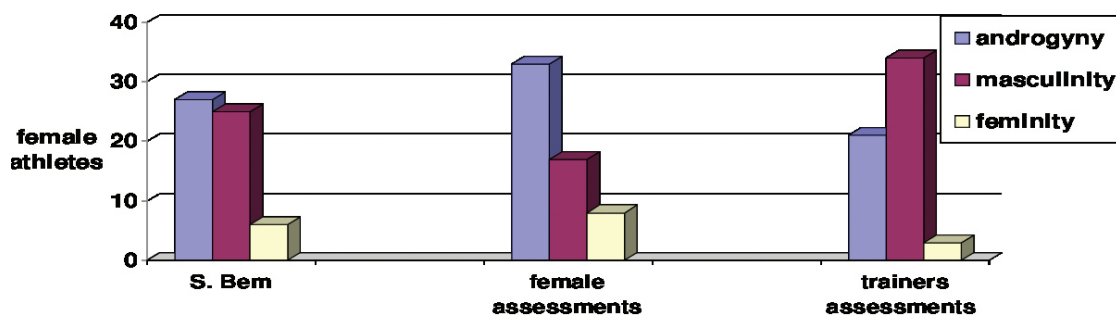


Figure 1. Data about the psychological gender of female athletes

Discussion

Most of the data about the psychological characteristics of female athletes practising boxing are based on one-off surveys or interviews with these individuals. Experts note that one-time interviews do not accurately determine the psychological gender of female athletes. The scientists recommend conducting multiple surveys of female athletes over a long time, thus improving the research quality. It is also useful to interview close acquaintances, relatives, and trainers of the studied female athletes, thus increasing the level of information reliability (McGannon et al., 2019). In our studies, two surveys of the studied female athletes were conducted, in which their close relatives, friends, and trainers were also interviewed.

The literature presents data about the predominance of women with traits of psychological masculinity in martial arts (Burdzicka-Wolowik & Goral-Radziszewska, 2014). In our studies, the majority of female athletes ($n=27$) are dominated by signs of psychological androgyny. Experts note that many women with psychological self-identification practising martial arts usually indicate an androgynous psychological gender (Cardoso et al., 2016). Experts attribute this to the subconscious fears of many female athletes receiving reproaches for excessive masculinity (Read, 2017). In our studies, the majority ($n=33$) of female athletes with an independent assessment of their psychological gender also identified themselves as representatives of the androgynous psychological gender. However, the survey data show that objectively the androgynous psychological gender includes a significantly ($p<0.01$) smaller ($n=27$) number of female athletes.

Studies of the psychological gender characteristics of young (18-22 years old) Russian female athletes practising martial arts have shown a significant (over 70% of the total)

predominance of individuals with psychological androgyny (Kovalev et al., 2019). Masculinity traits were found among only 23% of the participants. In our studies, traits of psychological androgyny were identified among 47% of female athletes aged from 18 to 26 years. The prevalence of masculinity was detected among 45% of the studied female athletes. Perhaps there are more female athletes with a predominance of psychological masculinity at a more mature age (after 22 years) in sports activities. Women with a different psychological gender finish an active sports career in favour of creating a family and having children.

Data from the trainers of the studied female athletes shows that most trainers have attributed excessive masculinity to their athletes. This feature is typical for male trainers who train women in martial arts. Scientists recommend that educational events should be held for trainers with the involvement of psychologists for the correct assessment of the psychological gender and the creation of a favourable psychological atmosphere in women's sports teams (McGannon et al., 2019).

A significant ($p<0.01$) discrepancy between the data of an objective assessment of the gender psychological characteristics of female athletes practising martial arts and the independent psychological identification was revealed among these individuals. Many female athletes fear reproaches of excessive masculinity and endow themselves with excessive traits of androgyny and femininity. The results also show a predominance ($p<0.05$) among the studied female athletes 18-26 years old who are the individuals with features of the androgynous psychological gender. The obtained data are somewhat inconsistent with general ideas about the predominance of masculine psychological traits among the majority of female athletes practising martial arts.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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SHORT REPORT

Functional State of Military Personnel Engaged in Unarmed Combat

Volodymyr Klymovych¹, Artur Oderov¹, Serhii Romanchuk¹, Yaroslav Pankevich¹, Ivan Pylypchak¹, Oleksandr Roliuk¹, Orest Lesko¹, Bilichenko Olena², Viktor Dobrovolskyi³ and Oleksandr Vorontsov⁴

¹National Academy of the Army, Department of Physical Education, Special Physical Training and Sports, Lviv, Ukraine, ²Kremenchug Mykhailo Ostrogradsky National University, Department of Human Health and Physical Culture, Kremenchug, Ukraine, ³Military Institute of Taras Shevchenko National University of Kyiv, Military Training Department, Kyiv, Ukraine, ⁴National Academy of Security Service of Ukraine, Department of Special Physical Training Kyiv, Ukraine

Abstract

Thirty-two soldiers engaged in hand-to-hand combat participated in the survey (Master of Sports (MS) - 4 people, Candidate Master of Sports (KMS) - 12 people, and the first sports category (I) - 16 people). The surveys were conducted under the aegis of the Hetman Petras Sagaidachny National University of Ground Forces (Lviv). The study made it possible to predict and evaluate the functional state of the cardiovascular system of military captains, to carry out a qualitative selection in the sports section with hand-to-hand combat, as well as to rationally construct training regimens, competitions and monitor their functional status. It is established that the servicemen who are engaged in the hand-to-hand combat segment have a high level of physical development, excellent cardiac performance, are of the normotonic type and have average values of general physical capacity (PWC170) and aerobic possibilities, namely maximum oxygen consumption.

Keywords: functional state, aerobic capacity, anthropometric indicators, unarmed combat, cadets

Introduction

The high pace of training and competitive loads puts high demands on the functional status of servicemen who are engaged in hand-to-hand combat. In military practise, to achieve a high result, the optimum condition of the nervous and cardiovascular systems, the high level of development of speed-strength qualities, high-speed endurance, aerobic and anaerobic capabilities of servicemen is a prerequisite (Klymovych & Olkhovyi, 2016). The determination of the functional status of military personnel requires a comprehensive analysis of morphological parameters, the level of development of motor qualities, aerobic and anaerobic possibilities, and the state of the cardiovascular system (e.g., Costa et al., 2016). Since there is practically no data on the comprehensive analysis of the

functional state of servicemen who are engaged in hand-to-hand combat in the available scientific and medical literature, we conducted a study of the morphological and functional indicators that enable a comprehensive assessment of the functional state and determine the level of their preparedness (Rayevsky & Kanisevsky, 2010).

The duration and intensity of exercises, as well as their number, all of which determine the overall load are planned, taking into account the functional capabilities of the body and physical capacity. In this case, the principle of gradual increases in physical activity must be guided (Yavorsky, 2016). To date, only the complex harmonious development of qualities enables the high achievements of military men, and not merely one or two, leading physical, psychological or functional



Correspondence:

V. Klymovych
National Academy of the Army, Department of Physical Education, Special Physical Training and Sports, Heroyiv Maydanu, 79012
Lviv, Ukraine
E-mail: klimovichvolodymyr@gmail.com

qualities (Klymovych, Olkhovyi & Romanchuk, 2016).

Thus, current data indicate the importance of indicators of the functional preparedness of servicemen who are engaged in unarmed combat in achieving their high results. At the same time, the authors of these publications consider only certain aspects of functional readiness, which reduces the theoretical and practical value of the research (Klymovych et al., (2019).

Most works devoted to the study of servicemen involved in unarmed combat relate to certain characteristics of their functional state in different conditions of training and adversarial activity (Rolyuk et al., 2016; Yoshimura, 1997). The literature does not disclose data on the comparison of the functional status of servicemen engaged in unarmed combat at rest and after metered physical loads of various types. Although numerous authors apply a large number of methods to evaluate the functional state of different systems of the body and their response to the load, the study of complex nature is practically absent. Since the control of any one functioning system can lead to erroneous conclusions about the failure of adaptation mechanisms in general, there is a need to work out a system of integrated assessment of the functional readiness of servicemen engaged in unarmed combat. In addition, there are only a limited number of publications on research in this area that supports the relevance of our work.

Kruszewski et al., (2017) studied the features of speed-force training in combat sports. However, data on the analysis of the cardiovascular system, as well as the aerobic and anaerobic capabilities of servicemen engaged in unarmed combat are absent in the literature. There are practically no publications on the assessment of physical development and functional state of the analysis of the cardiovascular system, and aerobic and anaerobic capabilities of servicemen of this category. In this regard, the main task was to select tests to assess the functional state of the analysis of the cardiovascular system, and aerobic and anaerobic capabilities of soldiers engaged in

unarmed combat, which could be conducted during mass surveys, and testing them in groups of servicemen who wish deal with hand-to-hand combat. The proposed set of tests should include tests for the assessment of physical development, as well as for the study of the functional state of the cardiovascular system.

Classes of unarmed combat, military all-round, martial arts, sports games, etc., expand the professional suitability of servicemen engaged in technical activities.

The purpose of this paper is to consider the level of physical development and the functional state of the soldiers who are engaged in hand-to-hand combat and to identify and analyse the functional and morphological characteristics that characterize the functional state of the analysis of the cardiovascular system, the aerobic and anaerobic capabilities of the soldiers.

Methods

Methods of research - theoretical and methodical analysis and generalization of scientific and methodical literature; medical and biological methods (anthropometry, physiometry, physical fitness tests); methods of mathematical statistics. The statistical analysis of the data was performed using standard procedures in Excel 7.0 and SPSS 11.5.

Results

During the anthropometric measurements, it was found that the body mass of the subjects was on average 69.34 ± 2.78 kg, body height 175.56 ± 2.39 cm, and chest circumference of 99.60 ± 3.90 cm (Table 1). On the basis of the indicators, we have identified indices that allow us to assess the physical development of servicemen engaged in unarmed combat. The obtained data testify that the Kettla index of the subjects is 394.5 ± 39.07 g/cm, and the body mass index ranges from $19-25$ kg/m². Both indicators confirm the average regulatory value for healthy individuals.

Table 1. Morphological and physiometric indices servicemen engaged in unarmed combat (n=32)

Indexes	M \pm SD
Body height (cm)	175.56 \pm 2.39
Body weight (kg)	69.34 \pm 2.78
chest circumference (cm)	99.60 \pm 3.90
Strength (by kistovym dynamometer-kg)	49.70 \pm 4.10
Heart rate (min)	64.31 \pm 5.10
Systolic blood pressure	122.40 \pm 7.70
Blood pressure is diastolic	80.70 \pm 4.90

However, the development of the muscles of different groups in the surveyed soldiers was unequal, since the magnitude of manual dynamometry (49.7 ± 4.1 kg) and the value of the strength index ($69.08 \pm 8.72\%$) indicate a lack of flexor muscles fingers of the hand. The strong body composition of the surveyed military men and the good development of the chest indicate the high values of the Erisman index (11.04 ± 1.32) and the low values of the Pinyu index, which was lower than 26 in all surveyed.

According to several indicators of the body structure, in particular, the development of the chest and the weight-growth ratio, the troops involved in the examination significantly exceed the average normative values for healthy individuals of

this age, indicating a high level of physical development.

The assessment of physical condition also involves the measurement of various physiometric indicators, in particular, the basic parameters of the cardiovascular system. The obtained data testify to the fact that the average indexes of systolic blood pressure at rest were 122.40 ± 7.70 mmHg, and diastolic 80.70 ± 4.90 mmHg, (i.e., within the normal range), CO $43-61$ ml, and average values of the minute volume of blood 3.84 ± 0.61 l.

The influence of the sympathetic and parasympathetic nervous system on the regulation of blood circulation in a state of rest is characterized by the vegetative index of Kerdo (VC). This indicator of servicemen engaged in hand-to-hand

combat has a predominantly negative value in the range (minus) -11 to -66 units, indicating the dominance of parasympathetic regulation.

The functional state of the cardiovascular system was also characterized by the use of Ruffie's test, the average value of which is 1.64 ± 0.36 , which indicates excellent cardiac performance. The absolute value of PWC170 is 1296.19 ± 75.63 kgm/min, the relative value of PWC170 is 15.49 ± 0.44 kgm/min per kilogram of body weight corresponding to single events (Wilmore & Kostlyla, 2001). The average value of maximum oxygen consumption in the surveyed military personnel was 3.7 ± 0.46 l min⁻¹, relative 47.09 ± 0.96 l min⁻¹ kg⁻¹, indicating average aerobic capacity. In the course of the study, it became clear that there is a dominant development of speed-strength qualities, which is associated with the specific aspects of this sport.

The analysis of the cardiovascular system indicators is widely used by domestic and foreign authors when evaluating the functional readiness of servicemen engaged in unarmed combat (e.g., Prontenko et al., 2018). The analysis of the research of the scientists showed that in the current conditions the professional activity has certain characteristics and high demands on the physical and psychological readiness of the military personnel of the Armed Forces of Ukraine (Romanchuk, 2015).

Discussion

Previous studies have shown that the level of preparedness of servicemen engaged in unarmed combat is insufficient to perform professional and combat tasks (Klymovych, Oderov, Korchagin, Olkhovyi & Romanchuk, 2019). Our main task

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Conflict of Interest

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was to select tests to assess the functional state of the analysis of the cardiovascular system, aerobic and anaerobic capabilities of soldiers engaged in unarmed combat that could be conducted in mass surveys and test them in groups of servicemen who wish to engage in unarmed combat.

The research complemented the results of other researchers regarding the positive effects of the use of physical exercises on overall physical fitness and the health of military servicemen engaged in unarmed combat (Romanchuk, 2015).

The novel element of our results is that the proposed set of tests includes tests for the assessment of physical development, as well as for the study of the functional state of the cardiovascular system.

A programme of applied physical training has been developed, the essence of which is to provide physical readiness and accelerate the process of adaptation of graduate officers to professional (combat) activity. The applied content of the author's programme enables forming the necessary qualitative performance of professional activities of officers. In addition, it has been established that this programme enables maintaining or even improving the overall physical qualities of military personnel during physical training.

In the process of analysis of scientific sources, normative documents and practical experience of military experts, it has been proved that, in the practice of military and combat sports, in order to achieve a high result, the optimal condition of the cardiovascular and nervous systems, the high level of development of speed-strength qualities, high-speed endurance, aerobic and anaerobic opportunities for athletes. At the same time, it is insufficient to study the level of functional preparedness of servicemen engaged in unarmed combat.

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SHORT REPORT

Morphological Characteristics and Body Composition of the Winners of the Soccer Cup of Bosnia and Herzegovina and Kosovo

Jovan Gardasevic¹, Dusko Bjelica¹, Ivan Vasiljevic¹, Marin Corluca², Fitim Arifi³ and Sami Sermahaj⁴

¹University of Montenegro, Faculty for Sport and Physical Education, Niksic, Montenegro, ²University of Mostar, Faculty of Mathematics and Science Education, Mostar, Bosnia and Herzegovina, ³University of Tetovo, Faculty for Sport and Physical Education, Tetovo, North Macedonia, ⁴University College, Department of Physical Culture, Sport and Recreation, Pristina, Kosovo

Abstract

This research aimed to determine the differences among the top soccer players of a club in Bosnia and Herzegovina, FC Siroki Brijeg, and the top soccer players of a club in Kosovo, FC Besa Peje, the winners of the Soccer Cup in their countries, in the morphological characteristics and body composition. A sample of 40 subjects was divided into two sub-samples. The first sub-sample consisted of 22 players FC Siroki Brijeg, the average age of 24.00 ± 6.22 , the winner of the Cup of Bosnia and Herzegovina in the season 2016/17, while the other sub-sample consisted of 18 players of FC Besa Peje of the average age of 21.83 ± 3.17 , the winner of the Cup of Kosovo in the 2016/17 season. Soccer players were tested immediately after the end of the 2016/17 competition season. Morphological characteristics were evaluated using a battery of seven variables: body height, body weight, waist circumference, triceps skinfold, biceps skinfold, skinfold of the back, and abdominal skinfold. The body composition was evaluated using a battery of three variables: body mass index, fat percentage, and muscle mass. The standard central and dispersion parameters of all variables were calculated. The significance of the differences between the players of the top two soccer clubs in the morphological characteristics and variables for assessing body composition was determined using a t-test for independent samples. The t-test results showed a statistically significant difference only in two variables waist circumference and triceps skinfold.

Keywords: soccer, morphological characteristics, body composition

Introduction

A soccer game is said to be the most important secondary thing in the world; it gathers huge masses at stadiums and in front of TVs (Gardasevic, Bjelica, & Vasiljevic, 2019). It is a highly dynamic and fast team game that, with its richness of movement, belongs to the category of polystructural sports games (Gardasevic, Bjelica, & Corluca, 2018; Bjelica, Popovic, Gardasevic, & Krivokapic, 2016). Soccer is a sport that is characterized by numerous and various complex and dynamic kinesiological activities, which are then characterized by either

cyclical (Sermahaj, Popovic, Bjelica, Gardasevic, & Arifi, 2017; Gardasevic, Bjelica, & Vasiljevic, 2017) or acyclical movement (Gardasevic, Bjelica, & Vasiljevic, 2016; Gardasevic, Bjelica, Milasinovic & Vasiljevic, 2016; Gardasevic, Popovic, & Bjelica, 2016). In sport, top scores can be achieved only under conditions of well-programmed training processes (Gardasevic, Akpinar, Popovic, & Bjelica, 2019; Gardasevic & Bjelica, 2019; Bjelica, Popovic, Tanase, & Gardasevic, 2017; Bojanic, Petkovic, Gardasevic, Muratovic, & Vasiljevic, 2015). Various studies are to be done to establish certain principles and norms for the



Correspondence:

J. Gardasevic
University of Montenegro, Faculty for Sport and Physical Education, Narodne omladine bb, 81400 Niksic, Montenegro
E-mail: jovan@ucg.ac.me

transformational processes of the anthropological characteristics essential for soccer (Bjelica & Gardasevic, 2018; Bjelica, Popovic, & Gardasevic, 2016a; Bjelica, Popovic, & Gardasevic, 2016b); with morphological characteristics and body composition among them as expected (Vasiljevic, Bjelica, & Gardasevic, 2018; Corluka, Bjelica, & Gardasevic, 2018; Vasiljevic, Bjelica, Popovic, & Gardasevic, 2015; Gardasevic, Vasiljevic, Bjelica, & Popovic, 2015). Findings regarding morphological characteristics and body composition are of crucial importance for complex sports such as soccer (Milasinovic, Gardasevic, & Bjelica, 2017; Gardasevic, Rasidagic, Krivokapic, Corluka, & Bjelica, 2017). Research on morphological characteristics and body composition among athletes of different sports indicates that such athletes have their own specific characteristics (Gardasevic, 2019; Gardasevic, 2018; Gardasevic, Masanovic, & Arifi, 2018; Masanovic, Gardasevic, & Arifi, 2018a; Masanovic, Gardasevic, & Arifi, 2018b; Arifi, Sermahhaj, Gardasevic, Alaj, & Metaj, 2018; Arifi, Gardasevic, & Masanovic, 2018; Arifi et al., 2017).

Today, soccer is undoubtedly the number one sport in the world in popularity (Gardasevic, Georgiev, & Bjelica, 2012), and the same applies to Bosnia and Herzegovina and Kosovo (Bjelica, Gardasevic, Vasiljevic, Arifi, & Sermahhaj, 2019; Gardasevic, Bjelica, Vasiljevic, Arifi, & Sermahhaj, 2019).

In the 2016/17 competitive season, FC Siroki Brijeg was the winner of the Cup of Bosnia and Herzegovina, and FC Besa Peje was the winner of the Cup of Kosovo. This research aimed to analyse the differences in some morphological characteristics and body composition among top soccer players of FC Siroki Brijeg and FC Besa Peje.

Methods

A sample of the subjects consists of a total of 40 top-level soccer players, divided into two sub-samples. The first one

consists of 22 players of FC Siroki Brijeg, the average age of 24.00 ± 6.22 , the winner of the Cup of Bosnia and Herzegovina, and the second one that consists of 18 players of FC Besa Peje of the average age of 21.83 ± 3.17 , the winner of the Cup of Kosovo in the season 2016/17.

Morphological research has been carried out with respect to the basic rules and principles related to the selection of measuring instruments and measurement techniques standardized in accordance with the International Biological Program guidelines. For this study, seven morphological measures have been taken (body height, body weight, waist circumference, triceps skinfold, biceps skinfold, skinfold of the back, and abdominal skinfold) and three body composition assessment variables (body mass index, fat percentage, and muscle mass). An anthropometer, calliper, and measuring tape were used for morphological measurements. To evaluate the body composition, Tanita body fat scale - model BC-418MA, was used.

Differences in morphological characteristics and the composition of the body of the players of these two clubs were determined by using a discriminatory parametric procedure with t-test for small independent samples, with statistical significance of $p < 0.05$.

Results

Based on the obtained values of t-test results, it can be noted that there are statistically significant differences in two variables at $p < 0.05$. It is two morphological measures waist circumference and triceps skinfold. It can be stated that the soccer players of FC Siroki Brijeg have statistically significantly higher waist circumference and smaller triceps skinfold than the players of FC Besa Peje do (Figure 1). In all other variables, the differences are negligible and not statistically significant.

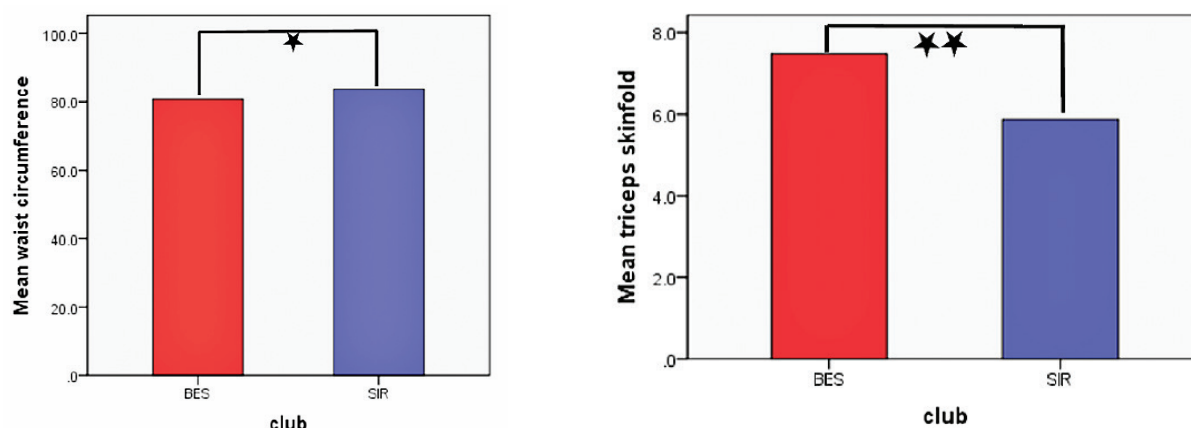


Figure 1. Statistically significant differences between soccer players FC Siroki Brijeg (SIR) and FC Besa Peje (BES) in two variables (* $p < .05$; ** $p < .01$)

Discussion

It can be observed that the players of both clubs are of the approximately similar mean values of the variables analysed, which is not surprising because these are the top two clubs in Bosnia and Herzegovina and Kosovo. Gardasevic, Bjelica, and Vasiljevic (2019) found similar results on a sample of soccer players from Montenegro. Very similar anthropometric characteristics of soccer players were obtained, which shows that they have similar characteristics and body composition throughout the region (Gardasevic, Bjelica, Popovic, Vasiljevic, & Milosevic, 2018; Corluka & Vasiljevic, 2018). The t-test results showed a statistically significant dif-

ference only in two variables: waist circumference and triceps skinfold. For other variables, some values are better for players of FC Siroki Brijeg and some for players of FC Besa Peje, although, insignificantly for statistics, which indicates that these players have very similar body composition and anthropometric parameters. The values obtained in this research can be useful for coaches of these clubs for making a comparison of their players with others and formulate their work in a way that enables a reduction of those parameters that are not beneficial and raising those that are to a higher level. That will surely make their soccer players even better and more successful. Furthermore, both clubs should turn

to other research studies and check the functional-motoric status, psychological preparation, and tactical training of

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Conflict of Interest

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their players and analyse whether there is room for their improvement.

SHORT REPORT

A Tool to Monitor and Evaluate Swimming: Development Design and Compilation of Model

Nur Azis Rohmansyah^{1,2}, Bertika Kusuma Prastiwi¹, Utvi Hinda Zhannisa¹, Setiawan¹ and Ashira Hiruntrakul³

¹Universitas PGRI Semarang, Department of Physical Education, Semarang, Indonesia, ²Khon Kaen University, Faculty of Graduate School, Department of Exercise and Sport Sciences, Khon Kaen, Thailand, ³Khon Kaen University, Faculty of Applied Science and Engineer, Department of Branch of Sport Science, Nong Khai Campus, Thailand

Abstract

Finis Tempo Trainer Pro (audible metronome pacing device) is an electronic tool used for pacing training and movement efficiency. However, it is not suitable for beginner athletes because the trainer cannot control whether the tempo of the movements made by the novice athlete is in accordance with the tempo set in the tool. A further problem is caused by the sound of the tool which is only heard by athletes so it takes awareness and honesty of athletes to match and maintain the tempo of the swimming movement in accordance with the tempo of the tool. Coaches need tools that can be used to train the efficiency of swimming movements in novice athletes. The following criteria for tools to aid in calculating the cycle of swimming movements: the sound can be heard by the coach or athlete; it can be used by more than one athlete; it also has an affordable price.

Keywords: functional state, aerobic capacity, anthropometric indicators, unarmed combat, cadets

Introduction

Swimming is one of the most suitable and enjoyable sports and entertainment activities for many people in different age ranges, especially in summer (Hossein et al., 2018). Swimming performance is influenced by a complex interaction of physiological, morphological, neuromuscular, biomechanical, and technical factors. More specifically, swimming speed is a product of stroke rate and length, and an increase in stroke rate or stroke length has been found to improve swimming performance independently (Barbosa et al., 2010a). It has been suggested that increasing swimming speed requires programmes with elements of high frequency, duration, and intensity, resulting in a high overall training volume (González-Boto, Salguero, Tuero, González-Gallego, & Márquez, 2008). The technique done correctly will support efficient motion (Barbosa et al., 2010b). Efficient swimming movements will be easier to do with a good understanding of the technique and correct implementation of it (Wakayoshi,

D'Acquisto, Cappaert, & Troup, 1995). One way to measure the power used when swimming is to count the number of movements performed (Girolid, Calmels, Maurin, Milhau, & Chatard, 2006). The more movements that are carried out, the greater power is used.

Finis Tempo Trainer Pro (audible metronome pacing device) is an electronic tool used for pacing training and movement efficiency. However, it is not suitable for beginner athletes because the trainer cannot control whether the tempo of the movements made by the novice athlete is in accordance with the tempo set in the tool. Finis Tempo Trainer Pro has some disadvantages when used in swimming movement efficiency training for beginner athletes; among others, in terms of the benefits of not being able to count the cycles of swimming movements, one tool can only be used for one athlete; it cannot issue sounds that can be heard by the trainer so the coach cannot control the tempo of the athlete's swimming movements; the purchase price



Correspondence:

A.Hiruntrakul

Khon Kaen University, Faculty of Applied Science and Engineer, Department of Branch of Sport Science, Nong Khai Campus, Thailand

E-mail: hashir@kku.ac.th

is relatively expensive; there is a risk of leakage if used in water, and the batteries in the device cannot be replaced because doing so causes leakage in the device, so it cannot be used again in water.

Based on the weaknesses that exist in Finis Tempo Trainer Pro device and the trainer's need for tools that help develop the efficiency of the swimming motion, it is necessary to develop tools that are suitable to the trainer's needs. The purpose of this study is developing the device to aid in the efficiency of swimming movements. The tool was developed based on the previous tool, Finis Tempo Trainer Pro. Crawl swimming is the style chosen, because the cycle of swimming movements can be calculated according to the swinging movements of both legs.

Methods

The study was conducted from March to July of 2019 in a swimming pool facility located in Semarang, Indonesia. This research was approved by Universitas PGRI Semarang. Twenty-five elite national-level junior swimmers (16.5 ± 1.2 years old) and ten professional swimming coaches. Trainer observation and athlete assessment data on the Tempo Trainer tool draft uses the answers "yes" (1) and "no" (0). Data from observations of effectiveness by swimming experts and microcontrollers on the Tempo Trainer tool can be drafted into a scale of values. Valuation ranges from "ineffective" to "very effective". The range of scores on the expert effectiveness observation sheet is a score of 1 for ineffective assessment, a score of 2 for an ineffective assessment, a score of 3 for a fairly effective assessment, a score of 4 for an effective assessment, and a score of 5 for a very effective assessment. The model arranged is considered feasible to be tested on a small scale or a large scale quantitatively calculated the score reaches a minimum standard of eligibility. Categorization norms are used in accordance with the provisions of Azwar (2011).

The validity and reliability test of the Tempo Trainer Draft was conducted using questionnaire data for trainer respondents and athlete respondents on small- and large-scale trials. Validity and reliability tests were performed using Microsoft Excel 2007. The instrument in this study was a questionnaire compiled by the researcher. The compiled questionnaire is then used to provide an assessment or validation of the initial draft of the Tempo Trainer tool and observations of the implementation of field trials both small and large scale. The instrument used in assessing and analysing the appropriateness of the tool uses the PIECES (Performance, Information, Economic, Control, Efficiency, Services) analysis procedure (Turban, McLean, & Wetherbe, 2000).

Results

After completing the revision of the draft Tempo Trainer, which was tested on a small scale, it was followed up by conducting a large-scale field trial. The implementation of large-scale trials is then observed and evaluated by swimming experts, microcontroller experts, swimming coaches, and athletes. Data obtained in large-scale trials, namely: data from observations of the evaluation of the draft Tempo Trainer by swimming experts in large-scale trials shows that all the total values obtained are categorized as good and located at intervals ≥ 51.33 . Thus, it can be con-

cluded that the Tempo Trainer is a good tool; data from observations of evaluations of the Tempo Trainer draft by microcontroller experts in large-scale trials show that the total value obtained is 44 so that it is categorized as good because it lies in the 33rd interval. Therefore, it can be concluded that the draft of the Tempo Trainer tool is categorized as good for helping the efficiency of the swinging foot movements; the observation data on the assessment of the Tempo Trainer draft by the swimming coach in large-scale trials shows that the total value of 131 is categorized as good because it is located at intervals interval 93.33. Therefore, it can be concluded that the draft of Tempo Trainer is categorized as good in helping the efficiency of Crawl swing movements in swimming. Based on these data, it can be stated that the Tempo Trainer draft is valid for use with a value of $r_{xy}=0.7945$ and from the reliability test analysis the r value=0.908 is obtained: thus, it can be said that the Tempo Trainer draft is reliable; data from the assessment of the Tempo Trainer draft by athletes in small-scale trials shows that the total score is 142 so that it is located at an interval of ≥ 100 . It can be concluded that the athlete's evaluation of the Tempo Trainer draft is categorized as good. Based on these data, the results obtained can be stated that the Tempo Trainer draft is valid for use with a value of $r_{xy}=0.5125$, and the reliability test analysis results obtained as follows the value of $r=0.750$; thus, it can be said that the Tempo Trainer draft is reliable.

Product Specification

Tempo Trainer is a development of the Finis Tempo Trainer Pro (Audible metronome pacing device) whose main function is to set a tempo. The Tempo Trainer is programmed so that it can adjust the tempo in the form of sound or rhythm used as a reference for crawl arm movements. The rhythm in the Tempo Trainer tool consists of six types of speed, namely: speed of 30 cycles per minute, movement speed of 32 cycles per minute, speed of 34 cycles per minute, speed of 36 cycles per minute, five (5) speeds of 38 cycles per minute, and speed 40 cycles per minute. The results of the calculation of arm movements will be displayed numerically on the LCD screen. The sound of Tempo Trainer can be heard by the trainer through speakers designed to be attached to the box. The use of this tool must be accompanied by an underwater speaker so that it can be heard by athletes from underwater.



Figure 1. Tempo trainer Pro development

Discussion

The results of the development of the Tempo Trainer tool to help the efficiency of freestyle arm movements in the sport of swimming suggest that the tool can be mass-pro-

duced. This is related to the opinion of some coaches who want the tool to add equipment owned by the swimming association to support training and facilitate the trainer in training the efficiency of freestyle leg movements.

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Conflict of Interest

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- ✓ FAMILY NAME-statement.PDF – (authorship statement)
- ✓ FAMILY NAME-declaration.PDF – (declaration of potential conflict of interest)
- ✓ FAMILY NAME-fig1.tiff – (Figure 1)

1.4. Peer Review Process

A manuscript submitted for publication will be submitted to the review process as long as it fits the following criteria:

- The study was not previously published, nor has been submitted simultaneously for consideration of publication elsewhere;
- All persons listed as authors approved its submission to SM;
- Any person cited as a source of personal communication has approved the quote;
- The opinions expressed by the authors are their exclusive responsibility;
- The author signs a formal statement that the submitted manuscript complies with the directions and guidelines of SM.

The editors-in-chief and associate editors will make a preliminary analysis regarding the appropriateness, quality, originality and written style/grammar of the submitted manuscript. The editors reserve the right to request additional information, corrections, and guideline compliance before they submit the manuscript to the ad-hoc review process.

SM uses ad-hoc reviewers, who volunteer to analyze the merit of the study. Typically, one or two expert reviewers are consulted in a double-blind process. Authors are notified by e-mail when their submission has been accepted (or rejected). Minor changes in the text may be made at the discretion of the editors-in-chief and/or associate editors. Changes can include spelling and grammar in the chosen language, written style, journal citations, and reference guidelines. The author is notified of changes via email. The final version is available to the author for his or her approval before it is published.

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1.6. After Acceptance

After the manuscript has been accepted, authors will receive a PDF version of the manuscripts for authorization, as it should look in printed version of SM. Authors should carefully check for omissions. Reporting errors after this point will not be possible and the Editorial Board will not be eligible for them.

Should there be any errors, authors should report them to the Office e-mail address **sportmont@ucg.ac.me**. If there are not any errors authors should also write a short e-mail stating that they agree with the received version.

1.7. Code of Conduct Ethics Committee of Publications



SM is hosting the Code of Conduct Ethics Committee of Publications of the **COPE** (the Committee on Publication Ethics), which provides a forum for publishers and Editors of scientific journals to discuss issues relating to the integrity of the work

submitted to or published in their journals.

2. MANUSCRIPT STRUCTURE

2.1. Title Page

The first page of the manuscripts should be the title page, containing: title, type of publication, running head, authors, affiliations, corresponding author, and manuscript information. *See example:*

Talented High School Football Players' Perception of Talent Identification Criteria

Original Scientific Paper

Talent Identification Criteria

Vazjwar Matin¹ and Stig Arve Sæther¹

¹University of Science and Technology, Department of Sociology and Political Science, Trondheim, Norway

Corresponding author:

S. A. Sæther

Norwegian University of Science and Technology

Department of Sociology and Political Science

Dragvoll, 7491 Trondheim, Norway

E-mail: stigarve@ntnu.no

Word count: 2,946

Abstract word count: 236

Number of Tables: 3

Number of Figures: 0

2.1.1. Title

Title should be short and informative and the recommended length is no more than 20 words. The title should be in Title Case, written in uppercase and lowercase letters (initial uppercase for all words except articles, conjunctions, short prepositions no longer than four letters etc.) so that first letters of the words in the title are capitalized. Exceptions are words like: "and", "or", "between" etc. The word following a colon (:) or a hyphen (-) in the title is always capitalized.

2.1.2. Type of publication

Authors should suggest the type of their submission.

2.1.3. Running head

Short running title should not exceed 50 characters including spaces.

2.1.4. Authors

The form of an author's name is first name, middle initial(s), and last name. In one line list all authors with full names separated by a comma (and space). Avoid any abbreviations of academic or professional titles. If authors belong to different institutions, following a family name of the author there should be a number in superscript designating affiliation.

2.1.5. Affiliations

Affiliation consists of the name of an institution, department, city, country/territory (in this order) to which the author(s) belong and to which the presented / submitted work should be attributed. List all affiliations (each in a separate line) in the order corresponding to the list of authors. Affiliations must be written in English, so carefully check the official English translation of the names of institutions and departments.

Only if there is more than one affiliation, should a number be given to each affiliation in order of appearance. This number should be written in superscript at the beginning of the line, separated from corresponding affiliation with a space. This number should also be put after corresponding name of the author, in superscript with no space in between.

If an author belongs to more than one institution, all corresponding superscript digits, separated with a comma with no space in between, should be present behind the family name of this author.

In case all authors belong to the same institution affiliation numbering is not needed.

Whenever possible expand your authors' affiliations with departments, or some other, specific and lower levels of organization.

2.1.6. Corresponding author

Corresponding author's name with full postal address in English and e-mail address should appear, after the affiliations. It is preferred that submitted address is institutional and not private. Corresponding author's name should include only initials of the first and middle names separated by a full stop (and a space) and the last name. Postal address should be written in the following line in sentence case. Parts of the address should be separated by a comma instead of a line break. E-mail (if possible) should be placed in the line following the postal address. Author should clearly state whether or not the e-mail should be published.

2.1.7. Manuscript information

All authors are required to provide word count (excluding title page, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References), the Abstract word count, the number of Tables, and the number of Figures.

2.2. Abstract

The second page of the manuscripts should be the abstract and key words. It should be placed on second page of the manuscripts after the standard title written in upper and lower case letters, bold.

Since abstract is independent part of your paper, all abbreviations used in the abstract should also be explained in it. If an abbreviation is used, the term should always be first written in full with the abbreviation in parentheses immediately after it. Abstract should not have any special headings (e.g., Aim, Results...).

Authors should provide up to six key words that capture the main topics of the article. Terms from the Medical Subject Headings (MeSH) list of Index Medicus are recommended to be used.

Key words should be placed on the second page of the manuscript right below the abstract, written in italic. Separate each key word by a comma (and a space). Do not put a full stop after the last key word. *See example:*

Abstract

Results of the analysis of

Key words: *spatial memory, blind, transfer of learning, feedback*

2.3. Main Chapters

Starting from the third page of the manuscripts, it should be the main chapters. Depending on the type of publication main manuscript chapters may vary. The general outline is: Introduction, Methods, Results, Discussion, Acknowledgements

(optional), Conflict of Interest (optional). However, this scheme may not be suitable for reviews or publications from some areas and authors should then adjust their chapters accordingly but use the general outline as much as possible.

2.3.1. Headings

Main chapter headings: written in bold and in Title Case. *See example:*

- ✓ **Methods**

Sub-headings: written in italic and in normal sentence case. Do not put a full stop or any other sign at the end of the title. Do not create more than one level of sub-heading. *See example:*

- ✓ *Table position of the research football team*

2.3.2 Ethics

When reporting experiments on human subjects, there must be a declaration of Ethics compliance. Inclusion of a statement such as follow in Methods section will be understood by the Editor as authors' affirmation of compliance: "This study was approved in advance by [name of committee and/or its institutional sponsor]. Each participant voluntarily provided written informed consent before participating." Authors that fail to submit an Ethics statement will be asked to resubmit the manuscripts, which may delay publication.

2.3.3 Statistics reporting

SM encourages authors to report precise p-values. When possible, quantify findings and present them with appropriate indicators of measurement error or uncertainty (such as confidence intervals). Use normal text (i.e., non-capitalized, non-italic) for statistical term "p".

2.3.4. 'Acknowledgements' and 'Conflict of Interest' (optional)

All contributors who do not meet the criteria for authorship should be listed in the 'Acknowledgements' section. If applicable, in 'Conflict of Interest' section, authors must clearly disclose any grants, financial or material supports, or any sort of technical assistances from an institution, organization, group or an individual that might be perceived as leading to a conflict of interest.

2.4. References

References should be placed on a new page after the standard title written in upper and lower case letters, bold.

All information needed for each type of must be present as specified in guidelines. Authors are solely responsible for accuracy of each reference. Use authoritative source for information such as Web of Science, Medline, or PubMed to check the validity of citations.

2.4.1. References style

SM adheres to the American Psychological Association 6th Edition reference style. Check "American Psychological Association. (2009). Concise rules of APA style. American Psychological Association." to ensure the manuscripts conform to this reference style. Authors using EndNote® to organize the references must convert the citations and bibliography to plain text before submission.

2.4.2. Examples for Reference citations

One work by one author

- ✓ In one study (Reilly, 1997), soccer players
- ✓ In the study by Reilly (1997), soccer players
- ✓ In 1997, Reilly's study of soccer players

Works by two authors

- ✓ Duffield and Marino (2007) studied
- ✓ In one study (Duffield & Marino, 2007), soccer players
- ✓ In 2007, Duffield and Marino's study of soccer players

Works by three to five authors: cite all the author names the first time the reference occurs and then subsequently include only the first author followed by et al.

- ✓ First citation: Bangsbo, Iaia, and Krstrup (2008) stated that
- ✓ Subsequent citation: Bangsbo et al. (2008) stated that

Works by six or more authors: cite only the name of the first author followed by et al. and the year

- ✓ Krstrup et al. (2003) studied
- ✓ In one study (Krstrup et al., 2003), soccer players

Two or more works in the same parenthetical citation: Citation of two or more works in the same parentheses should be listed in the order they appear in the reference list (i.e., alphabetically, then chronologically)

- ✓ Several studies (Bangsbo et al., 2008; Duffield & Marino, 2007; Reilly, 1997) suggest that

2.4.3. Examples for Reference list

Journal article (print):

- Nepocatyč, S., Balilionis, G., & O'Neal, E. K. (2017). Analysis of dietary intake and body composition of female athletes over a competitive season. *Montenegrin Journal of Sports Science and Medicine*, 6(2), 57-65. doi: 10.26773/mjssm.2017.09.008
- Duffield, R., & Marino, F. E. (2007). Effects of pre-cooling procedures on intermittent-sprint exercise performance in warm conditions. *European Journal of Applied Physiology*, 100(6), 727-735. doi: 10.1007/s00421-007-0468-x
- Krstrup, P., Mohr, M., Amstrup, T., Rysgaard, T., Johansen, J., Steensberg, A., Bangsbo, J. (2003). The yo-yo intermittent recovery test: physiological response, reliability, and validity. *Medicine and Science in Sports and Exercise*, 35(4), 697-705. doi: 10.1249/01.MSS.0000058441.94520.32

Journal article (online; electronic version of print source):

- Williams, R. (2016). Krishna's Neglected Responsibilities: Religious devotion and social critique in eighteenth-century North India [Electronic version]. *Modern Asian Studies*, 50(5), 1403-1440. doi:10.1017/S0026749X14000444

Journal article (online; electronic only):

- Chantavanich, S. (2003, October). Recent research on human trafficking. *Kyoto Review of Southeast Asia*, 4. Retrieved November 15, 2005, from <http://kyotoreview.cseas.kyoto-u.ac.jp/issue/issue3/index.html>

Conference paper:

- Pasadilla, G. O., & Milo, M. (2005, June 27). *Effect of liberalization on banking competition*. Paper presented at the conference on Policies to Strengthen Productivity in the Philippines, Manila, Philippines. Retrieved August 23, 2006, from <http://siteresources.worldbank.org/INTPHILIPPINES/Resources/Pasadilla.pdf>

Encyclopedia entry (print, with author):

- Pittau, J. (1983). Meiji constitution. In *Kodansha encyclopedia of Japan* (Vol. 2, pp. 1-3). Tokyo: Kodansha.

Encyclopedia entry (online, no author):

- Ethnology. (2005, July). In *The Columbia encyclopedia* (6th ed.). New York: Columbia University Press. Retrieved November 21, 2005, from <http://www.bartleby.com/65/et/ethnolog.html>

Thesis and dissertation:

- Pyun, D. Y. (2006). *The proposed model of attitude toward advertising through sport*. Unpublished Doctoral Dissertation. Tallahassee, FL: The Florida State University.

Book:

- Borg, G. (1998). *Borg's perceived exertion and pain scales*: Human kinetics.

Chapter of a book:

- Kellmann, M. (2012). Chapter 31-Overtraining and recovery: Chapter taken from *Routledge Handbook of Applied Sport Psychology* ISBN: 978-0-203-85104-3 *Routledge Online Studies on the Olympic and Paralympic Games* (Vol. 1, pp. 292-302).

Reference to an internet source:

- Agency. (2007). Water for Health: Hydration Best Practice Toolkit for Hospitals and Healthcare. Retrieved 10/29, 2013, from www.rcn.org.uk/newsevents/hydration

2.5. Tables

All tables should be included in the main manuscript file, each on a separate page right after the Reference section.

Tables should be presented as standard MS Word tables.

Number (Arabic) tables consecutively in the order of their first citation in the text.

Tables and table headings should be completely intelligible without reference to the text. Give each column a short or abbreviated heading. Authors should place explanatory matter in footnotes, not in the heading. All abbreviations appearing in a table and not considered standard must be explained in a footnote of that table. Avoid any shading or coloring in your tables and be sure that each table is cited in the text.

If you use data from another published or unpublished source, it is the authors' responsibility to obtain permission and acknowledge them fully.

2.5.1. Table heading

Table heading should be written above the table, in Title Case, and without a full stop at the end of the heading. Do not use suffix letters (e.g., Table 1a, 1b, 1c); instead, combine the related tables. *See example:*

- ✓ **Table 1.** Repeated Sprint Time Following Ingestion of Carbohydrate-Electrolyte Beverage

2.5.2. Table sub-heading

All text appearing in tables should be written beginning only with first letter of the first word in all capitals, i.e., all words for variable names, column headings etc. in tables should start with the first letter in all capitals. Avoid any formatting (e.g., bold, italic, underline) in tables.

2.5.3. Table footnotes

Table footnotes should be written below the table.

General notes explain, qualify or provide information about the table as a whole. Put explanations of abbreviations, symbols, etc. here. General notes are designated by the word *Note* (italicized) followed by a period.

- ✓ *Note.* CI: confidence interval; Con: control group; CE: carbohydrate-electrolyte group.

Specific notes explain, qualify or provide information about a particular column, row, or individual entry. To indicate specific notes, use superscript lowercase letters (e.g. ^{a,b,c}), and order the superscripts from left to right, top to bottom. Each table's first footnote must be the superscript ^a.

- ✓ ^aOne participant was diagnosed with heat illness and n = 19.^bn = 20.

Probability notes provide the reader with the results of the tests for statistical significance. Probability notes must be indicated with consecutive use of the following symbols: * † ‡ § ¶ || etc.

- ✓ *P<0.05, †p<0.01.

2.5.4. Table citation

In the text, tables should be cited as full words. *See example:*

- ✓ Table 1 (first letter in all capitals and no full stop)
- ✓ ...as shown in Tables 1 and 3. (citing more tables at once)
- ✓ ...result has shown (Tables 1-3) that... (citing more tables at once)
- ✓in our results (Tables 1, 2 and 5)... (citing more tables at once)

2.6. Figures

On the last separate page of the main manuscript file, authors should place the legends of all the figures submitted separately.

All graphic materials should be of sufficient quality for print with a minimum resolution of 600 dpi. SM prefers TIFF, EPS and PNG formats.

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Figures and figure legends should be completely intelligible without reference to the text.

The price of printing in color is 50 EUR per page as printed in an issue of SM.

2.6.1. Figure legends

Figures should not contain footnotes. All information, including explanations of abbreviations must be present in figure legends. Figure legends should be written below the figure, in sentence case. *See example:*

- ✓ **Figure 1.** Changes in accuracy of instep football kick measured before and after fatigued. SR – resting state, SF – state of fatigue, * $p > 0.01$, † $p > 0.05$.

2.6.2. Figure citation

All graphic materials should be referred to as Figures in the text. Figures are cited in the text as full words. *See example:*

- ✓ Figure 1
- × figure 1
- × Figure 1.
- ✓ ...exhibit greater variance than the year before (Figure 2). Therefore...
- ✓ ...as shown in Figures 1 and 3. (citing more figures at once)
- ✓ ...result has shown (Figures 1-3) that... (citing more figures at once)
- ✓ ...in our results (Figures 1, 2 and 5)... (citing more figures at once)

2.6.3. Sub-figures

If there is a figure divided in several sub-figures, each sub-figure should be marked with a small letter, starting with a, b, c etc. The letter should be marked for each subfigure in a logical and consistent way. *See example:*

- ✓ Figure 1a
- ✓ ...in Figures 1a and b we can...
- ✓ ...data represent (Figures 1a-d)...

2.7. Scientific Terminology

All units of measures should conform to the International System of Units (SI).

Measurements of length, height, weight, and volume should be reported in metric units (meter, kilogram, or liter) or their decimal multiples.

Decimal places in English language are separated with a full stop and not with a comma. Thousands are separated with a comma.

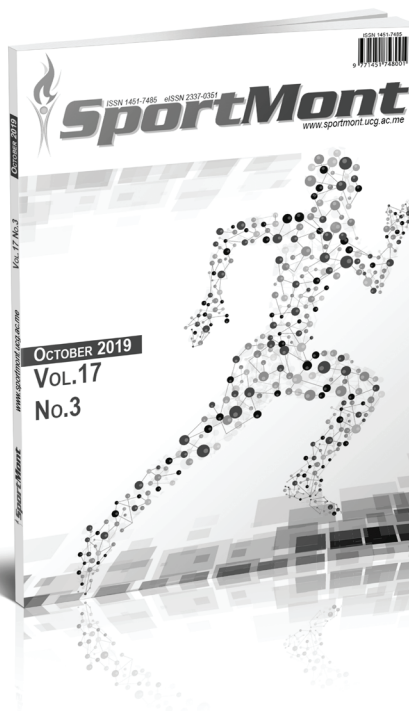
Percentage	Degrees	All other units of measure	Ratios	Decimal numbers
✓ 10%	✓ 10°	✓ 10 kg	✓ 12:2	✓ 0.056
× 10 %	× 10 °	× 10kg	× 12 : 2	× .056
Signs should be placed immediately preceding the relevant number.				
✓ 45±3.4	✓ p<0.01	✓ males >30 years of age		
× 45 ± 3.4	× p < 0.01	× males > 30 years of age		

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Latin names of species, families etc. should be written in italics (even in titles). If you mention Latin names in your abstract they should be written in non-italic since the rest of the text in abstract is in italic. The first time the name of a species appears in the text both genus and species must be present; later on in the text it is possible to use genus abbreviations. See example:

✓ First time appearing: *musculus biceps brachii*

Abbreviated: *m. biceps brachii*



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Sport Mont (SM) is a print (ISSN 1451-7485) and electronic scientific journal (eISSN 2337-0351) aims to present easy access to the scientific knowledge for sport-conscious individuals using contemporary methods. The purpose is to minimize the problems like the delays in publishing process of the articles or to acquire previous issues by drawing advantage from electronic medium. Hence, it provides:

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SM covers all aspects of sports science and medicine; all clinical aspects of exercise, health, and sport; exercise physiology and biophysical investigation of sports performance; sport biomechanics; sports nutrition; rehabilitation, physiotherapy; sports psychology; sport pedagogy, sport history, sport philosophy, sport sociology, sport management; and all aspects of scientific support of the sports coaches from the natural, social and humanistic side.

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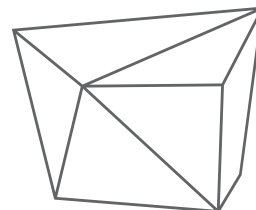
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Bulevar Džordža Vašingtona bb
81000 Podgorica, Montenegro
Tel +382 20 269 262
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University of Montenegro

Cetinjska br.2
81 000 Podgorica
Montenegro

E-mail:
rektor@ac.me
rektorat@ac.me

Phone: + 382 20 414 255
Fax: + 382 20 414 230

Web:
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Since its foundation, the University of Montenegro has continuously been conducting reforms in the area of education and research, while since 2003 in line with the trends in EHEA. After adoption of the Bologna Declaration, University of Montenegro organized systematic preparation of documents aligned with it. Already in 2003, the experimental teaching programme started and today, all studies are organised in line with the Bologna principles. During the last two years systematic reforms of the University's study programmes have been conducted in order to harmonize domestic higher education system with European standards and market needs to highest extent.

The University of Montenegro has unique academic, business and development objectives. It comprises 19 faculties and two research institutes. The seat of the UoM is in Podgorica, the capital city, while university units are located in eight Montenegrin towns. The University support services and centers (advisory services, accounting department, international cooperation, career orientation) are located in the Rectorate.

Academic community of University of Montenegro is aware of the importance of its functioning for further development of the state and wider region. It has been so far, and will be in the future, the leader in processes of social and cultural changes, along with the economic development.

In the aspect of attaining its mission, University of Montenegro is oriented towards the priority social needs of the time in which it accomplishes its mission; open for all the students and staff exclusively based on their knowledge and abilities; dedicated to preservation of multicultural and multi-ethnic society in Montenegro; entrepreneurial in stimulating social and economic application of supreme achievements within the scope of its activities.

In 2015/16 there were a total of 1.192 employees at UoM, 845 of which were engaged in teaching. In the same year there were 20.236 students registered at all three cycles of studies.

Internationalization is high on the agenda of UoM priorities, thus it has participated in a number of international projects – over 50 projects funded under the Tempus programme, over 15 Erasmus Mundus Action 2 projects for student mobility, a number of projects under FP7 funding scheme or IPA supported projects, Erasmus + capacity building and International credit mobility projects and other.

For more information about University of Montenegro, please visit our website www.ucg.ac.me or send e-mail to pr.centar@ac.me.





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*Montenegrin Journal
of Sports Science and Medicine*



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MJSSM covers all aspects of sports science and medicine; all clinical aspects of exercise, health, and sport; exercise physiology and biophysical investigation of sports performance; sport biomechanics; sports nutrition; rehabilitation, physiotherapy; sports psychology; sport pedagogy, sport history, sport philosophy, sport sociology, sport management; and all aspects of scientific support of the sports coaches from the natural, social and humanistic side.

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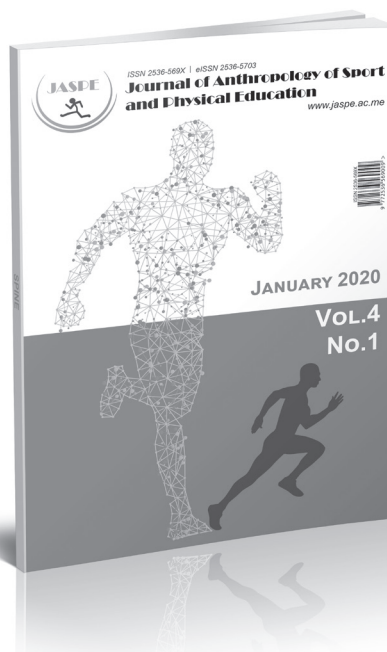
Stevo POPOVIC, Editor-in Chief – stevop@ucg.ac.me

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Journal of Anthropology of Sport and Physical Education



ISSN 2536-569X

Journal of Anthropology of Sport and Physical Education (JASPE) is a print (ISSN 2536-569X) and electronic scientific journal (eISSN 2536-5703) aims to present easy access to the scientific knowledge for sport-conscious individuals using contemporary methods. The purpose is to minimize the problems like the delays in publishing process of the articles or to acquire previous issues by drawing advantage from electronic medium. Hence, it provides:

- Open-access and freely accessible online;
- Fast publication time;
- Peer review by expert, practicing researchers;
- Post-publication tools to indicate quality and impact;
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JASPE is published four times a year, in January, April, July and October of each year. JASPE publishes original scientific papers, review papers, editorials, short reports, peer review - fair review, as well as invited papers and award papers in the fields of Anthropology of Sport and Physical Education, as well as it can function as an open discussion forum on significant issues of current interest.

JASPE covers all aspects of anthropology of sport and physical education from five major fields of anthropology: cultural, global, biological, linguistic and medical.

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Univerzitet Crne Gore

UNIVERZITET CRNE GORE PRAVNI FAKULTET – PODGORICA

UNIVERZITET
CRNE GORE



PRAVNI
FAKULTET
PODGORICA



Faculty of Law was founded on October 27th, 1972 in Podgorica as a scientific and artistic educational institution, in which educational and research work was organized in the area of law and similar social studies. While making into law the establishment of this institution, Assembly of Socialist Republic of Montenegro highlighted that "The establishment of this institution of high education is necessary for meeting overall demands of the society of the Republic". Faculty of Law is one of the founding fathers of the University of Montenegro.

During the forty-five years of its existence Faculty of Law grew to a modern, contemporary, scientific and artistic educational institution. Forty-five generations studied at the faculty. About 17.000 students enrolled at the faculty and 4285 students graduated from the faculty. About 15 percent of the students studied abroad. Part of the best students continued postgraduate and doctoral studies at prominent university centers. Most of the former students stayed in Montenegro due to family ties. 88 professors and associates worked at the faculty, out of whom there were 26 guest professors. Today most of the professors and cadre at the faculty are former students.

Faculty organizes graduate and postgraduate studies. There

are teaching and cadre resources for organizing specialist and doctoral studies in all the areas of law.

As a university branch Faculty of Law realizes a big number of its planned aims and tasks and finds solutions for many important questions of cadre organization, technical and material problems. With the help of the University of Montenegro, faculty largely develops the international cooperation net.

Faculty follows world trends and achievements in the area of high education with the aim to coordinate its work with European and world demands. This year faculty made the first steps in realization of Bologna declaration. There is enough cadre for all the necessary teaching at the faculty.

The faculty was founded because of expression of need to reach the necessary standard for socio-economic, political, cultural and social development of Montenegro. During its overall existence faculty shared the fate with Montenegrin society. It will continue to do so by making steps towards implementing new practises and creating new relations, with the help of implementation of modern European trends.

The faculty is a complex organization and managing institution nowadays.

Faculty of Economics

University of Montenegro

The Faculty of Economics celebrated its 57th anniversary this year, and it is the oldest higher education institution in the country. Since its establishment, 8,630 students graduated at our Faculty.

Today, Faculty of Economics is a largely interdisciplinary institution, characterized by expressed dynamism in its work. Employees at the Faculty are dedicated to constant improvements and enhancements, all in accordance with the needs brought by the changes.

We provide our students with the best theoretical and practical knowledge, enabling them to develop critical spirit in approaching economic phenomena and solving concrete problems in daily work. From September 2017, at the Faculty, the new generation will start a 3 + 2 + 3 study, which will improve the quality of studying.



Development of Faculty of Economics in the coming period will follow the vision of development of the University of Montenegro, pursuing full achievement of its mission

Comprehensive literature, contemporary authors and works have always been imperative in creation of new academic directions at Faculty of Economics, which will form the basis of our future.

Faculty and its employees are dedicated to developing interest in strengthening the entrepreneurial initiative, creative and interdisciplinary approach among young people, using modern teaching and research methods. In this regard, the Faculty has modern textbooks and adequate IT technology, which supports the objectives set.





Univerzitet Crne Gore

UNIVERZITET CRNE GORE INSTITUT ZA BIOLOGIJU MORA



University of Montenegro – Institute for marine biology is located in Kotor, Montenegro. Since its establishment in 1961, the Institute performed comprehensive research of the marine and coastal area, which has its wide impact to the environmental protection, pollution-prevention and practical application. Core competencies of the Institute are focused on research in the fields of marine conservation, ichthyology and marine fisheries, marine chemistry, aquaculture, plankton research, neuro and eco-physiology. The main research area is investigating and protection of Adriatic sea with special interest of South Adriatic area. Institute for marine biology have a wide range of international cooperation with Marine research institutions and Universities all over Mediterranean area through a numerous EU funded scientific projects.

All over the year Institute is looking to hire a young students from the field of general biology, marine biology, marine chemistry, molecular biology or similar disciplines on voluntary basis to work with us. We need opportunity for international internship or MSc or PhD thesis that could be performed on Institute in our 5 different labs: Fisheries and ichthyology, Aquaculture, Marine chemistry, Plankton and sea water quality and Benthos and marine conservation.

Every year Institute organize several summer schools and workshop for interested students, MSc and PhD candidates. From 01-05 July 2019 we will organize Summer school "Blue Growth: emerging technologies, trends and opportunities" in frame of InnoBlueGrowth Project who is financed by Interreg Med programme. Through the specific theme courses, workshops and working labs offered – covering different areas of the blue economy – the Summer School aims at encouraging young people involvement in blue economy sectors by offering high-quality technical knowledge and fostering their entrepreneurial spirit. The Summer School will facilitate fruitful exchanges and a stronger understanding among a variety of actors coming from different Mediterranean countries with diverse profiles, including representatives from the academia, the public and private sectors, but also potential funders and investors. These activities will count on specific team building activities for participants as well to reinforce interpersonal skills and foster cohesion among blue academia and sectors.

If You are interested apply on the following link: <https://www.ucg.ac.me/objava/blog/1221/objava/45392-ljetnja-skola-plavi-rast-nove-tehnologije-trendovi-i-mogucnosti>

University of Montenegro – Institute for marine biology

Dobrota bb, P.o. box 69. 83550 Kotor, Montenegro

ibmk@ucg.ac.me

+38232334569

www.ucg.ac.me/ibm



UNIVERSITY OF MONTENEGRO FACULTY OF MECHANICAL ENGINEERING Podgorica



www.ucg.ac.me/mf

Mechanical engineering studies in Montenegro started during the school year 1970/71. On April 15th, within the Technical Faculty, the Department of Mechanical Engineering was formed. The Department of Mechanical Engineering of the Technical Faculty was transformed in 1978 into the Faculty of Mechanical Engineering, within the University "Veljko Vlahović". Since 1992 the Faculty of Mechanical Engineering is an autonomous University unit of the University of Montenegro. It is situated in Podgorica.

The University of Montenegro is the only state university in the country, and the Faculty of Mechanical Engineering is the only faculty in Montenegro from the field of mechanical engineering.

Activities of the Faculty of Mechanical Engineering can be divided into three fields: teaching, scientific-research work and professional work.

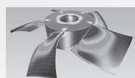
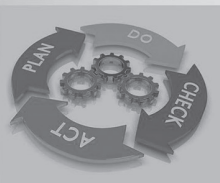
Two study programmes were accredited within the Faculty of Mechanical Engineering:

- Academic study programme MECHANICAL ENGINEERING
- Academic study programme ROAD TRAFFIC

The study programmes are realised according to the Bologna system of studies in accordance to the formula 3+2+3.

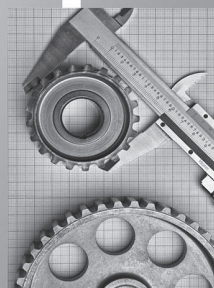
On the study program Mechanical Engineering it is possible to study next modules:

- Mechanical Engineering – Production
- Applied Mechanics and Construction
- Energetics
- Energy Efficiency
- Mechatronics
- Quality



At the Faculty of Mechanical Engineering, as organisational units, there are centres and laboratories through which scientific-re- search and professional work is done:

- Centre for Energetics
- Centre for Vehicles
- Centre for Quality
- Centre for Construction Mechanics
- Centre for Traffic and Mechanical Engineering Expertise
- Centre for transport machines and metal constructions
- 3D Centre
- Didactic Centre – Centre for Automation and Mechanomics training
- European Information and Innovation Centre
- Cooperation Training Centre
- Laboratory for Metal Testing
- Laboratory for Turbulent Flow Studies
- Laboratory for Vehicle Testing
- Laboratory for Attesting of Devices on the Technical Examination Line



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USEFUL CONTACTS

Editorial enquiries and journal proposals:

Dusko Bjelica
Stevo Popovic
Editors-in-Chief
Email: office@mjssm.me

Selcuk Akpinar
Executive Editor
Email: office@mjssm.me

Marketing enquiries:

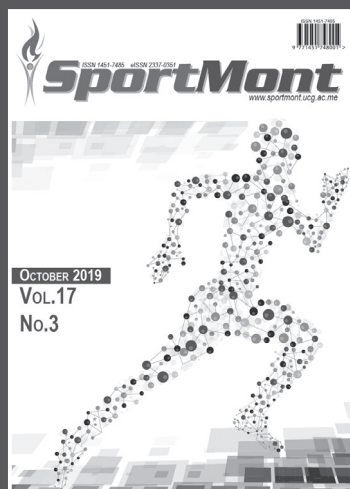
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2th - 5th April 2020,
Dubrovnik - Croatia