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The effect of the exercises brain on boxers’ eye-hand coordination, dynamic balance and visual attention performance

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Keywords: cognitive exercise, dynamic balance, visual attention, hand-eye coordination.

Abstract

Purpose: The purpose of this study is to investigate whether exercising brain performed by boxers have any kind of effect on visual attention, eye-hand coordination and dynamic balance performances of athletes.

Material: In accordance with the purpose of this study, 29 athletes who do exercises regularly at Sakarya Boxing Club have been divided into two groups as control and experiment group. The Star Excursion Balance test was used to measure participants’ dynamic balance performance, the Bourdon-Wiersma Stipple test was used to measure visual attention, and Alternate Hand Wall Toss test was used to measure eye-hand coordination as pre and post-test. Repeated Measures Anova analysis was used for analysis of the obtained data.

Results: In terms of the obtained data, it has been observed that between pre and pro tests a significant development pattern shows itself for whole study group. On the other hand, as for the investigation of the pre and post-test interactions of experiment and control group, When pre and post-test interactions of experimental and control groups were examined, there was no significant difference in visual attention and dynamic balance development, but in eye-hand coordination test, improvement in experimental group was found to be higher than in control group.

Conclusions: The findings of the study in which exercising brain applied to boxers for 8 weeks showed that there was no significant difference between dynamic balance and visual attention development values, but there was a significant difference between control experimental groups, eye-hand coordination development values.

Introduction

Today’s sport has started to be perceived and practiced very differently than in the recent past. Sportive activities that are increasingly different have been done for different purposes [1]. One of the sportive activities that differentiate is brain exercises. Life kitetic found and developed by Horst Lutz et al. is a brain training system that is practiced using exercises combined with visual, mental and cognitive tasks. These exercises have such physical and cognitive positive effects as concentration, problem solving skills, reflexes, balance, coordination and coping with stress in elite athletes and sedentary people [2]. Visual attention, eye-hand coordination and balance have been included in the literature from past to present in terms of general knowledge, especially in research articles and the effect of various exercises on these characteristics have been investigated [3,4,5]. However, whether brain exercise has an impact on these physical and cognitive features is a problem that needs to be investigated.

Attention is considered to be the subjective awareness of the world around us at first, while attention is considered as a neural system in which visual, auditory, and motor systems are used for the selection of similar information by the neuropsychological approach [6]. Visual attention refers to a series of cognitive processes that allow the necessary information to be found from scattered (complex) visual scenes, and the unnecessary information to be filtered out [7]. In the literature, there are studies examining the cognitive features such as visual attention and the effects of exercises on cognitive performance to improve the performance of these features. In the present study, the effects of acute exercise on cognitive performance were investigated and specific exercises were reported to have a greater effect than those of acute exercise [8]. When we look at the specific exercise studies on visual attention, it is concluded that visual attention can be improved and trained by specific web based training [9].

Hand-eye coordination is a visual system capability that coordinates the revised information to control hands, directing and managing tasks such as writing or capturing a ball successfully [10].

When the researches carried out are examined, it is concluded that acute and specific exercises have positive effects on hand-eye coordination. In the related study on the effects of hand-eye coordination on balance and hand-eye coordination in the elderly, swimming exercises was proven to have positive effects on hand-eye coordination [11]. In another study on hand-eye coordination training of table tennis athletes, it is reported that the table tennis athletes trained on hand-eye coordination performed better than those who were not trained [12]. In this study, we investigated the effects of hand-eye coordination on the effects of Traditional Chinese coordination exercises, TaiChiChuan (TCC), on hand-eye coordination in the elderly and it is reported that those who applied hand-eye coordination exercises exhibited better hand-eye coordination performance than those who did not [13].

Balance is defined as the state or ability to maintain control over the body’s support centre. The most important feedback mechanisms in balance are vestibular, somatosensory and visual systems [6,14]. In this study, we will discuss the relationship between the equilibrium (balance) and the relationship between the two variables [15, 16]. When we examine the effects of various exercise programs on balance development, it is seen that exercise
programs have positive effects on balance development. The effects of pliometrics, dynamic stabilization and balance training for 7 weeks on the strength, balance and fall forces of female athletes were examined and it is reported that these exercises have a positive effect on balance [17]. Similar results were obtained in the study of different exercise methods on the follow-up of balance development. Especially in athletes, it is reported that neuromuscular training or specific exercises such as yoga for 6 to 8 weeks has a positive effect on the development of balance [18, 19, 20].

Brain exercises were developed by Lutz and his colleagues as a multimodal training method that combines coordinated, cognitive and visual tasks and performs the physical activities of the participants and also cognitive activities. This training method consists of combinations of motor activities, cognitive skills, visual perception training and especially perception of peripheral vision. The main characteristic of this training method is to move the limbs in different combinations, capture, throw, and thus to train visual perception and limb-eye coordination [21].

The effects of acute and specific exercises on cognitive and motor features, especially visual attention, hand-eye coordination and balance were investigated in the investigated studies. However, there was no study that examined the effects of brain exercise on these three abilities as a whole. Therefore, this research will help us to understand whether the brain exercises that are increasingly being applied by athletes and sedentary people have effects on visual attention, hand-eye coordination and balance ability. When we consider the concept above, it may be stated that the aim of this study is to investigate whether brain exercises in boxers for 8 weeks have effects on athletes’ visual attention, hand-eye coordination and balance performances.

**Material and Methods**

**Participants**

29 athletes who were trained regularly in Sakarya Boxing Club participated voluntarily in this study using experimental pattern with control group. The participants were randomly divided into two groups. While 15 of them were in the experimental group, 14 of them were included in the control group.

Physical characteristics of the participants; age is 20.4± 0.8 years, body weight is 74 ± 9.4 kg and height is 176 ± 8.1 cm.

**Data Collection Tools**

The body weights of the athletes were measured with Seca 808 (Germany) brand electronic scales with 0.1kg sensitivity and height measurements with portable stadiometer with Seca 213 (Germany) brand with 1mm sensitivity. In the application of the Visual attention test, the Bourdon attention test was used for marking papers belonging to the Wiersma form with 450 figures on it. The Dunlop brand tennis ball and the Casio HS-80TW-DF brand chronometer were used in the application of the Alternate Wall Hand Toss for hand-eye coordination. In the implementation of the Star Excursion dynamic balance test, the platform prepared in accordance with the test protocol was prepared and Troy 23124 brand strip meters were used to measure the reach distances of the participants.

**Collection of Data**

Anthropometric measurements, balance and hand-eye coordination tests were carried out in Sakarya University Faculty of Sports Sciences gymnasium saloon and visual attention test was carried out in the class which was arranged for testing. The anthropometric measurements, balance and attention tests of the control and experiment groups were carried out on the same day and hand-eye coordination was carried out on the same day. Following the pre-test, brain exercises were performed for 8 weeks and 3 days a week in addition to the branch training of experimental group. The control group was not included in the brain exercise and they continued their own branch training with the experimental group. At the end of 8 weeks, the participants underwent the final tests within the framework of the selected tests protocols.

**Determination of dynamic balance performance**

The Star Excursion Balance Test (SEBT) was used to determine the dynamic balance and dynamic postural control performances of the participants. SEBT is a balance test that requires force, flexibility, and proprioception performance used in dynamic balance measurement [22]. The person who performs the test tries to reach out in 8 different directions with one leg and 45 degrees of angle between them, while the other leg remains in the centre point and tries to maintain its stability [23].

The validity of the SEBT test was reported between 0.89 and 0.92 [24]. After warming the participants for general and test, they reached 8 different directions on the test platform three times, respectively, and recorded in meters and centimeters, which are best from 3 accesses. The same practice was carried out for the other foot. In order to ensure the validity of the test, leg-length measurements were taken for each of the participants. The measurement was repeated when participants moved the balance leg from the platform centre, lost balance or were unable to contact the stated directions.

**Measurement of visual attention performance**

In order to measure the visual attention performance of the participants, the Bourdon-Wiersma stipple test developed and then conducted by Benjamin Bourdon was used. In this test, participants are asked to find and select the necessary information from complex visual scenes in accordance with visual attention. The Bourdon-Wiersma test form contains three, four and five point shapes and the participants are requested to mark four point ones of these3 figures [25, 26] Participants were given 6 minutes to mark the correct shapes on the form with 450 figures and the correct and wrong shapes were recorded.

**Measurement of hand-eye coordination performance**

In order to determine the hand-eye coordination
performance of the participants, the Alternate Hand Wall Toss test was used. The number of successful catches carried out in the test aimed at capturing the tennis ball with the right hand and the left hand is recorded in the 30-minute period of time [27].

Data Analysis

SPSS 22 program was used in the analysis of the obtained data. ANOVA (Repeated measurements ANOVA) analysis was used to determine whether the change in the pre and final test measurements of the participants in the experiment and control group was significantly different from the groups. P<0.05 was considered as significant.

Results

There was a significant improvement in hand-eye coordination between the pre-test and the final test in the whole research group \([F(1.27)=70.493; \ p<0.05]\). When the experimental-control group’s pre-test-final test interactions were examined, it is seen that the development of the experimental group was significantly higher than the control group \([F(1.27)=8.439; \ p<0.05]\).

There is a significant improvement in the attention skill among the pre-test and final test in the whole Research Group \([F(1.27)=6.495; \ p<0.05]\). When the pre-post test interactions of the experiment-control group are examined, it was seen that the experiment-control group showed a development at a similar level and the development of attention level was not statistically different in terms of the experiment-control group \([F(1.27)=.014; \ p>0.05]\).

There is a significant improvement in the balance skill between pre-test and final test in the whole research group.

Table 1. Comparison of Hand-Eye Coordination of Pre and Post Test Results of Boxers

<table>
<thead>
<tr>
<th>Tests</th>
<th>Groups</th>
<th>N</th>
<th>X</th>
<th>Ss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>Experiment</td>
<td>15</td>
<td>20.73</td>
<td>4.74</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>14</td>
<td>18.71</td>
<td>5.75</td>
</tr>
<tr>
<td>Post-test</td>
<td>Experiment</td>
<td>15</td>
<td>26.47</td>
<td>5.12</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>14</td>
<td>21.50</td>
<td>5.20</td>
</tr>
</tbody>
</table>

Table 2. Comparison of Visual Attention of Pre and Post Test Results of Boxers

<table>
<thead>
<tr>
<th>Tests</th>
<th>Groups</th>
<th>N</th>
<th>X</th>
<th>Ss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>Experiment</td>
<td>15</td>
<td>72.87</td>
<td>11.13</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>14</td>
<td>66.50</td>
<td>8.76</td>
</tr>
<tr>
<td></td>
<td>Experiment</td>
<td>15</td>
<td>78.13</td>
<td>9.14</td>
</tr>
<tr>
<td>Post-test</td>
<td>Control</td>
<td>14</td>
<td>72.29</td>
<td>12.88</td>
</tr>
</tbody>
</table>
[F(1.27)=6.104; p<0.05]. Experimental-control group’s pre-and final-test interactions examined have shown similar levels of improvement in the experimental and control groups and it is concluded that the experimental and control groups are statistically significantly different at the level of the balance of the development [F(1.27)=.292; p>0.05].

Discussion
Boxing is a combination of technical, tactical, durability, speed and coordination features. In addition to the basic characteristics of the fist, others are also part of the ring. Success will be achieved with the completion of these features and the proliferation of scientific research, development of general training programs, physical characteristics and the selection of talented athletes will be possible by teaching of technical and tactical studies through different methods.

One of the most important findings of this study is that the effects of brain exercise on the various coordinative and cognitive characteristics of athletes; hand-eye coordination repeated measurements on the preliminary and final test results were found to be significantly higher in the ANOVA analysis than in the experimental group [F(1,27)=8,439; p<0.05]. The most obvious characteristics of brain exercises are moving the limbs in different combinations, capturing, throwing objects, and thus training visual perception and limb-eye coordination [21]. Therefore, visual skill training is practiced intensively in brain exercises. When the literature is examined, it has been observed that all exercises including brain exercises and similar visual training have positive effects on hand-eye coordination and this finding supports the results in our study. When we look at studies involving visual training like brain exercise, it is seen that Du Toit and others (2011) reported that visual training made significant progress in hand-eye coordination of university students. In another study, “Eyerobic” (visual skill training) exercises were applied to female footballers and at the end of the exercise period, balance and hand-eye coordination values were reported to be higher than control group [28].

Table 3. Comparison of the Dynamic Balance of Pre and Post Test Results of Boxers

<table>
<thead>
<tr>
<th>Tests</th>
<th>Groups</th>
<th>N</th>
<th>X</th>
<th>Ss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>Experiment</td>
<td>15</td>
<td>86.01</td>
<td>7.906</td>
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<td></td>
<td>Control</td>
<td>14</td>
<td>90.16</td>
<td>4.304</td>
</tr>
<tr>
<td>Post-test</td>
<td>Experiment</td>
<td>15</td>
<td>87.92</td>
<td>8.992</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>14</td>
<td>91.39</td>
<td>5.065</td>
</tr>
</tbody>
</table>

It is known that balance skill, which is the basis of performance, plays an important role in the successful display of many sports skills, in changing directions, in stopping, in starting, keeping the object, in moving the object, and in maintaining the body’s specific position.

According to Meinel and Schnabel, balance ability is defined as keeping the whole body in balance and maintaining the state of the body during and after displacement of the body [29]. Human’s ability to maintain balance can be defined as a determining factor in the development of other motor systems [30]. The control of balance is a complex motor capability that includes the integration of sensory inputs as well as the planning and application of flexible motion patterns [31]. The ability of the whole body to move in coordination as a whole takes place in a correct proportion with the ability to balance [32].

In this study, based on the results of the measurements on dynamic balance, the development differences in balance level are not statistically significant in terms of experiment and control group [F(1,27)=.292; p>0.05]. In a study conducted on basketball players, it was reported that brain exercise training for 12 weeks at basketball players had no effect on balance scores of the athletes [33]. Similarly, at the study conducted on young football players, it was reported that there was no significant difference between the pre-test and final test scores of the participants in the brain exercise training for 8 weeks [34]. The researches examining the effects of brain exercise on balance support the findings of this study.

In this study, the measurements of visual attention were examined and it was concluded that the development of the control and experiment group showed similar development but the visual attention level was not significantly different from the experimental and control group [F(1,27)=0.14; p>0.05]. The resources that scientists who develop and practice brain exercises refer to as a reference to prove the effects of these exercises on important cognitive skills and visual attention are generally about young children or students who have difficulty reading [34]. There are studies in the literature that reported positive effects of specific exercises on
visual attention [8]. In addition to this study, there was only one study which examined the development of visual attention of athletes who train intensively in brain exercise and contrary to this research, positive results were reported. In this research conducted by Vural (2016), it was found that brain exercises had positive effects on the visual attention performances of athletes. Therefore, more research is needed to examine the impact of brain exercise on visual attention development, especially in trained and advanced athletes.

As a result, the results of this study showed that there was a significant difference in hand eye coordination development values between control and experimental groups of brain exercises performed in boxers for 8 weeks, while dynamic balance and visual attention did not differ significantly between development values. Since brain exercise exercises are based on simultaneous perception, evaluation, making the right choice and making the appropriate decision, we believe that coaches should be involved in brain exercise exercises in athletes’ training and that the criteria for athletes’ performance will contribute significantly to the field of sports sciences as they have a significant place in determining the current levels of athletes.

Conclusions
We also think that brain exercise will help athletes make the right decisions in training or competition by enabling them to think continuously. It is thought that after the exercises that are performed in this way, the athlete will soon be able to demonstrate the dominance of the more advanced coordinative features and will become a well-featured athlete who understands fast and makes decisions quickly by reflecting them to his team or to himself. Because of such many benefits, we think that sports scientists and coaches will benefit from brain exercises and it will be important to include brain exercises in training plans.

Conflict of interests
The authors state that there is no conflict of interest.
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Influence of music on the level of physical fitness of the students practicing rugby (rugby players students)

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Authors’ Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: to develop a training technology with the application of music at rugby training of 16-17-year-olds players.

Material: Rugby players (n=20) from sports club “KhTZ” (16-17-year-olds) participated in a research. Athletes were divided into two groups: the control group (n=10), the experimental group (n=10). The experimental group trained with music. The groups were tested on the level of physical fitness at the beginning and at the end of the experiment. The following tests were applied: 30 m run, 400 m run, barbell press in a prone position (maximum value), 3 km run.

Results: It is defined the influence of music on physical fitness indicators of athletes. It is revealed a confident increase in indicators of the general endurance (3 km run) and special endurance (400 m run) in students of the experimental group. The students of the control group had a confident increase in result in 400 m but in smaller significance value.

Conclusions: The received data confirm the expediency of music application in young athletes’ training for the development of the general and special endurance.

Keywords: rugby, music, endurance, strength, fitness.

Introduction

The kinds of sport demanding the high level of physical fitness development, athletics, mental strength become more popular nowadays among students of colleges. One of such kind of sport is the rugby [1, 2]. The influence of this game on athletes’ organism is behind of emergence and development of this sport [3, 4]. Collins T. highlighted this [1]. The popularity of rugby among young people is also demonstrated by the emergence of virtual rugby games. Cummins A. and Craig C. highlighted this [5].

However, the training process of rugby is rather hard. It is connected with injury risk, and risk of overtraining [6, 7]. The rugby demands on endurance, strength, speed, mental endurance etc [8]. Rugby is also a combative sport which demands the development of a musculoskeletal system [8]. Brown J.C. et al. [9] highlight the necessity of injury prevention in rugby. It is connected with the expensive treatment of athletes, injured in rugby. The improvement of the training process and the search for ways to increase the training efficiency are necessary. Prophylaxis of injury is connected with the improvement of the mechanism of motor action management by a nervous system. Therefore it is possible to presuppose that introduction of levers on the central nervous system into training process will promote the increase in efficiency of the training process. One of the injury prevention means is the increase in the level of physical fitness of players. Other injury prevention means is the creation of a positive emotional background of training. Creation of a positive background of training increases adaptive capabilities of rugby veterans [10]. Thus, the positive emotional background will promote the increase in efficiency of the training process of young rugby players.

The music is one of means of the positive background creation in training. It was conducted the range of research concerning the influence of music and sport on the person organism. So, Cabane C. et al. [11] revealed that children during music or sports classes demonstrate higher results in the study. However Cizek E. et al. [12] highlight that music classes demand certain power consumption. Application of music as the mean of increase in the level of physical activity and working capacity was confirmed at the physiological level by Clark I.N. et al. [13]. Authors determined that music can promote diligent participation in the study process. Authors drew a conclusion concerning the efficiency of music application in the programs directed to the increase of level of physical activity of humans. Therefore it is possible to presuppose that it is possible to increase fitness with music application in special physical training. The part of a brain (nucleus accumbens) [13] which produces dopamine is activated during listening music: this hormone is influenced by the mood [13, 14]. The pleasure of listening music is rather a
difficult phenomenon. Applied music helps the person “to be synchronized” with society and improves collaboration [14].

The research demonstrates that music influences positively on the performance of boring and monotonous tasks. However, music can disturb when studying something new [14, 15].

In the researches of Korobeynikov G.V. et al. [16, 17] was determined the high influence of psychophysiological functions on the efficiency of the training process of athletes. In our research, the role of psychophysiological factors in different kinds of the sport was also confirmed [18-20]. This is also relevant for aesthetic sports [18, 21]. It also defines the unity of music and sport as the demonstration of psychophysiological functions [22, 23]. It will promote the increase in efficiency of training process [24-26]. This is relevant for athletic sports (rugby, etc.) [27-29]. The particularly important values in training of young athletes have pedagogical control of the level of physical activities [30-32]; optimization of physical activities [33-35].

The hypothesis of a research consisted in revealing the influence of music on the efficiency of training process (increase in the level of physical fitness of rugby players in 16-17-year-olds).

The purpose of the research is to develop a training technology with the application of music at rugby training of 16-17-year-olds players.

Material and methods.
Participants. Rugby players (n=20) from sports club “KhTZ” (16-17-year-olds) participated in a research. Athletes were divided into two groups: control group (n=10), experimental group (n=10). The experiment was conducted from September 25, 2017, to February 22, 2017, in the preparatory period at the stage of specialized basic training. At the beginning and at the end of the experiment, the groups were tested on the level of physical fitness. Results of the first testing demonstrated the identity of groups according to the level of physical fitness (p>0,05) (tab. 1). Players were tested in the following tests [25, 26]: 30 m run; 400 m run; barbell press in a prone position (maximum value); 3 km run.

Organization of research. The experimental group trained with music (each athlete used personal earphones). The following exercises were performed to the music: warm-up in the movement, cross run, hit the ball, ball catching, and play with the sports implements. Group exercises were performed without earphones. Music was applied for all athletes. The portable acoustic speaker was applied for this purpose. During performing group exercises the experimental group was separated from the control group. The athletes listened to one track in earphones before the beginning of the game and at the end of training.

The music of the following styles was applied in the experiment: post-grunge, alternative rock, alternative metal, hard rock, and nu-metal. All these styles are characterized by the existence of music bridges in the general background of bass tones; a variety of the guitar sound; non-standard sound changes.

Statistical analysis. Digital material was processed by means of traditional methods of mathematical statistics. It was determined the arithmetic mean of X, average quadratic deviation of S (standard deviation), a standard mistake (m), assessment of the reliability of differences between parameters of initial and final results. Student t-test was applied with the appropriate level of the significance (p).

The correlation analysis of indicators was carried out when processing primary materials of this research. Data processing was carried out by means of Microsoft Excel, SPSS. Distinctions considered confident at significance value of p <0,05.

Results.
The theoretical justification of the choice of music.
The rock was chosen as the musical style. The nature

<table>
<thead>
<tr>
<th>Test</th>
<th>Group</th>
<th>Statistical indicators</th>
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<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>30 m run, sec</td>
<td>E</td>
<td>4,37</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>4,38</td>
</tr>
<tr>
<td>400 m run, sec</td>
<td>E</td>
<td>1,06</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>1,08</td>
</tr>
<tr>
<td>Barbell press in a prone position,</td>
<td>E</td>
<td>93,00</td>
</tr>
<tr>
<td>maximum value, kg</td>
<td>C</td>
<td>88,00</td>
</tr>
<tr>
<td>3 km run, min</td>
<td>E</td>
<td>11,53</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>11,77</td>
</tr>
</tbody>
</table>

Note: E – experimental group; C – control group
of rock music reflects the condition of mentality when the person overcomes something. Therefore the rock music is applied in gyms. It is known that rugby is physically difficult sport [27, 28]. The rugby demands development of all types of endurance: strong, anaerobic and glycolytic, general, etc. It is possible to presuppose that rock music in training will help athletes to overcome negative feelings. These feelings are connected with the necessity to suffer from high physical loads. Therefore, we decided to apply rock music style in the experimental group of 16-17-year-olds rugby players.

Experimental justification of music application in training process of rugby players.

Creation of educational and training process in rugby with the application of music in training made a positive influence on the level of the general and special physical fitness of players. The analysis of data demonstrates the significant increase in indicators of special and general endurance in athletes of the experimental group (fig. 1, 2, tab. 1-3). The players of the control group have less expressed change of this indicator. The control and the experimental groups had confident differences in the tests “400 m run”, “3 km run” and “barbell press in a prone position” (fig. 1. 2, tab. 4) (p <0,001, p <0,01) after carrying out the experiment.

It was revealed the significant increase of indicators of the general endurance (3 km run) and special endurance (400 m run) in students of the experimental group. The students of the control group had a confident increase in result in 400 m but in smaller significance value.

Discussion.

The research suggested the hypothesis that application of music in training of young rugby players 16-17-year-olds will promote the efficiency of training process (the level of physical fitness increases). In the research was offered application of music in training (rock style) for improvement of the quality of educational and training process. At the beginning of the research was presupposed that music in training will influence positively on the efficiency of the training process of young rugby players 16-17 year olds. The rugby demands development of all types of endurance (strong, anaerobic and glycolytic, general, etc.) [27, 28, 36]. We presupposed that rock music in training will help athletes to overcome negative feelings. It is connected with the need to suffer high physical loads. The age of athletes is 16-17-year-olds and they are in the condition of the fight (internal and external).

The research revealed the significant increase in indicators of the general and special endurance in students of the experimental group. It was determined the significant differences in groups in the tests of general and special endurance and the maximum strength. Thus, the suggested hypothesis was confirmed.

We explain the efficiency of music with the use of means activating limbic system [37, 38]. Such means is music. In this case, the organism works more economically due to additional release of endorphins. It promotes concentration on overcoming difficulties and performance of hard work. It helps the athlete to perform work more intensively. The athlete also recovers faster after loads.

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**Fig. 1.** Results of the test “400 m run” by athletes of the experimental and the control groups before and after the experiment:

1 – before the experiment, 2 – after the experiment;

- the experimental group;
- the control group

*** - differences are statistically significant at p<0,001
The application of music gives more pleasure to athletes than «routine» training. Therefore such training is more effective. Generally, music affected the physical fitness of athletes. Listening to the music during performing exercises athletes could carry out exercises longer. For example: in the run, the signal of fatigue was partially blocked by music. The athlete could run quicker the larger distance. Athletes performed the locks of the rival more rigidly: they overcame our fear. During the performance of physical exercises with music, athletes could do in 2-3 times more repetitions with a larger weight. Examinees also noticed that it is much better to perform physical training with music.

The person achieves good results when is training with pleasure and concentrates on overcoming difficulties when performing hard work. Training process in rugby on the development of special endurance is hard work. Therefore the effect of music application was rather essential.

In the test 30 m run wasn’t observed the significant changes. Therefore it is possible to draw a conclusion that application of music influences on the development of the general and special endurance and on the indicators of the maximum strength of rugby players. The music application didn’t exert significant influence on the development of high-speed abilities. It can be explained...
The emergence of changes in a nervous system provoked by music requires the certain time. The exercises on the development of high-speed qualities last rather small periods. Therefore the development of high-speed qualities is less sensitive to musical influence in comparison with endurance.

The proposed method of music application allows increasing the efficiency of training process on the development of the general and special endurance of rugby players of 16-17-year-olds. The analysis of the role of psychophysiological factors in the context of music influence on the efficiency of training process demands more detailed researches.

**Conclusions.**

1. It is developed the music technology in training of rugby players of 16-17-year-olds and its introduction in the study and training process.
2. It is defined the influence of music on the indicators of special physical fitness of rugby players of 16-17-year-olds.
3. The received data confirm the expediency of music application in training of young rugby players for development of the general and special endurance.

**Financing**

The research is conducted according to:

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- the research work of Ministry of Education and Science of Ukraine for 2015-2016. «Theoretical and methodical bases of means application the information, pedagogical, medical-biological orientation for motor and spiritual development and formation of healthy lifestyle» (№ of the state registration 0115U004036).
- the research work of Ministry of Education and

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**Table 3.** The indicators of physical fitness of young rugby players of the control group before and after the experiment (n = 10)

<table>
<thead>
<tr>
<th>Test</th>
<th>Group</th>
<th>Statistical indicators</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>( \bar{x} )</td>
</tr>
<tr>
<td>30 m run, sec</td>
<td>CB</td>
<td>4,38</td>
</tr>
<tr>
<td></td>
<td>CA</td>
<td>4,35</td>
</tr>
<tr>
<td>400 m run, sec</td>
<td>CB</td>
<td>1,08</td>
</tr>
<tr>
<td></td>
<td>CA</td>
<td>1,06</td>
</tr>
<tr>
<td>Barbell press in a prone position, maximum value, kg</td>
<td>CB</td>
<td>88,00</td>
</tr>
<tr>
<td></td>
<td>CA</td>
<td>92,00</td>
</tr>
<tr>
<td>3 km run, min</td>
<td>CB</td>
<td>11,77</td>
</tr>
<tr>
<td></td>
<td>CA</td>
<td>11,74</td>
</tr>
</tbody>
</table>

Note: CB – the control group before the experiment; CA – the control group after the experiment.

**Table 4.** The indicators of physical fitness of young rugby players of the experimental (n = 10) and the control (n = 10) groups after carrying out the experiment

<table>
<thead>
<tr>
<th>Test</th>
<th>Group</th>
<th>Statistical indicators</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>( \bar{x} )</td>
</tr>
<tr>
<td>30 m run, sec</td>
<td>E</td>
<td>4,28</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>4,35</td>
</tr>
<tr>
<td>400 m run, sec</td>
<td>E</td>
<td>1,02</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>1,06</td>
</tr>
<tr>
<td>Barbell press in a prone position, maximum value, kg</td>
<td>E</td>
<td>99,50</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>92,00</td>
</tr>
<tr>
<td>3 km run, min</td>
<td>E</td>
<td>11,34</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>11,74</td>
</tr>
</tbody>
</table>

Note: E – the experimental group; C – the control group
Science of Ukraine for 2017-2018. «Theoretical and methodical bases of application of information, medical-biological and pedagogical technologies for realization of individual physical, intellectual and spiritual potential and formation of healthy lifestyle» (№ of the state registration 0117U000650).

Conflicts of interest
The authors declare that there is no conflict of interests.

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The influence of cheerleading exercises on the demonstration of strength and endurance of 15-17-year-olds girls

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Abstract

Purpose: to define dynamics of indicators of endurance and strength development of 15-17-year-olds girl-students after application of cheerleading exercises.

Material: The study involved students of I-III courses of a nonsports profile (n=385, age – 15-17 years). The level of strength and endurance development was determined by tests. In the educational process of the student of experimental groups was introduced cheerleading (basic motor actions by hands and legs, jump elements, stunt, dancing combinations). Duration of a class was 1 hour 30 minutes.

Results: it is determined positive dynamics of development of indicators of strength and endurance after application of exercises of cheerleading. The most significant growth was observed in indicators of muscle strength of hands. The most significant growth in results of the level of strength development was observed in girls aged 15 years. Priority for students of 15-17-year-olds is a complex development of physical qualities.

Conclusions: application in the educational process of elements of cheerleading influenced positively on the level of strength and endurance development of girls of 15-17-year-olds. The most significant growth of indicators of strength was determined in 15-year-old girl students, indicators of endurance were determined in 16-year-old girl students.

Keywords: physical qualities, students, physical training, cheerleading elements.

Introduction

Modern conditions of life set high requirements to the health condition, vitality and activity of the population, a different age. However, there is a tendency to decline the indicators of health and decrease in the level of motor fitness of the young population of Ukraine. It is determined «low» level of physical development of students [1, 2]; «average» level of functioning of the cardiovascular system of primary and elementary school children [3, 4]; «average» and «below average» of 7-8 forms school children [5]. It is determined that the third part of high school children (35–38%) have a deviation in health condition [6].

The negative tendency concerning the development of motor qualities is proved by the researches of the level of physical fitness of 17-19-year-olds girl students [7, 8]. It is determined that 35,4% of students have the average level of physical fitness, 28,4% – below the average, 8,6% – low, 22,9% – above the average, 4,7% – the high level. It is determined that pupils of 5-6 forms under the influence of cheerleading exercises demonstrated «below the average» level of endurance development and «average» level of strength development [9]. It is observed the significant decrease in the level of development of the main physical qualities in comparison with the previous generation of motor actions abilities of high school pupils [10].

The important place among physical qualities is taken by strength and endurance that reflect important indicators of the functional condition of the locomotor system of the person. The analysis of scientific data demonstrates that priority means in health improvement of youth and increase the level of physical fitness is the performance of physical exercises and optimum physical activity. Actually, physical health of students is an integrated indicator of their vitality [11, 12]. It includes physical development, physical fitness, physical condition. It is the content of physical culture which is an integral part of the general culture of society. In other research [13] the attention is focused on the fact that physical exercises provoke corporal joy, satisfaction, and pleasure. According to the other data [14], physical training can realistically, reasonably and safely promote a solution to the overweight problem and obesity in children. At the same time, it is desirable to attract all children to physical activity both within physical training classes, and after it. The east practices [15] also promote positive dynamics of indicators in exchange processes (that is the maximum consumption of oxygen, VO2max) and arterial blood pressure of students.

It is known that modern students aren’t satisfied by the traditional approach to after physical training studies [16, 17]. They are interested in innovative means, approaches, and forms of physical activity classes. Therefore there is a sense in the optimization of physical training process [18].

It was found out a significant amount of the researches devoted to search and introduction into physical training process the various traditional and nonconventional means, forms and approaches. All of them are directed to increase the level of functional and motor action readiness of the different age contingent. Other authors [19] suggest to include sports games into the classes content of secondary school. This type of motor action activity influences on the functional and motor action readiness
of pupils identical with others games-based sport. The effective means of flexibility and coordination abilities development of students are east practices [20]. The application of power exercises in the physical training process influences positively on the level of physical fitness and functionality of students [21, 22]. It is also determined that introduction of aerobics into the teaching and educational process of physical training influenced positively on the development of physical qualities [23, 24].

At the same time, several types of research were directed into the study of teachers’ activity in the application of innovative approaches into the educational institutions. It was determined the insufficient level of their introduction into the educational process in the research of innovative forms and methods of study [25]. The significant quantity of teachers (62%) introduces the differentiated study, fitness, aerobics, Internet technologies and intersubject communications into the educational process [26]. However, in all variety of pedagogical innovations, this process was found out the insufficient readiness of teachers to this activity. Therefore it is necessary to hold special scientifically-based events devoted to the continuous professional development of physical culture teachers [27, 28]. It will expand their opportunities concerning the introduction of the innovative content.

It is defined that 15-17-year-olds students have inclinations to the new non-conventional types of motor action activity [16, 17]. The cheerleading contains the wide range of various intensive motor actions which include elements of choreography, acrobatics, gymnastics, sport and national dances [29-31]. It is differed by visual appeal, variable influence, dynamic, availability of the application. In other researches positive changes in indicators of physical development [1] and physical efficiency [32] of 15-17-year-olds students under the influence of cheerleading exercises.

The analysis of scientific and methodical literature revealed the existence of the insignificant quantity of the researches devoted to studying of cheerleading influence on the young organism. It was determined the positive influence of cheerleading on the development of motor memory and on coordinate motor actions of preschool age children [33, 34]. It was revealed that the cheerleading carries out the significant influence on the development of physical qualities of primary school age children [35]. It is proved the positive influence of cheerleading exercises on the level of strength and endurance development in secondary school pupils [9]. Introduction of a reasonable technique of occupations of a cheer dance on out-of-class occupations allows students to improve their physical condition [36]. It is observed in other researches [37, 38] that in cheerleading athletes have positive dynamics of indicators of the level of coordination development, high-speed and power and high-speed abilities, flexibility, and strength. The question of cheerleading influence on the physical qualities manifestation of 15-17-year-olds students is insufficiently studied.

The hypothesis of the research presupposed that the innovative component of the physical training content in the form of cheerleading exercises has to be reflected in the indicators of strength and endurance of the main muscle groups of 15-17-year-olds girls.

The purpose of the research is to define dynamics of strength and endurance indicators of 15-17-year-olds girl-students after application of cheerleading exercises.

**Material and methods**

*Participants*. The study involved students of I-III courses of a nonsports profile (n=385, age – 15-17 years). All participants signed the informed consent to participation in a research.

*Organization of a research.*

Researches were conducted at Teacher Training College of Kharkiv Humanitarian Pedagogical Institute. It was created 3 control and 3 experimental groups: I group – girl-students of the I course, II group – girl-students of the II course, III group – girl-students of the III course. All girl-students belong to the main and preparatory medical groups. During the experiment, the educational process of girl-students of control groups was based on the typical motor action activity for these educational institutions (track and field, volleyball, basketball). These classes included theoretical, technical and tactical training. The cheerleading was introduced into the educational process of girl-students of the experimental groups (basic motor actions by hands and legs, ump elements, stunt, dancing combinations). Duration of a class was 1 hour 30 minutes. The study was performed in several stages: 1st stage – study to the basic motor actions, 2nd stage – the study of basic jumps, 3rd – the study of stunt and pyramids, 4th – a combination of stunts of the studied elements. The study was based on the principle from simple to difficult.

The level of endurance development was defined according to the results of 2000 m run (sec). The level of strength development was determined by indicators of press up in lying position (quantity of times), torso rising from lying position into sitting one in 1 minute (quantity of times), advanced single leg jumps (m), hand dynamometry (kg) forward. The «3 advanced single leg jumps» test was performed in standing position. It consists in a continuous performance of 3 advanced single leg jumps. The distance which was overcome by the student in meters was a result. The received results were compared to a standard scale (tab. 1) [39] and were estimated by a certain number of points.

*Statistical analysis:*

Materials of the research were processed by Excel. It was calculated: arithmetic mean (m) for the characteristic of population by separate parameters; standard mistake of mean (m) - for definition of arithmetic mean deviation from the corresponding parameters of population; significance of differences (p) – with the purpose to determine the level of changes of average means of the studied parameters after the experiment by means of Student t-test (t) at the significance level p>0,05.
Results
The received data concerning strength development before experiment testify to absence of significant differences between data of students of the experimental and the control groups (р>0,05). The comparison of the received results with a standard scale [39] demonstrated that the strength development level of I-III courses students corresponding to the grade «sufficient» (tab. 2).

The data after the experiment (fig. 1) determined that all indicators of strength development level in girl-students of the experimental groups considerably and significantly improved (р<0,05 – 0,001). The most essential changes were in indicators of pressing ups in lying position. The most significant growth in results of strength development level is observed in 15 year-olds girls.

Indicators of girl-students of the control groups also improved a little, but less essential and non-significant (р>0,05). Comparison of the received data after the experiment with estimated standards demonstrated the increase in grade on one point in the following cases: by results of pressing ups in lying position in students of II group (from 2 points on 3 points); by results of torso rising from lying position into sitting one in students of III group (from 2 points on 3 points); by results of single leg jumps in I and II age groups (from 1 point on 2 points); by results of hand dynamometry in students of III groups (from 3 on 4 points). Other grades were left without changes in spite of considerable and significant

Table 1. Standardizing estimations

<table>
<thead>
<tr>
<th>Age, years</th>
<th>Estimation, points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Standardizing estimations of pressing ups in lying position (quantity of times)</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>19</td>
</tr>
<tr>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>17</td>
<td>22</td>
</tr>
</tbody>
</table>

Standardizing estimations of torso rising from lying position into sitting one (quantity of times)

| 15          | 43 | 38 | 33 | 29 | 24 |
| 16          | 44 | 39 | 35 | 30 | 25 |
| 17          | 45 | 40 | 35 | 31 | 26 |

Standardizing estimations of 3 advanced single leg jumps (m)

| 15          | 5,80 | 5,30 | 4,50 | 4,25 | 3,70 |
| 16          | 6,00 | 5,50 | 4,70 | 4,30 | 3,80 |
| 17          | 6,10 | 5,60 | 4,90 | 4,35 | 3,80 |

Standardizing estimations of 2000 m run (min, sec)

| 15-17       | 9.40 | 10.30 | 11.20 | 12.10 |

Standardizing estimations of hand dynamometry (kg)

| Sufficient | Satisfactory | Good | Excellent |
| 15          | 18 and less  | 19   | 24        | 29       |
| 16-17       | 24 and less  | 25   | 30        | 35       |

Table 2. Estimation of the strength development level of girl-students before the experiment

<table>
<thead>
<tr>
<th>Indicators</th>
<th>I group</th>
<th>II group</th>
<th>III group</th>
</tr>
</thead>
<tbody>
<tr>
<td>pressing ups in lying position (quantity of times)</td>
<td>«average»</td>
<td>«below average»</td>
<td>«low»</td>
</tr>
<tr>
<td>torso rising from lying position into sitting one (quantity of times)</td>
<td>«average»</td>
<td>«average»</td>
<td>«below average»</td>
</tr>
<tr>
<td>3 advanced single leg jumps (m)</td>
<td>«low»</td>
<td>«low»</td>
<td>«low»</td>
</tr>
<tr>
<td>hand dynamometry (kg)</td>
<td>«above average»</td>
<td>«average»</td>
<td>«average»</td>
</tr>
<tr>
<td>pressings ups in lying position (quantity of times)</td>
<td>«average»</td>
<td>«below average»</td>
<td>«low»</td>
</tr>
<tr>
<td>torso rising from lying position into sitting one (quantity of times)</td>
<td>«average»</td>
<td>«average»</td>
<td>«below average»</td>
</tr>
<tr>
<td>3 advanced single leg jumps (m)</td>
<td>«low»</td>
<td>«low»</td>
<td>«low»</td>
</tr>
<tr>
<td>hand dynamometry (kg)</td>
<td>«above average»</td>
<td>«average»</td>
<td>«average»</td>
</tr>
</tbody>
</table>
The similar comparison of results of girl-students of control groups wasn’t found out changes according to the presented rating scale. The exception indicators are hand dynamometry where grade in students of III groups increased from 3 on 4 points.

The analysis of primary results of endurance demonstration (2000 m run), testify to identity of the experimental and the control groups (p>0,05). The comparison of data with estimated criteria [39] demonstrated «low» level of endurance development in all groups (tab. 3).

The analysis of data after the experiment demonstrated that indicators of endurance development in girl-students considerably and significant improved (p<0,001). The most significant growth of indicators is observed in 16-year-old girls (fig. 2). The comparison of results with the standards [39], demonstrated changes according to the rating scale. Therefore the level of endurance development is «low».

The subordinate data of control groups determined that they improved a little. These changes in students of II and III groups are significant (p<0,05 – 0,01). Thus, girl-students of I group improved results in 22 seconds; II – in 42 seconds; III – in 46 seconds. It is also determined considerable and significant domination of results of girl-students of the experimental groups (p<0,001) (fig. 3). The comparison of subordinate indicators of the control groups with standards [39] didn’t demonstrate changes according to the presented rating scale.

**Discussion**

The result of generalization of the experimental data and the theoretical analysis we revealed the effective

### Table 3. Estimation of endurance development level in girl-students before the experiment

<table>
<thead>
<tr>
<th>Indicators</th>
<th>I group</th>
<th>II group</th>
<th>III group</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000 m run (sec)</td>
<td>«low»</td>
<td>«low»</td>
<td>«low»</td>
</tr>
<tr>
<td>Experimental group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td>«low»</td>
<td>«low»</td>
<td>«low»</td>
</tr>
</tbody>
</table>

![Fig. 1. Indicators of strength development level of girl-students of the experimental groups before and after the experiment: a – pressing ups in lying position (quantity of times); b – torso rising from lying position into sitting one (quantity of times); c – 3 single leg jumps (m); d – hand dynamometry (kg); CU – conventional units; B – before the experiment; A – after the experiment; 1, 2, 3 – numbers of groups.](image1.png)

![Fig. 2. Indicators of the endurance development level of girl-students of the experimental groups before and after the experiment. s – seconds; B – before the experiment; A – after the experiment; 1, 2, 3 – numbers of groups.](image2.png)
influence of cheerleading exercises on the separate studied indicators of students.

The introduction of cheerleading in process of physical training of 15-17 year-olds students supplements the existing data concerning the application of cheerleading in educational and training process of the young generation.

In earlier researches was defined the positive dynamics of indicators of strength and endurance development level in pupils of 5-6 forms under the influence of cheerleading exercises [9]. Authors determined that exercise of cheerleading had an essential influence on a growth of legs strength indicators. According to our researches, the growth in strength indicators of students was more essential. It is mostly observed in indicators of muscles hands strength. It is confirmed by other data [39-41]. Authors note that the age of 15-17 year is sensitive for development of strength and endurance. It is determined the progressive growth of noted indicators during this period.

Other authors confirm [37, 38] that cheerleading athletes have positive dynamics in indicators of the development level of coordination, high-speed abilities, flexibility, and strength. The technology of work with implement was improved. The optimum correlation of training means was experimentally determined. It allows considerably increase the level of special fitness and increase of technical skills of cheerleaders. It was also defined [36] positive influence on the physical development and motor action activity of students of the introduction of one of the cheerleading types – a cheer dance on extracurricular classes (sections). As distinguished from above-mentioned scientific works our researches are focused on the application of cheerleading in the educational process, not in sports training. Also, our researches are focused on the age of 15-17 year whereas above-mentioned works are focused on senior age group of students. It is an essential difference and significant supplement to the available researches in the field of professional cheerleading. Our received results testify to the efficiency of cheerleading application in training and educational process. In other researches [35] was defined a growth of integrated indicator of physical fitness of 1-4 forms pupils. It was in result of attended the extra sports section of cheerleading. The most significant growth of physical qualities is observed in indicators of flexibility, dexterity and strength of certain sets of muscles. However unlike these researches, we have also investigated strength of muscles of abdominal press and strength of hand. It gives the possibility to estimate more deeply the influence of cheerleading system exercises.

According to results of other research [33] the cheerleading influences positively on the development of motor action memory and on coordinate of motor actions of preschool age children. We agree with the fact that mentioned positive changes are important for preschool age children [34]. The priority for 15-17 year-olds students is a complex development of physical qualities.

Proceeding from the above the most significant growth of students’ physical qualities is under the influence of cheerleading exercises.

Our results supply data concerning the positive influence of cheerleading exercises on the development of motor action qualities [9]. It also expands the data concerning the influence of cheerleading on indicators of physical development and physical efficiency of college students [1, 32, 36]. We definitely revealed the most susceptible cheerleading exercises for development of strength abilities of college students. We found out the age periods of expedient application of cheerleading as to a development tool of strength and endurance. It is proved that the cheerleading can be applied as an alternative type of motor action activity for the development of strength and endurance of 15-17 year-olds students.

Conclusions

Application of cheerleading elements in the educational process influenced positively on the level of strength and endurance development of girl-students from Teacher Training College. Thus, it is revealed the significant increase in muscle strength of girdle of superior extremity, abdominal press, and legs after application of cheerleading. Above-mentioned changes testify the increase in the level of development of all forms of demonstration of strength abilities. It was defined the potential decrease of time for overcoming a distance which is stipulated the increase in intramuscular and intermuscular coordination, work productivity of cardiovascular and respiratory systems. It is also confirmed the development of general endurance.

Above-mentioned changes testify that the applied system of cheerleading exercises is effective means of the
increase in the level of physical qualities development.

Thus, our researches allow recommending to physical training teachers of colleges to complete the content of classes with cheerleading exercises.

Acknowledgements

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Conflicts of interest

The authors declare that there is no conflict of interests.

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Optimal distance of an external focus of attention in standing long jump performance of athletes

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Abstract

Purpose: Recently, studies have shown that an external focus of attention improves the performance of individuals. Some studies have also confirmed the superiority of distances away from body for external focus of attention. The aim of this study was to determine the optimal distance of an external focus of attention when performing athletes’ standing long jump.

Material: 51 volunteer students (M age = 23.31 ± 5.26 years) were selected as sample. At first all they performed a standing long jump in control status (without instruction for focus of attention). Then in an interpersonal counterbalanced design, a pair of jumps was performed with four different distances of an external focus of attention. These distances included 0.5, 2.5, 4 and 8 meters from the jump start line marked with colored tapes on the ground.

Results: The results showed that having an external focus of attention compare to the control conditions has a significant advantage in the performance of the athlete’s standing long jump. Also, the performance of athletes at different distances of an external focus of attention was compared. Results showed that the four-meter distance was significantly better performance than the half-meter distance of an external focus of attention.

Conclusions: Four-meter distance can be introduced as the optimal distance of an external focus of attention in the performance of athletes’ standing long jump.

Keywords: students, distance effect, jumping, concentration, environmental cues.

Introduction

The way of using attention is one of the variables affecting performance and learning of motor skills; in recent years, it has attracted the attention of many scholars. In fact, the empirical evidence suggests that the focus of attention during the performance of motor skills may affect the quality of performance [1]. The researchers and in particular, William James explain attention with some of its features such as concentration, focus, and consciousness [2]. Since humans can only process a limited amount of information at any given moment [3], the process of voluntarily paying attention to a specific area of stimuli is called focusing attention.

According to Nideffer’s theory (1976), the focusing of attention may take place in two scope (wide versus narrow) and direction (external versus internal) dimensions [4]. The internal focus strategies refer to situations in which one focuses on part of his/her body or movements during performance. On the other hand, the external attention strategies refer to situations in which one pays attention to effects and results of his/her movement at environment [5]. The difference between these attentive strategies is summarized in a few words; however, the different effects of these attention strategies on performance and motor learning are determined [1]. This effect has been shown to increase effectiveness (accuracy and distance) and efficiency (kinetic and kinematic indices) of movements by applying external attention strategies rather than internal attention strategies, regardless of skill level of performers [6]. Singer et al. (1993) showed that in order to achieve higher levels of self-efficiency and consequently, better performance, it is necessary to use the attention instructions which divert learner’s attention from physical movements. The focus of attention strategies of Singer et al. (1993) emphasizes the importance of avoiding attention from internal dimensions of movement [7]. On the other hand, the empirical research emphasizes on applying external attention strategies rather than internal attention strategies [1].

The benefits of external attention strategies are well described by limited performance hypothesis. Based on this hypothesis, the effort to consciously control the movement as internal focus strategies limits the motor system and prevents from automatic processes which control the movement. Conversely, moving away attention from movement and shifting it to motion effects (external attention strategies) allows the system to achieve self-organization through greater involvement in automated processing processes; this may result in improved performance and movement [8, 9]. The constraint-driven approach is another view which is provided about underlying mechanisms of external attention. According to this approach, the external focus of attention facilitates the fitting of environmental information, promotes the dynamic characteristics of self-organizing movement in motor system, and subsequently, improves motor performance. In other words, the focus on effects of moving in environment gives direction to search processes of performance factors and helps performer to search and discover specific environmental information which are needed to develop the pairing of perception and practice and self-organize task performance constraints [10]. The optimal motor learning theory of Wolf and Lewthwaite (2016) argues that the motivation and attention factors improve pairing of goals with practice and lead to improved performance and learning of movement. According to this theory, if external attention strategies are used, the motor and cognitive systems of performers may move in right direction and avoid from self-conflicts and unrelated attention focus conditions; this may finally
lead to stronger consolidation process and optimal learning [11].

Several studies have shown that the use of instructions which attract the attention of performer to out of his/ her body may improve motion skills learning and performance in comparison with instructions which draw attention of individual to body and its organs. Some tasks were jump height [12], dart throwing [13], goal directed ball throwing [14], hitting the golf ball [15], tennis [16] and throwing accuracy [17]. Depending on type of motor tasks and skill level of performers, the effects of factors will be different. All these categories of attention will be involved in both obvious and hidden control processes to lead to an optimal performance. In other words, different attention strategies may be effective in choosing different types of obvious or hidden control processes [18].

Although the strategy of focus of attention in performance of tasks such as standing long jump is confirmed to be external, the optimal distance of external focus of attention from body is the next question which needs to be investigated. Several studies have investigated the optimal distance of external focus of attention in two states: far from body and near the body. They often have concluded that the external focus of attention at far from body will lead to improved performance [19-21]. However, some studies have not seen significant differences between different distances of external focus of attention. For example, Westphal and Porter (2013) showed superiority of external focus of attention at 0.5 m distance of external focus of attention to control situation; however, they did not see any difference in three and five meters distances of external focus of attention [22]. Therefore, the skills that do not require movement precision and there is no specific goal for external attention, the attention focus of performer is still questioned. The introduction of optimal distance of external focus of attention may help to better perform the task.

Material and methods

Participants: Participants consisted of 51 male students (mean age= 23.31±5.26 years old, mean height= 181.47±19.17 cm, and mean weight= 71.73±10.6 kg) who voluntarily participated in study. They were considered athletes due to at least three years of regular exercise practice. Based on their self-reported forms, the participants did not suffer from any physical and motor limitation or injury and specific disease-causing effects on motor function.

Research Design: In this applied, semi-experimental, field study the participants were asked to warm up for 10 minutes before performing standing long jumps. Then, the correct way of standing long jump performance was reviewed and they were asked to jump twice to measure their jump distance; the best record was recorded as control jump (without focus of attention instruction). Placing one of marked signs on land as external attention focus at jump time, then, the participants performed two jumps at each distance; the longest distance at each external attention focus was recorded as record of that distance. The order of attention focus distances was determined in counterbalance design for each participant to control the effect of order on participants’ performance. At the time of changing the distance of external attention focus (after both jumps), one minute rest interval was considered. The external focus of attention sites which were marked with 40-cm long and 5-cm wide tapes on ground were at distance of 0.5, 2.5, 4, and 8 meters from jump start line.

Statistical Analysis: The collected data were analyzed using SPSS software, version 21. The mean and standard deviation were used to describe statistically the data. The Excel software was used to create charts. The Shapiro-Wilk test was used to examine data distribution normality and Levene’s test was used to study the homogeneity of variances. The inferential statistics included repeated measures and one-way analysis of variance. The significance level in all analyses was considered to be .05.

Results

The mean of participants’ standing long jump at different attention focuses is summarized in table 1.

The results of analysis of variance with repeated measures indicated that there was a significant difference between participants’ performance under different conditions of attention focus ($F_{(3,025, 151.27)} = 23.603$, $P=0.001$, $\eta^2 =0.321$). Bonferroni’s post-hoc test was used to determine the best distance of external attention focus in performing standing long jump; the results are summarized in table 2.

According to above table, the performance of athletes at all distances of external attention focuses is significantly better than control condition (without attention focus instructions). Also, the performance of athletes in distance of 4 m from external attention focus is significantly better than 0.5 m distance. Therefore, it can be said that the 4-meter distance of external attention focus is considered as an optimal distance for performance of standing long jump by athletes; this is displayed in figure 1.

<table>
<thead>
<tr>
<th>Distance of an External Focus of Attention</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Instruction (Control)</td>
<td>201.27</td>
<td>18.886</td>
</tr>
<tr>
<td>0.5 M</td>
<td>208.04</td>
<td>18.476</td>
</tr>
<tr>
<td>2.5 M</td>
<td>211.90</td>
<td>18.719</td>
</tr>
<tr>
<td>4 M</td>
<td>212.88</td>
<td>17.358</td>
</tr>
<tr>
<td>8 M</td>
<td>210.33</td>
<td>18.621</td>
</tr>
</tbody>
</table>
Discussion
The athletes’ performance at all distances of external attention focus was significantly better than control condition (without attention focus instructions). The athletes benefited from external attention focus (regardless of attention focus distance) and the lack of attention focus instructions did not weaken performance of athletes; this is consistent with findings of many studies [12, 20-28]. The restricted action hypothesis (Wulf et al.) attributes the supremacy of external focus of attention to diverting attention from motion and shifting it toward motion effects. It argues that this allows the system to involve more in automated processing processes through self-organization and this may improve motor function. The Vance et al.’s theory of efficient muscular activity (2004) studies the difference between various attention focuses at neuromuscular level and argues that the external attention increases recurrent motor units and effective coordination between muscles; thereby, it improves motor function. The findings of this study may be explained using this theory.

Also, the athletes’ performance at 4-meter distance from attention focus was significantly better than 0.5 meter distance. Therefore, it can be said that the distance of 4 meter from external focus of attention is an optimal distance for standing long jump performance. Few studies have suggested contradicted results. For example, Asadi et al. (2016) did not report difference in standing long jump performance under far and near external attention focuses [27]. Westphal and Porter (2013) did not report difference in standing long jump performance at three and five meters external attention focus distances [22]. However, Bell and Hardy (2009) regarding golf shot [29], Ahmadi and Borhani (2015) on jump service at volleyball [30], and Porter et al. (2013) regarding standing long jump [21] provided consistent results with findings of this study; they stated that the skilled athletes performed better at far external focus of attention than near external focus of attention. Although this study only defined two

<table>
<thead>
<tr>
<th>i</th>
<th>j</th>
<th>Mean Difference (i-j)</th>
<th>Standard Error</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 M</td>
<td>0.5 M</td>
<td>-9.059 *</td>
<td>1.163</td>
<td>0.001</td>
</tr>
<tr>
<td>2.5 M</td>
<td>0.5 M</td>
<td>-6.765 *</td>
<td>1.227</td>
<td>0.001</td>
</tr>
<tr>
<td>4 M</td>
<td>0.5 M</td>
<td>-11.608 *</td>
<td>1.612</td>
<td>0.001</td>
</tr>
<tr>
<td>8 M</td>
<td>2.5 M</td>
<td>3.863</td>
<td>1.342</td>
<td>0.059</td>
</tr>
<tr>
<td>4 M</td>
<td>2.5 M</td>
<td>-4.843 *</td>
<td>1.138</td>
<td>0.001</td>
</tr>
<tr>
<td>8 M</td>
<td>4 M</td>
<td>2.549</td>
<td>1.182</td>
<td>0.358</td>
</tr>
<tr>
<td>2.5 M</td>
<td>4 M</td>
<td>-0.980</td>
<td>1.365</td>
<td>1.000</td>
</tr>
<tr>
<td>8 M</td>
<td>8 M</td>
<td>1.569</td>
<td>1.305</td>
<td>1.000</td>
</tr>
<tr>
<td>4 M</td>
<td>8 M</td>
<td>2.549</td>
<td>1.182</td>
<td>0.358</td>
</tr>
</tbody>
</table>

NOTE. i & j are different distances. * Mean difference is significant at .01 levels

Figure 1: Participants’ performance at different conditions of attention focus

Table 2: Bonferroni test results compared to performance of athletes at different distances of external attention focus
far and close levels for external focus of attention and did not investigate a range of different distances.

Conclusions

It is argued that the athletes have better performance at far distance of external focus of attention; however, very far distances (8 meters) of external focus of attention may lead to weakened performance. It seems that if focus of athletes’ attention in tasks such as standing long jump be chosen to be more far from body so that the landing point is in ambient vision of athlete, he/she will have best performance. Wulf (2013) believes that the distance of focus of attention is directly related to skill level of individuals; the skilled people use far external attention focus strategies more effectively. Therefore new studies should be conducted to introduce the optimal distance of external focus of attention in nonathlete people and compare it with athletes.

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Conflict of Interests

The author declare that there is no conflict of interest regarding the publication of this paper.

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Application of various forms of physical education as a factor of increase in the level of physical activity of medical students

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Authors’ Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: increase in the level of weekly physical activity of medical students of HEI by application of various forms of physical education training.

Material: Senior students participated in a research (n=78 – males, n=190 – females, age – 21-23 years). Indicators of physical strength development were estimated by the number of pull-ups on a horizontal bar (males) and by the number of floor push-ups (females). Development of speed was estimated by the time of cover 100 m a distance. Level of the general endurance of an organism was estimated by results of cover 3000 m a distance by male students and 2000 m by female students.

Results: it was revealed a significant increase in time of physical activity training in students of experimental groups. The average time of physical training was 3±0.08 hours per a week. This indicator is significantly above (P<0.01), than in students of control groups. Indicators of strength development, speed and general endurance in students of experimental groups is significantly above (P<0.01). Body weight indicators significantly increased (P<0.05) in 2.3±0.2 kg in students of control groups. Indicators of body weight slightly increased in 0.4±0.2 kg in students of experimental groups.

Conclusions: various forms of physical education promote increase in the weekly level of physical activity of students.

Keywords: health, physical activity, students, medical, various, physical training, body weight.

Introduction

Health care experts confirm that the lack of physical activity is one of the leading risk factors of global mortality. It is revealed the significant decrease in the level of daily physical activity of the population [1] in the countries with the high standard of living and in developing countries [2]. The decrease in physical activity is caused by the spread of noninfectious diseases in the majority of the countries in the world. These diseases have essential connection with a personal way of life and with a lack of physical training and motor actions in daily activity [3]. The essential lack of physical activity is observed in students of medical higher education institutes. More than a half of medical students in Thailand have no sufficient level of physical activity during a day. The decrease in the level of physical activity of future doctors is connected with intensive educational activity and overtime work in hospitals [4]. According to the experts’ opinion, there is a strong connection between the personal level of physical activity and success of medical practice [5]. Also, there are data concerning a positive connection between the regular physical activity of medical students and level of their academic achievements [6]. Thus, the lack of daily physical activity exerts a significantly negative impact on the level of physical health and professional readiness of future doctors. It is necessary to recognize that the problem of physical activity lack is relevant not only for medical students. Researches devoted to the physical activity level of USA colleges’ students demonstrated that from 40 till 50% of young people has essential lack of daily physical activity [7].

The development of obesity in young people [8] during the study at the higher education institutions is also a serious problem [9]. This problem is distinctive of medical students. The researches of G. El-Kassas demonstrated that about a third of medical university students of Lebanon have overweight and obesity [11]. Experts confirm that young people nowadays don’t pay attention to the daily physical exercises [10, 12] and have sedentary lifestyle [13] in front of TV and computers [14]. It is revealed the lack of daily physical activity in a significant number of students in South Korea. Unfortunately, most of Korean students don’t consider physical training as the important part of a study, in comparison with study mathematics or medical sciences [14].

It is determined the need to develop and apply the specific programs for the increase in physical activity and the decrease in the sedentary lifestyle of students at the universities worldwide [15, 16]. Special attention should be paid on normalization of nutrition and actions promoting the increase in physical activity in students. Performance of these tasks will allow to decrease significantly the future risk of emergence of various noninfectious diseases.
The normal body weight, the optimum mode of every day and daily physical activity are the factors exerting a positive impact on the level of young people health. The overweight of a body is a factor of negative influence on youth health. Researches demonstrated that the operated intervention in the educational process allows to achieve significant changes in the culture of food and physical activity level of students. According to S. Beni’s opinion, the operated intervention in programs of physical training and youth sport has to be based on a social interaction of teachers and students and increase of positive emotions. It is also necessary to provide growth of positive emotions in students of physical exercises and sport.

Researches demonstrate that the main motives for sports activities and physical training for modern students are: the growth of popularity among other students of higher education institution, the social status and physical appeal. The motivation plays a crucial role in the maintenance of physical activity. Therefore, it is necessary to maintain the motivation of young people at the high level for increase the physical activity of students. Achievement of the high level of students’ motivations is possible only by the transition from obligatory programs of physical education of youth to individual and personal programs of physical development of student’s youth. It is known that in some countries educational programs devoted to the physical training of youth significantly change the orientation from sports improvement to programs devoted to the physical training of youth significantly change the orientation from sports improvement to fitness. In China, the government accepted the national strategy providing participation of the population in fitness. The overweight of a body is a factor of negative influence on youth health. Researches demonstrated that the operated intervention in the educational process allows to achieve significant changes in the culture of food and physical activity level of students. All students had to attend physical culture classes not less than once a week. Such trainings are provided by curricula of future doctors. All students annually underwent medical inspection at the university clinic and had no contraindications to physical activity. Level of students’ physical development at the beginning of the experiment wasn’t significantly differed. All students gave the consent to participation in researches.

Hypothesis. Authors presupposed that providing the choice of a various option of physical activity to medical students in convenient time will promote an essential increase in the level of their daily physical activity. The variability meant a possibility to choose the most attractive a type of physical activity.

The purpose of the research. Increase in level of weekly physical activity of medical universities students by application of various forms of physical training classes in the educational process.

Material and methods. Participants: The total number of examined people was 268 (males – n=78, females – n=190). All examined persons were students of senior (4-5) courses of Krasnoyarsk State Medical University named after Prof. V.F. Voino-Yasenetsky. Age of examined persons was 21-23 years. All students had to attend physical culture classes not less than once a week. Such trainings are provided by curricula of future doctors. All students annually underwent medical inspection at the university clinic and had no contraindications to physical activity. Level of students’ physical development at the beginning of the experiment wasn’t significantly differed. All students gave the consent to participation in researches.

Organization of a research. Researches were conducted within an academic year. Students (males and females) were divided into equal groups: control – № 1 – males (n=39) and experimental – № 2 – males (n=39), control – № 3 – females (n=95) and experimental – № 4 – females (n=95). The students of control groups attended physical culture classes according to the educational schedule and the educational program. The students of experimental groups attended physical culture classes in the personal choice. It was allowed visits to the fitness centers, swimming pools, gyms, etc. At the same time, only students determined time of these visits, choosing the most convenient schedule. The indispensable condition was performance of temporary requirements to training – not less than 120 minutes per a week. All students submitted reporting documents: checks, bills, training plans. It allowed to determine precisely the time volume and intensity of physical activity on the various type of training.

At the beginning and at the end of the academic year all students hit a control qualifying standard allowing to estimate objectively their level of physical development. Indicators of physical strength development were estimated by the number of pull-ups on a horizontal bar (males) and by the number of floor push-ups (females). Development of speed was estimated by time of cover 100 m a distance. Level of the general endurance of an organism was estimated by results of cover 3000 m a distance by male students and 2000 m a distance by female students.

It was applied data concerning dynamics of body weight changes for estimation students’ health level. Assessment of body weight indicators was performed by regular weighing. Authors didn’t purposefully apply different body weight indexes for assessment. According to the data of the last researches BMI indicators – Body Mass Index are exposed to considerable criticism of experts. Experts consider that BMI doesn’t consider a correlation of muscular and body fat mass and types of fat tissue distribution in organism.

Statistical analysis: The statistical analysis of control results was carried out by SPSS 20 program. The Student t-test was applied for checking results of average values in the connected samples.
Results

At the beginning of researches the physical strength development indicators in male students weren’t practically differed. Students of group №1 in the test of pull-ups on a horizontal bar performed 9±2 pull-ups on average. Students of group №2 performed 9±3 pull-ups on average. At the end of researches was revealed a significant difference (P<0,01) in the number of pull-ups in students of the experimental group. Students of group №1 performed 7±2 pull-ups. Students of group №2 performed 10±3 pull-ups on average. At the beginning of researches, female students didn’t have significant differences in results of the test – floor push-ups. The number of push-ups in students of the control group was 13±3 push-ups on average. In students of the experimental group, the number of push-ups was 14±2 on average. At the end of researches results of performance of this test were significantly differed (P<0,01) in students of the experimental group. Females from group №3 performed 12±3 push-ups on average, and females from group №4 performed 16±3 push-ups on average.

At the beginning of academic year indicators of speed development in male students of experimental and control groups weren’t significantly differ. The average time of cover 100 m a distance by students of group №1 was 14±0,8 s. Students of group №2 demonstrated 14±0,9 s on average. At the end of researches was revealed a significant difference (P<0,01) in indicators of cover time 100 m a distance by students of the experimental group. The average time of students of group №1 was 15±0,4 s. Students of group №2 demonstrated 14±0,3 s on average. Female students at the beginning of the researches had identical indicators of speed development. Average time in students of group №3 was 16±0,5 s on average. Students of group №4 demonstrated 16±0,5 s on average. At the end of the academic year was revealed a significant difference (P<0,01) in indicators of cover time 100 m a distance in students of the experimental group. On average students of group №3 cover a distance in 17±0,8 s, and students of group №4 in 15±0,9 s.

At the beginning of researches the level of the general endurance development in students wasn’t significantly differed. At the end of researches were revealed significant differences (P<0,01) in 2000 m run tests and 3000 m run in experimental groups. In males of group №1 results of this test were worse in 30 s on average. In males of group №2 results of cover 3000 m a distance improved in 38 s on average. In females of group №3 results of test run became worse in 37 s on average. Females of group №4 increased the results in this test in 44 s. Thus, the difference between control and experimental groups in results of this test was more than 1 minute.

At the beginning of researches body weight indicators had no significant differences. In students of group №1 the average value of body weight was 86±0,7 kg. In students of group №2 this indicator was 87±0,2 kg. In females of group №3 the value of body weight was 65±0,6 kg on average. In students of group №4 this indicator was 66±0,4 kg. At the end of researches the average values of body weight indicators became significantly differ (P<0,05). It was revealed differences in groups of males and females. It was revealed the increase in body weight within 2,2-2,6 kg in males of the control group. Males from the experimental group didn’t demonstrate significant differences in body weight indicators. It was revealed the increase in body weight in 1,8-2,2 kg on average in females of the control group. Female students of experimental group didn’t demonstrate significant changes in body weight indicators. It should be noted that it was revealed dynamics of increase in body weight in all examined students. It can be explained by the natural process of growth of students’ organism. Key indicators of students’ tests are presented in table 1.

The volume of physical activity of students was considered according to the general time spent by young people for weekly physical activity. The track of time was carried out directly on physical culture classes. Also, students provided data concerning number and time of training in sports complexes and fitness clubs within every week of researches. At the beginning of researches data

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Group №1 (n=39)</th>
<th>Group №2 (n=39)</th>
<th>Group №3 (n=95)</th>
<th>Group №4 (n=95)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength, times</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.r.</td>
<td>9±2</td>
<td>7±2</td>
<td>9±3</td>
<td>10±3</td>
</tr>
<tr>
<td>e.r.</td>
<td>9±3</td>
<td>10±3</td>
<td>13±3</td>
<td>12±3</td>
</tr>
<tr>
<td>Speed, s</td>
<td>14±0,8</td>
<td>15±0,4</td>
<td>14±0,9</td>
<td>14±0,3</td>
</tr>
<tr>
<td>Endurance, min</td>
<td>14,22</td>
<td>14,58</td>
<td>14,20</td>
<td>13,42</td>
</tr>
<tr>
<td>Volume of physical activity, min/week</td>
<td>136±4</td>
<td>134±5</td>
<td>138±3</td>
<td>182±4</td>
</tr>
<tr>
<td>Body weight, kg</td>
<td>86±0,7</td>
<td>89±0,4</td>
<td>87±0,2</td>
<td>87±0,6</td>
</tr>
</tbody>
</table>
| Note. b.r. – beginning of researches; e.r. – end of researches
| 146±0,3                     | 131±5           | 132±4           | 130±3           | 176±4           | 65±0,6   | 67±0,8   | 66±0,4   | 66±0,9   |
concerning the weekly volume of physical activity of students of experimental and control groups wasn’t significantly differ. At the end of researches was revealed quite significant increase ($P<0,01$) in time of physical activity training in students of experimental groups. In males of the experimental group the weekly volume of physical activity increased in $41\pm2$ minutes on average, in comparison with data at the beginning of researches. In females of the experimental group this indicator increased in $44\pm1$ minutes on average. In students of control groups (males and females) the volume of weekly physical activity was practically at the level of the beginning of researches. Dynamics of volume changes of students’ physical activity during researches is presented in figure 1.

**Discussion**

The scientific discussion devoted to the most suitable pedagogical models of physical education of youth and students in modern conditions is continued nowadays [31-34]. Experts confirm that the exists structure of medical higher education could cause violation of a healthy lifestyle of future doctors. It is rather difficult to maintain optimum level of physical activity during training of medical students. Busy schedule of training and features of educational activity prevent young people to find time for regular training of physical activity [35]. It should be noted the negative dynamics of decline in level of physical health of medical universities students (in particular Krasnoyarsk State Medical University named after prof. V.F Voino-Yasenetsky) during study period [36]. It was revealed considerable deviations in values of body weight in modern medical students towards increase in body weight and development of obesity [37]. Experts need to pay special attention to this problem and to find effective ways of its decision. Researches demonstrate the existence of essential communication between the level of physical activity and health of the doctor [5] and success of its medical practice [38]. Results of the last researches of level of physical activity of medical students and the practicing doctors in the USA demonstrate: doctors with normal body weight index more likely will achieve increase in level of physical activity of the patients [39]. Polls of patients demonstrate that most of them expect from doctors the health services delivery service in various and emergency situations. Sports activities help medical students to increase the level of the physical and mental training necessary for carrying out various rescue operations [40].

Modern sociological researches demonstrated that a considerable part of students is ready to pay for physical culture extra classes. According to data of S. Kościółek, about 64% of higher education institutions students of Poland pay for physical culture extra classes [41]. Teachers should support the high level of interest of students to physical culture classes. Scientists confirm that situational interest is the main motivation for students in the field of physical training [42]. It is revealed that positive emotions and increase in popularity among coursemates are the main motives to sports activities and physical activity in students from European countries [22]. The main motives of students to physical activity in Russian higher education institutions are: increase in physical appeal and popularity of different types of physical activity among peers [43].

Scientists confirm that essential changes in the existing programs of physical training of youth are necessary. These changes have to promote formation in young people of the resistant motivational need for the active motion [44]. It should be noted that changes shouldn’t include the only simple increase in daily physical activity. Experts...
confirm that the existing education systems don’t allow to increase significantly the time of physical training [45], games and sport [46]. It is necessary to develop activities for the increase in motivations to physical activity in free time. Researches demonstrate that regular physical activity promotes decrease of fat tissue content in organism and increase in functionality of cardio respiratory system [47]. The experts emphasized the need for physical activity promotion among medical universities students. In the future (as the practicing doctors) such students could conduct the successful professional practice of patients’ consultation concerning physical activity in everyday life [1].

Thus, data of experts’ scientific observations are consistent with the direction of authors’ researches. Increase in level of physical activity of students is recognized as one of the main directions of high-quality vocational training of future doctors. Various forms of physical education promote the increase in weekly level of physical activity of students. It allows to confirm the achievement of the goal of a research.

Conclusions.

1. In the modern scientific literature, experts express the essential doubt concerning the level of physical development and health of students of medical schools is expressed. The researches demonstrate that a considerable part of future doctors has no sufficient volume of daily physical activity. The lack of physical activity negatively affects the level of physical development and health of future doctors.

2. The significant increase in weekly volume of physical activity of medical students is possible by application of various forms of physical culture in the course of physical training. It is revealed the essential increase in time of physical training within a week by students of experimental groups (on average in 42±1 minutes). These students attended classes on the basis of personal preferences and in convenient time only.

3. It is revealed significant (P<0,01) increase in key indicators of physical fitness of experimental groups of students, in comparison with control groups students. Results of tests allow to confirm the higher level of development of the main physical qualities of the students with various forms of physical culture.

4. The obtained data allow to recommend various forms of physical education of youth for counteraction to obesity spread among young people.

Conflict of interests

The authors state that there is no conflict of interest.

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Application of various forms of physical education as a factor of increase in the level of physical activity of medical students.


The electronic version of this article is the complete one and can be found online at: http://www.sportedu.org.ua/index.php/PES/issue/archive

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The investigation of the effects of some variables in the playoff games played in Turkey women’s basketball super league between 2013-2017 on winning and losing

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Authors’ Contribution:
A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: The aim of this research was to reveal positive and negative effects of the parameters causing to win or lose the game by investigating playoff series games played in Turkey Women’s Basketball Super League between 2013-2017.

Material: The data used in the research was obtained from end of game statistics given by Turkish Basketball Federation (TBF). The variables measured (2-point field-goals percentage, 3-point field-goals percentage, free throw percentage, offensive rebound, defensive rebound, assist, steal, turnover, block, and free throws) were analyzed by Logistic Regression Analysis test method according to the winner and loser teams (P<0.05), and the goodness of fit of the test model was measured by Hosmer and Lemeshow Test (Hosmer-Lemeshow goodness of fit test).

Results: Hosmer and Lemeshow goodness of fit test result was found 0.724. The model was seen to be relatively small model (-2 Log likelihood, 139.731) Cox & Snell R Square showed that it explained 47% of the variance, and Nagelkerke R Square showed that it explained 63% of the variance.

Conclusions: According to the results of the research, it was found that a one-unit increase in 2-point field-goals percentage, 3-point field-goals percentage, offensive rebound, defensive rebound, steal and turnover variables had significant effects of winning and losing the game.

Keywords: Basketball, winners, losers, playoff.

Introduction

Basketball is a competitive sport with very ambiguous specific dynamics which is composed of technical fundamentals peculiar to itself and which is played by taking into account the limits of the players’ time, space and participation [1]. According to Glick and Marcotte [2], basketball players should be able to understand and apply the complex movements and their variations in order to achieve high efficiency during a game, should be able to predict the movements of their teammates and rivals, and decide quickly on the implementation of technical elements or performance indicators. Sampaio [3] expresses that the performance of the winner teams stems from a better strategic and tactical environment by improving the players’ more accurate and faster decision making abilities as well as having more opportunities to achieve their aims on the court.

In a basketball game, the coaches can win or lose the game especially with the decisions they make towards the end of the game in close-fought games when the game scores are very close. However, little is known about what factors usually distinguish success and failure at the end of the game. Usually, in order to increase the likelihood of success, detailed knowledge is required for the selection of the best tactical understanding, the strengths and weaknesses of the players, and different offensive and defensive strategies [4, 5].

The preparations for a team to be successful in basketball court involve the use of very complex strategies. One of the most effective strategies is the statistical analysis (scouting report). A complete and comprehensive analysis helps to prepare for the game in the best way by gathering detailed information about the opponent team [3].

Determining player and team performances statistically is used to facilitate tactical decision making [4]. Statistical analyses in basketball sport are widely used to clarify the game quantitatively [6]. Performance and statistical analyses for the coaches are fundamental tools for team sports especially like basketball in order to have valid and reliable information about their own teams and their rivals [7]. Coaches and researchers use this information to assess the variables such as how each player contributes to team performance, the importance of certain roles within the game, and the advantages of being the home team [8].

Men’s and women’s basketball teams in Turkey have had considerable success in the recent years in the international arena both in the clubs and national team levels. Besides, many athletes that have competed in Turkish leagues are being transferred to NBA teams, which is known as the world’s best basketball league. However, it is noticed that there are very few studies conducted on team and player performances from a holistic point of view. The aim of this study is to reveal the variables that directly affect winning and losing in a basketball game, and provide an insight regarding which variables should be allocated more time during the training periods while the coaches train their teams.

Material and methods

Participants: This research is composed of 94 games...
played in the playoffs of the five seasons of Women's Basketball Super League organized by Turkish Basketball Federation (TBF) between 2013-2017. The results of the study were obtained from the statistics of the end of game statistics that TBF published on the web page beginning from 2013 season [9].

The reason why only playoff games were included in the survey was the fact that they were the games played between the teams with relatively equal powers, and that the results of the research could be more significant.

Research Design: The statistical data for each game was classified into two separate categories as winner and loser, and they were used as dependent variables in the study. The variables found in the end of game statistics were in 2-point field-goals percentage, 3-point field-goals percentage, free throw percentage, offensive rebound, defensive rebound, assist, steal, turnover, block, and foul points and these variables were used as independent variables in the research.

Statistical Analysis: Logistic Regression Analysis test method was used for the analysis of the data and the test model’s goodness of fit was measured by the Hosmer and Lemeshow Test. The explanatory power of the model was assessed with Cox & Snell R Square and Nagelkerke R Square values, and 95% CI values (OR-odds ratio values that would be obtained from 95 of the studies when the study was repeated 100 times) were determined as confidence interval.

In statistics, Logistic Regression Analysis [10] is a regression model in which the dependent variable is binary. The binary logistic analysis model is used to calculate the likelihood of the binary ( dichotomous) result over one or more independent variables. There may be continuous, sequential or categorical independent variables in binary logistic regression analysis. While a multivariate model is being developed, the presence of a high degree of correlation (multikolliniarite) among the independent variables that will be included in the model should be investigated. It is expected that there should be at least 10 cases for each independent variable to be included in multivariate logistic regression analysis [11]. In this study, there were 10 independent variables in this study and 94 x 2 = 188 (winner/loser) cases were defined for each of them.

Hosmer-Lemeshow test is a statistical test method used for the goodness of fit in logistic regression models and is often used in risk estimation models. The test evaluates whether the observed state ratios in the subgroups of the model sample are matched with the expected state ratios. Hosmer-Lemeshow test specifically identifies the subgroups as one-tenth of the appropriate risk values. The models are named as expected and observed event rates of well-adjusted similar subgroups [11-13]. In order for the model to be supposed as good, it is demanded that “sig” value is greater than 0.05 [14].

Results

In TBF Women’s Basketball Super League, 100 games were played in the playoffs of the five seasons between 2013-2017. The statistics of one game for quarter-finals and one for semi-finals in 2013 season; two games for quarter-finals and one game for semi-finals in 2014 season; and one game for the finals in 2015 season were not published so 94 games were included in the study.

The mean scores of the winner teams were 13.62, 2-point field-goals percentage mean scores were 5.62, 3-point field-goals percentage mean scores were 8.19, free throw mean scores were 2.03, offensive rebound mean scores were 1.1, defensive rebound mean scores were 3.41, assist mean scores were 4.16, steal mean scores were 1.88, and block mean scores were 0.60 more than those of the loser teams. Turnover mean scores of the loser teams were 1.92, and foul mean scores were 0.19 more than those of the winner teams.

In logistic regression analysis, the winner team values were taken as the dependent variable reference point

| Table 1. Playoff games played between the years of 2013-2017. |
|----------------|---------|---------|---------|---------|
| **Playoff** | **2013** | **2014** | **2015** | **2016** | **2017** | **Total** |
| 1/4 finals | 8 | 7 | 9 | 9 | 9 | 42 |
| 1/2 finals | 6 | 5 | 6 | 8 | 6 | 31 |
| Final | 5 | 5 | 3 | 3 | 5 | 21 |
| Total | 19 | 17 | 18 | 20 | 20 | 94 |

| Table 2. The mean and difference values of the independent variables according to winner and loser teams. |
|----------------|----------|--------|--------|----------|--------|--------|--------|--------|--------|--------|
| **Point** | **2 point %** | **3 point %** | **Free throws %** | **Off. Reb. %** | **Def. Reb. %** | **Assist** | **Steal** | **Turnover** | **Block** | **Foul** |
| **Winner** | 73.83 | 49.40 | 35.67 | 74.93 | 10.63 | 27.20 | 17.32 | 7.00 | 12.02 | 2.20 | 16.50 |
| **Loser** | 60.21 | 43.78 | 27.48 | 72.90 | 9.2 | 23.79 | 13.16 | 5.12 | 13.94 | 1.60 | 16.69 |
| **Diff.** | 13.62 | 5.62 | 8.19 | 2.03 | 1.11 | 3.41 | 4.16 | 1.88 | -1.92 | 0.60 | -0.19 |

PHYSICAL EDUCATION OF STUDENTS

According to Omnibus Tests of Model Coefficients, Chi-square value of the model coefficient was found 120,892 and P value was found 0,000 (P <0,05) when 10 parameters were taken into account. The fact that P value is P <0.05 indicates that the model is significant and good. When Model Summary was analyzed, it was seen that the model was a relatively small model according to -2 Log Likelihood (139.731), which indicated that Cox & Snell R Square explained 47% of the variance and Nagelkerke R Square explained 63% of the variance. When Hosmer-Lemeshow goodness of fit test was examined, it was found that Chi-square value was 5.307 and P value was 0.724. The fact that P value was P> 0.05 and close to 1 indicated that the goodness of fit was high.

According to logistic regression analysis results, the 2-point field-goals percentage, the 3-point field-goals percentage, offensive rebound, defensive rebound, steal (negative) and turnover (positive) variables were found to have significant effect on winning and losing.

Accordingly, the fact that 2-point field-goals percentage was one point low increased the probability of losing the game by 1.21 times (1/0.821), that 3-point field-goals percentage was one point low increased the probability of losing the game by 1.11 times (1/0.895), that the number of offensive rebounds was one low increased the probability of losing the game by 1.31 times (1/0.760), that the number of defensive rebounds was one low increased the probability of losing the game by 1.34 times (1/0.745), that the number of steals was one low increased the probability of losing the game by 1.53 times (1/0.653), and that the number of turnovers was one low increased the probability of winning the game by 1.193 times.

Discussion

In the research, the positive and negative effects of some basic techniques (variables) used in a basketball game on winning and losing a game was investigated. In international literature, there are many studies investigating the indicators that affect winning and losing in basketball games [4, 14-16]. However, there is not enough information in any of them on the effect of what will cause winning or losing if there is one unit of increase in the variables.

Leicht et al. [17] revealed in their study which investigated what team performance indicators were in the women’s basketball games in Athens-2004, Beijing-2008, London-2012 and Rio de Janeiro-2016 Olympic Games that when defensive rebound, score percentage, steal and turnover variables come together by exhibiting high performance, they increased the probability of winning in the games by 91.1%, and when these variables were low, they increased the probability of losing by 96.7%. These findings seem to support our conclusions.

In another study conducted [18], it was aimed to identify the differences in the qualitative and quantitative indicators of the best eight teams’ shooting performances in the European Women’s Basketball Championship games between 1995 and 2011. It was revealed that the highest mean score of the winner teams was 78.3±8.1, the highest mean score in low post and high post shots was 52.9±6.5, the highest mean score in long distance shots was 17.4±4.6, and 3-point field-goals percentages were 34.4±5.9. These results show that 2-point and 3-point shots and their percentages are effective on winning and thus, they support the results that we have found significantly in our research.

In a study [19], the performance of ball possession in men’s and women’s basketball according to game periods was investigated. It was determined that the women possessed the ball more under both hoops in the first five minutes and used different defensive systems, while possessing the ball became more important for men in

Table 3. Significance, probability and reliability limit values of the logistic model.

<table>
<thead>
<tr>
<th></th>
<th>β</th>
<th>SE</th>
<th>Wald</th>
<th>Df</th>
<th>Sig.</th>
<th>Exp(β)</th>
<th>95% C.I. for Exp(β)</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-point field-goals %</td>
<td>-.197</td>
<td>.043</td>
<td>20.504</td>
<td>1</td>
<td>.000</td>
<td>.821</td>
<td>.754</td>
<td>.894</td>
<td></td>
</tr>
<tr>
<td>3-point field-goals %</td>
<td>-.111</td>
<td>.025</td>
<td>20.500</td>
<td>1</td>
<td>.000</td>
<td>.895</td>
<td>.852</td>
<td>.939</td>
<td></td>
</tr>
<tr>
<td>Free throws %</td>
<td>-.008</td>
<td>.016</td>
<td>.225</td>
<td>1</td>
<td>.635</td>
<td>.993</td>
<td>.962</td>
<td>1.024</td>
<td></td>
</tr>
<tr>
<td>Offensive rebounds</td>
<td>-.275</td>
<td>.067</td>
<td>16.659</td>
<td>1</td>
<td>.000</td>
<td>.760</td>
<td>.666</td>
<td>.867</td>
<td></td>
</tr>
<tr>
<td>Defensive rebounds</td>
<td>-.295</td>
<td>.071</td>
<td>17.227</td>
<td>1</td>
<td>.000</td>
<td>.745</td>
<td>.648</td>
<td>.856</td>
<td></td>
</tr>
<tr>
<td>Assists</td>
<td>.103</td>
<td>.063</td>
<td>2.682</td>
<td>1</td>
<td>.101</td>
<td>1.108</td>
<td>.980</td>
<td>1.253</td>
<td></td>
</tr>
<tr>
<td>Steals</td>
<td>-.426</td>
<td>.105</td>
<td>16.368</td>
<td>1</td>
<td>.000</td>
<td>.653</td>
<td>.532</td>
<td>.803</td>
<td></td>
</tr>
<tr>
<td>Turnovers</td>
<td>.177</td>
<td>.068</td>
<td>6.668</td>
<td>1</td>
<td>.010</td>
<td>1.193</td>
<td>1.044</td>
<td>1.365</td>
<td></td>
</tr>
<tr>
<td>Blocks</td>
<td>-.123</td>
<td>.153</td>
<td>.641</td>
<td>1</td>
<td>.423</td>
<td>.885</td>
<td>.655</td>
<td>1.194</td>
<td></td>
</tr>
<tr>
<td>Fouls</td>
<td>-.011</td>
<td>.077</td>
<td>.021</td>
<td>1</td>
<td>.884</td>
<td>.989</td>
<td>.851</td>
<td>1.149</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>22.725</td>
<td>4.153</td>
<td>29.935</td>
<td>1</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: P<0,05; β - The estimated coefficient; SE - Standard error of the estimate; Wald - Wald value; Df - Degree of freedom; Sig. - Significance value; Exp(β) - Exponentiated β/odds ratio; C.I. for Exp(β) - Confidence interval for Exponentiated β/odds ratio.
the last five minutes of the game in terms of winning the match. This result supports the conclusion of our research that steal and turnover variables were important in terms of possessing the ball more.

In another study [20], quarter-final, semi-final and final basketball games played at the 2008 Beijing Olympic Games were examined and it was investigated what the defense indicators were in the winner and loser teams in order to achieve success. According to the results of the research, it was stated that man-to-man defense was frequently used by both winner and loser teams, and that the loser teams used zone defense more. Besides, they expressed that the winner teams put two times more pressure than the loser teams and that both the winner and loser teams reached the highest percentage of impact when they put pressure in the front line. This may cause the team to make more steals or the opponent team to make more turnovers under pressure. In this research, the fact that steal and turnover variables had significant effect may be explained by the fact that they had a positive or negative effect on winning and losing.

Conclusions
As a result, considering the negative and positive parameters affecting winning and losing in the playoffs of the five seasons in TBF Women’s Basketball Super League between 2013-2017, it was revealed that in order to be the winner teams in playoff games, they had to make more steals and less turnovers, increase the percentage of 2-point and 3-point field-goals, and the number of offensive and defensive rebounds. Taking into account the fact that one unit increase in these variables has a significant effect on winning and losing, it can be stated that an increase of more than one unit during the game will greatly affect winning and losing. For this reason, it is thought and suggested that the coaches devote more time in the trainings to improve the skills and attentions of their players on these parameters and should make more trainings. This study can be conducted by taking into consideration the data of the games played during all seasons, and can be repeated on male teams and in different leagues.

Conflict of interests
The authors declare that there is no conflict of interests.

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Assessment of pre-competition emotional states of different mastery women-basketball players

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Abstract

Purpose: Before competitions, athletes often have different emotions, tension, instability, mistakes and doubts. Thus, pre-competition states have an important influence on the quality of athlete’s performance, but it is important for athletes to control these states. For the optimum competition performance, the emotional states of athletes and their ability to control them properly must be considered. Purpose: to assess the pre-competition emotional states of different mastery women-basketball players.

Material: For the assessment of pre-competition emotional states of women-basketball players, the competitive state anxiety inventory-2 as well as the SAN test were used and they helped to assess the pre-competition emotional states of women-basketball players: well-being, activity, mood.

Results: The results of the research showed the women-basketball players playing in the women’s basketball league of Lithuania assessed the cognitive anxiety with 24.8±9.29 points and the women-basketball players playing in Akvile basketball league assessed it with 13.9±3.85 points. Appropriate means of somatic anxiety indexes: 20.7±9.45 and 13.1±2.61 points. Meanwhile, the women-basketball players of lower mastery (30.7±4.85 points) had a higher self-confidence level than the women-basketball players of higher mastery (20.6±9.36 points). The women-basketball players of higher mastery assessed their pre-competition emotional states: well-being with 46.5 per cent and activity with 52.4 per cent and almost 40 per cent of the women-basketball players from the both groups assessed their mood at an average level.

Conclusions: After assessing the pre-competition emotional states of the women-basketball players of different mastery, it was revealed that the women-basketball players of higher mastery had higher cognitive and somatic anxiety before competitions compared with the women-basketball players of lower mastery. Meanwhile, the women-basketball players playing in Akvile basketball league were more self-confident. The well-being and activity of the women-basketball players of lower mastery assessed better than those of the women-basketball players of higher mastery, but there were no reliable differences of mood.

Keywords: women-basketball players, pre-competition, emotional, somatic, cognitive, self-confidence, well-being, activity, mood.

Introduction

Athletes often have proper physical data, comprehensive technical and tactical instructions, excellent physical form to get sport success, but they are unable to cope with emotions emerging under competitive conditions in sport. This information is important trying to understand the behaviour of athletes, planning to implement the possibilities of increase of sports activity results and trying to encourage the psychological preparation of athletes [1]. According to G. H. Lotfi et al. [2], the ability to control emotional states can be especially advantageous for athletes that has to compete against the rival. Thus, the success of basketball players largely depends both on their physical data or motor abilities and on psychological factors, such as the expression of emotions, ability to control them and self-confidence [3; 4]. Therefore, almost every team tries to eliminate any factors precluding the way to victory in their sport activity and tries to strengthen any factors facilitating the way to it.

According to some researchers, such as C. Robazza and L. Bortoli [5], the intensity of emotions of athletes is different both in trainings and in competitions and it often changes before, during and after them. The emotions reflecting the psychological state of an athlete before competitions can be controlled, diverted or ignored if they are related with sport results.

In the opinion of scientists T. Bozkus, M. Turkmen, M. Kul [6]; B. Eskandari et al. [7], anxiety is one of the most important emotional states because it has a direct influence of the achievements of athletes. There are a lot of scientific studies concentrating the main focus on the peculiarities of the expression of anxiety in athletes, coaches and referees. For example, some researchers, such as M. Humara [8], suppose that mild anxiety is obligatory for an athlete’s success. On the other hand, the studies of D. Gould, L. Petlichkoff and R. S. Weinberg [9] confirm that athletes, who often participate in competitions and have higher experience in doing sports, feel weaker anxiety. Meanwhile, L.A. Velickovska et al. at. [10] states that anxiety before competitions can be controlled taking into account the experience of previous competitions and assessing the results of activity in complicated situations. In other works, it is also tried to look for answers to questions in what way anxiety affects the representatives of individual and team sports [11; 12; 13], how similar or different the features of anxiety in the aspect of the sex of athletes are [12; 14], in what way
anxiety emerges in players during the game according to their positions and in what way anxiety is related with the experience and abilities of athletes [15]. Meanwhile, the outcomes of the researches performed by T. Covassin and S. Pero [16] show that competition anxiety is important for performances of athletes, but the coaches and athletes of different sports acknowledge the importance of self-confidence more and more often.

Whereas, self-confidence is indicated by most athletes as an integral part of their best performances or competitive success [17]. Studies confirm unambiguously the role of self-confidence is also important and it affects the competition anxiety of an athlete [18; 17; 19]. Sport activities help athletes to train their self-confidence and pay attention to their abilities because the technical aspects of the game are mastered more effectively in this way [20]. Athletes, who do not interpret any symptoms of the competition anxiety as something dangerous, are more self-confident than those athletes that are affected by the competition anxiety negatively and experience it as exhaustion. Thus, to sum up, we can state that high self-confidence of an athlete protects from a highly negative reaction to the pre-competition anxiety and strengthens the ability of athletes to control their emotions and cope with them before starting [17]. Scientists C. Modrono and F. Guillon [21] agree that athletes, who are interested in the problems of emotional states, are able to cope with their emotions better, have more self-confidence, do not have any fear, do not feel any thrill related with the sport activity or result to be reached. Thus, taking into account these things, a hypothesis is raised in the work that the pre-competition emotional states of women-basketball players of higher mastery are assessed more favourably than those of women-basketball players of lower mastery.

Moreover, there are a lot of unanswered questions about the type of anxiety of athletes participating in higher level sport competitions, especially of athlete women. Thus, these scientific discussions encourage developing the studies of peculiarities of the expression of emotional states of athlete women additionally in order to check the way of expression of competition emotions in women-basketball players of different mastery as there are few of them.

The purpose of the research — to assess the pre-competition emotional states of different mastery women-basketball players.

Material and methods

Participants: 171 women-basketball players that played in two different women’s basketball league championship of Lithuania participated in the research. All the women-basketball players were divided into two groups: 71 women-basketball players played in the women’s basketball league of Lithuania (in our case, their mastery was high) and 100 women-basketball players played in Avkile women’s basketball league (athlete women of low mastery). Verbal agreements of the coaches and women-basketball players were obtained before the research. The survey was carried out in the changing rooms an hour before the competition. During the research, it was tried to ensure the anonymity and confidentiality because the research participants were not asked to say their names or surnames and it was emphasized the data would be analysed in a statistically generalized form only and no individual answers will be publicized. Before the survey, the women-basketball players were familiarized with the purpose of the research and the instructions of filling out methodology were explained.

Organization of the research: in order to assess the emotional states of the women-basketball players, the competitive state anxiety inventory-2 (CSAI-2) was applied [22]; it consists of 27 statements divided into three categories, 9 statements in each. The respondents had to assess all the statements according to the four-point Likert scale (1 – absolutely no, 2 – a little, 3 – more or less, 4 – very much). This questionnaire allowed assessing cognitive anxiety, somatic anxiety and self-confidence.

Cognitive anxiety is a mental component of anxiety caused by negative anticipation or negative self-assessment [22].

Somatic anxiety is a kind of anxiety related with physiological symptoms: quick heartbeats, wet hands and unpleasant feelings in the stomach. Somatic anxiety is the experience of the own anxiety by the sportsman [22].

Self-confidence is a human sense and understanding that he/she is able to carry out the tasks set by life and by the own person [23].

Cognitive anxiety = \( (1+4+7+10+13+16+19+22+25)/9 \),

somatic anxiety = \( (2+5+8+11+14+17+20+23+26)/9 \),

self-confidence = \( (3+6+9+12+15+18+21+24+27)/9 \).


Cronbach alpha coefficients of the applied methodology were also calculated: 0.76 – for cognitive anxiety; 0.74 – for somatic anxiety; 0.67 – for self-confidence. The obtained coefficients show the validity of the questionnaire scales.

The purpose of the SAN test [24] was to assess the pre-competition emotional states of the women-basketball players according to three components: wellbeing, activity and mood. Each component analysed by us is defined by 10 pairs of words with opposite meanings which are assessed from 1 to 9 points.

Well-being

\[
W = \frac{\sum_{i=1}^{10} W_i}{10}
\]

Activity

\[
A = \frac{\sum_{i=1}^{10} A_i}{10}
\]

Mood

\[
M = \frac{\sum_{i=1}^{10} M_i}{10}
\]

Well-being – sense of the decisive internal state of physiological and psychical factors [25].
**Activity** – psychical and physical ability of the organism to act [25].

**Mood** – general emotional state of a person that is expressed externally and has a positive or negative impact on the individual’s activity and relations with the environment [25].

The validity of the SAN test was demonstrated with Cronbach alpha coefficient: 0.64 – for well-being, 0.71 – for activity, 0.69 – for mood [26].

**Statistical analysis:** for the analysis of the research data, the SPSS 21.0 program package was used. For the check of the mathematical statistical hypothesis and assessment of reliability of the difference between the researched groups, Student (t) and chi-square ($\chi^2$) criteria were used. Our scientific hypothesis was checked by choosing the significance level $\alpha=0.05$. The differences between appropriate indexes were considered statistically significant if the calculated statistical significance was $p<0.05$.

**Results**

By using the questionnaire of the competition state anxiety, we analysed the components of cognitive and somatic anxiety as well as self-confidence of the women-basketball players playing in the women’s basketball league of Lithuania (higher mastery) and Akvile basketball league (lower mastery). Analysing the expression of cognitive anxiety in the women-basketball players of different mastery before competitions, it can be noticed that the women-basketball players of higher mastery and those of lower mastery assessed cognitive anxiety with different points.

By using Student t criterion for independent samples, a statistically significant difference between the groups researched by us was revealed: $t (170) = 6.47$; $p<0.05$. The following means of cognitive anxiety indexes were determined: those of the women-basketball players playing in the women’s basketball league of Lithuania – 24.8±9.29 points and those of the women-basketball players playing in Akvile basketball league – 13.9±3.85 points (fig. 1). It allows stating that the women-basketball players of higher mastery have a higher cognitive anxiety level before competitions than the women-basketball players of lower mastery.

We also analysed the statistical indexes of somatic anxiety of the women-basketball players (fig. 2). It was revealed that the women-basketball players playing in the women’s basketball league of Lithuania had a statistically reliably higher level of somatic anxiety $t (170) = 4.35$; $p<0.05$ compared with the women-basketball players playing in Akvile basketball league.

The following means of somatic anxiety indexes were determined: those of the women-basketball players of the women’s basketball league of Lithuania – 20.7±9.45 points, those of the women-basketball players of Akvile basketball league – 13.1±2.61 points.

We also tried to assess the self-confidence level of the women-basketball players of different mastery before competitions that reflects their satisfaction and efforts trying to reach the goal during the sport activity.

The analysis of the research outcomes revealed that the self-confidence level of the women-basketball players playing in Akvile basketball league was higher (30.7±4.85 points) compared with the women-basketball players playing in the women’s basketball league of Lithuania (20.6±9.36 points). It is confirmed by the statistically significant difference obtained by applying Student t criterion: $t (170) = 3.59$; $p<0.05$ (fig. 3).

Trying to compare the pre-competition emotions of

---

**Fig. 1.** Distribution of cognitive anxiety indexes of women-basketball players of different mastery (in points)

Note: * – marking of the statistically reliable difference ($p<0.05$)
the women-basketball players of different mastery, it was revealed that both the women-basketball players of higher sport mastery and those of lower sport mastery assessed their well-being, activity and mood well enough because at least 25 per cent women-basketball players indicated that their emotional states were assessed at a high level in all cases.

By using $\chi^2$ criterion, it was determined that the assessments of two components of pre-competition states: well-being (p<0.05) and activity (p<0.05) were different statistically reliably. A high level of these components is emphasized more by the women-basketball players of higher mastery, respectively: well-being – 46.5 per cent and activity – 52.4 per cent. The mood was assessed at an average level by almost 40 per cent of the women-basketball players of both groups. It can be stated that the mood assessment indexes are not different statistically reliably both for the women-basketball players of high mastery and for those of low mastery and it allows stating that the women-basketball players assess their mood before competitions similarly irrespective of their sport mastery.

**Discussion**

During our research, the main attention was paid to the emotional states of the women-basketball players of two different women’s basketball leagues of Lithuania, such as cognitive and somatic anxiety, self-confidence
and well-being, activity and mood because we lacked studies analysing the emotional states of athletes in the aspect of different mastery. After analysing the statistical indexes of the components of pre-competition emotional states of the women-basketball players: cognitive and somatic anxiety as well as self-confidence, it emerged that the women-basketball players of high mastery had lower cognitive and somatic anxiety than the women-basketball players of lower mastery. It is likely these statistically significant differences were caused by higher experience of the women-basketball players. Taking into account this fact, the conclusion of similar works by M. Sedaraty [27] could be supported because athletes of higher mastery have a lower anxiety level compared with athletes of lower mastery. Meanwhile, the outcomes obtained in the works carried out by S. Jakovljević, M. Karalejić and L. Lazarević [3] showed that women-basketball players with higher sport experience were more oriented to sport achievements, less inclined to worry, more self-confident and more stable emotions were characteristic to them. However, these similarities cannot be interpreted as absolutely compliant with our data because the psychological parameters analysed in these studies are not identical and they are analysed in the aspect of age. Moreover, according to the data of the research performed by A. Türksoy [28], it was revealed that the cognitive and somatic anxiety level of teenagers-basketball players increased largely and the self-confidence level decreased. Furthermore, the author of this work emphasizes unambiguously that anxiety is an important barrier for athletes trying to reach successful sport performance. Nevertheless, some scientists, such as B. Eskandari et al., state that if athletes suffer from anxiety before competitions, their sport performances are mostly worse than of athletes who do not feel any thrill [7]. Meanwhile, researchers K.S. Khan and D. Alin [29], who analysed the emotional states of elite women and men-wrestlers, provided important evidence that there were no statistically significant differences between cognitive and somatic anxiety as well as self-confidence in the aspect of sex. For example, the studies carried out by H. Soltani, Z. Hojati and S.H. Reza Amini allow stating that athletes of individual sports are inclined to feel higher anxiety than athletes of team sports [13]. It is based with a stronger feeling of responsibility because athletes of individual sports feel stronger pressure and are more responsible for the results of their sport activity than athletes of team sports. However, it must be accentuated that the works performed by the above-mentioned authors do not analyse any peculiarities of pre-competition emotional states of women-basketball players of different mastery, but they analyse the emotional states of elite athletes, so it is difficult for us to compare them with the outcomes of our research. Besides, R. Malinauskas analysed the peculiarities of emotional states of athletes of cyclic sports and revealed the tendency that the emotional states of athletes were affected by such factors as importance of competitions, capacity of rivals, quality of organization of competitions, behaviour of a coach and other important persons and individual characteristics of an athletes [30]. As we did not research what affected the rise of pre-competition states of women-basketball players, we cannot assess whether this data is similar or different from our outcomes. However, comprehensive studies of S. Hanton, S.D. Mellalieu and R. Hall confirm that anxiety is especially strong before competitions and self-confidence acts as a variable that reduces or increases the anxiety arising because of the understanding of the importance of competitions [31]. Meanwhile, similar studies performed by J. Vodičar, E. Kovač and M. Tušak try to assess and compare cognitive, somatic anxiety and self-confidence of professional men-basketball players before and after competitions [17]. The outcomes of the research allow forming a conclusion that the symptoms of cognitive and somatic anxiety are expressed in men-basketball players before competitions more often

Table 1. Distribution of pre-competition emotional state indexes of women-basketball players of different mastery (in numbers and per cent)

<table>
<thead>
<tr>
<th>Components of emotional states</th>
<th>Researched</th>
<th>Level</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>²(2);</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well-being*</td>
<td>Women-basketball players of high mastery (n=71)</td>
<td>High</td>
<td>n</td>
<td>33</td>
<td>46.5</td>
<td>20</td>
<td>28.2</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Women-basketball players of low mastery (n=100)</td>
<td>Average</td>
<td>n</td>
<td>25</td>
<td>25.0</td>
<td>46</td>
<td>46.0</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Women-basketball players of high mastery (n=71)</td>
<td>Low</td>
<td>n</td>
<td>38</td>
<td>53.5</td>
<td>18</td>
<td>25.4</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Women-basketball players of low mastery (n=100)</td>
<td></td>
<td>n</td>
<td>34</td>
<td>34.0</td>
<td>45</td>
<td>45.0</td>
<td>21</td>
</tr>
<tr>
<td>Activity*</td>
<td>Women-basketball players of high mastery (n=71)</td>
<td></td>
<td>n</td>
<td>23</td>
<td>32.4</td>
<td>31</td>
<td>43.7</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Women-basketball players of low mastery (n=100)</td>
<td></td>
<td>n</td>
<td>32</td>
<td>32.0</td>
<td>39</td>
<td>39.0</td>
<td>29</td>
</tr>
<tr>
<td>Mood</td>
<td>Women-basketball players of high mastery (n=71)</td>
<td></td>
<td>n</td>
<td>23</td>
<td>32.4</td>
<td>31</td>
<td>43.7</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Women-basketball players of low mastery (n=100)</td>
<td></td>
<td>n</td>
<td>32</td>
<td>32.0</td>
<td>39</td>
<td>39.0</td>
<td>29</td>
</tr>
</tbody>
</table>

Note: * – marking of the statistically reliable difference (p<0.05)
than after competitions and it does not affect any self-confidence indexes.

Meanwhile, researchers T. Covassin and S. Pero confirm in their scientific works that winning athletes have a higher self-confidence level, so they express less negative emotions and are more oriented to the effectiveness of their acts than losing athletes [16]. Nevertheless, it can be stated that the outcomes of the works performed by M. Krepšul are very similar and it is tried to compare the pre-competition states of boxers of different mastery; better well-being and mood indexes are more characteristic to boxers of higher mastery compared with athletes of lower mastery, but the activity indexes are similar in these groups [32].

The data of our research comply with the outcomes of M. Krepšul: better emotional states are characteristic to athletes of higher mastery before competitions compared with athletes of lower mastery [32]. We think this assumption can be based with the data of researches of F. Guillén and R. Sánchez proving that elite women-players feel weaker symptoms of anxiety because most of them are able to cope with thrill better than athlete women who play at a lower level [15]. Moreover, other studies, for example, performed by V. Ivaškienė et al. [33], which analyse the well-being, activity and mood of sambo and judo women-students before competitions, confirm that the well-being, activity and mood of women-students doing these sports were at a high level and there were no significant differences according to the kinds of sports. Nevertheless, we cannot agree with the data of the research of V. Ivaškienė et al. [33] because we did not try to compare any emotional states according to the kinds of sports.

Certain limitations of this research should be mentioned as they may affect the final outcomes. First, the researched sample was formed from women-basketball players only. On the other hand, attention should be paid to quite a big difference of age of the researched (the women-basketball players were 17-39 years old). In order to check the assumptions of our work in the future, bigger and more various representation of the sample should be reached. Another limitation of the research is related with the assessment of pre-competition emotional states of the athlete women because we did not analyse any emotional states according to individual age groups. In spite of certain limitations, the outcomes of this research can be important for coaches, athletes and researchers of the sport science.

Quite contradictory works allow understanding that scientists have been interested for the issues of emotional states of athletes for many years, but it can be stated that the outcomes of their studies do not give an unambiguous answer about the peculiarities of emotional states of athletes of different mastery and more comprehensive scientific studies are necessary. Besides, our research drew directions for the researchers of emotional states of athletes how to supplement the available information. The following should be revealed in further studies: first, in what way the emotional states affect sport achievements; second, what methods or means would help to control emotional states in the most effective way, especially under the conditions of trainings and competitions; third, in what way the understanding of emotional states can be different taking into account the age, sex or sport done by athletes. We also think attention should be paid to the modelling of programs for the control of emotional states of athletes and check of their effectiveness. It should be emphasized that although there are some studies of T. D. Bishop, I.C. Karageorghis and P. N. Kinrade [34]; J. Vodičar, E. Kovač and M. Tušak [17] presenting the psychological preparation programs as the main and effective way, which helps athletes to cope with the difficulties of emotional states, it is still a relevant problem in sport.

Conclusions

After assessing the pre-competition emotional states of women-basketball players of different mastery, it was determined that the women-basketball players of higher mastery had higher cognitive and somatic anxiety compared with the women-basketball players of lower mastery. Meanwhile, the women-basketball players playing in Akvile basketball league were more self-confident and it means they are inclined to a better understanding of their capacity to carry out the tasks set by their coaches or by them.

After assessing the pre-competition emotional states of women-basketball players: well-being, activity and mood, the statistical indexes show that the well-being and activity of the women-basketball players of lower mastery are assessed better compared with the women-basketball players of higher mastery, but there are no reliable differences of mood and it means that the women-basketball players of both groups assess this component similarly.

Acknowledgements

Thank you to the coaches that allowed carrying out the research and women-basketball players that agreed to participate in the research.

Conflict of interests:

The authors declare that there is no conflict of interests.
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Application of fitball aerobics means in the system of physical education of female students of non-sporting specialties

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Authors’ Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: To estimate the influence of a fitball aerobics means on the level of physical and functional fitness of 18-19-year-olds female students.

Material: In the research participated 59 female students of 18-19-year-olds. It was executed testing of physical and functional indicators fitness of students. Female students practiced fitness according to Pilates technique and with the application of a fitball aerobics means.

Results: It was developed the experimental program of a fitball aerobics training considering the specific physiologic features of an organism. It was applied the selection of a fitball aerobics means of aerobic and power blocks of four modules. It was introduced the modular principle of planning the fitball aerobics training for the academic year. The applied complexes a fitball aerobics were directed to increase the level of physical and functional fitness.

Conclusions: application of a fitball aerobics means in the system of physical training of 18-19-year-olds female students promotes the increase in the level of physical and functional fitness.

Keywords: fitball, aerobics, students, physical condition, functional

Introduction

Nowadays there is essential growth of popularity of different types of fitness in student’s youth in years [1, 2]. The fitball aerobics attracts modern students with the availability, simplicity, a high emotional background expressed by all-improving direction [3, 4].

Many experts in the field of physical training presuppose that practical introduction of aerobics means in the system of physical training promote significant efficiency improvement of this process. Mastering various exercises of a new modern kind of a fitball aerobics allow to strengthen health and to improve physical fitness [5]. The wide arsenal of aerobics kinds allows to apply its means depending on target orientation [6]: cardio programs [7]; aerobics programs [8]; functional training [9, 10, 11] and so on.

There are a lot of works of domestic and foreign researchers devoted to opportunities of application of a fitball aerobics means for improvement of some components of a physical condition of different categories of the population.

It is examined the introduction of a fitball aerobics means for: rehabilitation of women in the postnatal period [8]; developments of the computer program for differentiation of physical loads among women of the first mature age [9]; rehabilitation actions for decrease of back pain [12]; prevention of backbone diseases in female students [13]; improvement of body posture and decrease in risk of back pain in persons who lead an inactive lifestyle [14, 15]; implementation of therapeutic or rehabilitation programs [16].

Biological features of women’s organism determine the need for essential reorganization of improving training process [17]. It is necessary to consider phases of a menstrual cycle in planning training loads [18]. That is the implementation of the individual approach to women’s training process [19]. On the other hand, there is a need for new methods which allow to improve a functional condition of women organism and promote the increase in results of training [20, 21]. Researchers proved the efficiency of development of separate physical qualities by fitball aerobics means [22]. It is studied features of physical training planning of females and women consider their morphofunctional and separate physiologic features [19, 23].

The application of aerobics means promotes: increase in motivation level to training in students [24]; optimization of separate components of physical development [9]; development of aerobic endurance [8]; to the substantial increase in the level of physical fitness [25]; improvement of nervous-muscular conductivity [26]. At the same time, the number of researches in this direction is insufficient. Most of them are limited by the application of fitball aerobics means for rehabilitation (recovery) of mature age persons after the postponed injuries or diseases [27]. Other directions of researches concerning youth participation had an insufficient methodical background and were limited by studying only of separate indicators of a physical condition of an organism.

Thus it wasn’t conducted the complete, complex research of effective application of a fitball aerobics means in the system of physical training in students of higher educational institutions.
Hypothesis. It is presupposed that introduction of a fitball aerobics means in the system of physical training among female students of 18-19-year-olds promotes optimization of physical and functional fitness.

The purpose of the research is to estimate the influence of a fitball aerobics means on the level of physical and functional fitness of 18-19-year-olds female students.

Material and methods.
Participants. In the research participated 59 female students of 18-19-year-olds of non-sporting specialty. Selection in experimental (EG, n=29) and control groups (CG, n=30) was provided with the method of a casual sample.

Design of a research. Testing of physical and functional fitness indicators was executed at the beginning (the first stage of an experiment) and in the end (the second stage of an experiment) of the academic year.

Results of the first stage of the experiment were applied for the development of the experimental program of fitball aerobics training. Students of CG and EG had additional extra training (2 times for a week). Female students practiced fitness according to Pilates technique [28] and with the application of a fitball aerobics means respectively.

It was offered to determine for students of experimental group 132 hours for a fitball aerobics training in the 3rd and 4th semesters of the academic year. It is 64 hours (32 training) during each semester. The training was carried out 2 times a week (60-70 min). In the course of each training, the female students carried out dancing and power exercises. The activity of female students at fitball aerobics training was organized by frontal method (all students executed exercises simultaneously).

Physical loads were differentiated by the teacher. Depending on the level of physical fitness, the female students were divided into groups and were ranked: in the first group – female students with low and below the average fitness level, in the second group – with average and above the average level.

The exercises were selected for the purpose of influence: on the functional systems of an organism, figure correction, reduce fatigue and nervous tension; emotional influence on the organism. The program contained 4 modules in which loads were distributed according to the didactic principles of physical training process creation. Loads on training increased gradually, considering the level of a physical condition.

In the aerobic block were applied basic steps of improving aerobics and their combination with the different motions of fitball (up and down hands, push-ups in deferent directions holding a fitball; beat off a fitball from a floor; play the fitball etc.). Such selection of the aerobic block means promoted the increase in aerobic opportunities of an organism and improvement of a functional condition of the cardiorespiratory system. In the peak of aerobic loads heart rate was 150-160 bpm.

In the first module (the aerobic block) was train technique of basic steps execution of improving aerobics with the simple motions with a fitball. Steps were executed at slow speed (one step in 2-time signature) 4 repetitions. After that were executed 8-16 repetitions of each step in every time signature. It was applied the intermediate march for preparation to execution of the following step.

At the one training were executed 4-8 steps depending on coordination complexity of these steps. After two months of training, steps were executed 4-8 repetitions of each step consistently without intermediate march. It was executed different kinds of basic steps (a march forward back and forth, sidestep back and forth, right-left, open step back and forth, right-left etc.).

In the power block of the first module exercise executed as one series of 10-16 repetitions (slow speed).

The breath holding is prohibited. Heart rate during power exercises execution is 120-130 bpm. Loads for females with different level of a physical condition is regulated by motion amplitude and preparatory position.

In the second module was observed a gradual increase in aerobic and power load. In the aerobic block were applied motions of medium-shock load (Hi-lo). They are characterized by the existence of jumps which are executed at slow speed. Basic steps were executed in different directions 4-8 repetitions consistently: the intermediate march wasn’t executed.

In the power block exercises were executed 2 series of 10-16 repetitions in each series. The exercises are executed on average speed. At the end of each series is added fixing of position during 10-15 s.

Selection of aerobic block exercises (the third module) was characterized by a higher coordination complexity. It was trained full-fledged combinations of basic steps with a fitball motion by linear progression method (one step trains, then the following step and then they are connected to each other. Further the third step trains – connected to each other. 1+2+3 step and so forth). Combinations trains from the right and from the left leg through an intermediate march. It was used motions with high-shock load (Hi): both legs get off a floor (that is the presence of flight phase: jumps and run with the maximum amplitude were used). Hands executed motions from a fitball up.

In the power block exercises executed 3 series of 10-16 repetitions in each series. Exercises were executed consistently one by one. Time for the change of preparatory position – is pauses of active rest.

In the fourth module (the aerobic block) was train a combination from the right and leg by the linear progression method: the intermediate march has used the minimum. It was used motions with highly shock load (Hi). The rate of music in the aerobic block is 140-142 bpm.

In the power block of exercises were executed 3 series 16-8-4 repetitions in each series at different speed (16 repetitions of exercise were executed in each time signature; 8 repetitions – 2 times signature of tension, 2 times signature of rest; 4 repetitions – 3 times signature of...
tension, 1 time signature of rest). At the end of each series was fixing of position during 10-15 s.

We didn’t use motions which are forbidden in improving aerobics and which provide the “wrong” load of the locomotor system and organism. Selection of tests was carried out considering the program of physical training for students of higher educational institutions [29, 30].

During the research all participants have executed the following tests [31, 32]:

• The dexterity development level was estimated by results of 4x9 m shuttle run, sec; high-speed abilities were estimated by results of 30 m run from the high start, s;

• high-speed and power abilities were estimated by results of a long jump from the spot, cm; the level of static force development was estimated by dynamometer test of the right and left hands, kg;

• dynamic force – by the number of push-ups in lying positions, the number of times;

• coordination abilities – by the time of keeping balance in Romberg’s test, s;

• level of flexibility development – a body bends, standing on a gymnastic bench, cm;

• was estimated force of back’s and press muscles, times.

Also were defined:

• level of the general physical working capacity (aPWC170, kgm∙min-1) – an integrated indicator of a physical and functional condition of an organism;

• index of physical working capacity (IC, c.u.) – the load complex for estimation of heart reaction to physical activity;

• heart index (HI, l.min⁻¹.m⁻²) – an indicator of heart function which represents the relation minute volume of heart to total body area;

• Robinson index (IR, c.u.) – estimates a systolic work of heart;

• hypoxia index (IH, c.u.) – characterizes the degree of organism resistance to oxygen deficiency;

• Skibinsky index (IS, c.u.) – characterizes potential opportunities of external breathing system, its resistance to hypoxia, level of coherence functioning with the blood circulatory system;

• level of a functional state of cardiovascular (LFScs, points) and respiratory (LFSrs, points) systems of an organism – integrated indicators of the general functional condition of an organism;

• level of physical health (LPH, points) – an integrated indicator of physical health; body type – an indicator of a correlation between fat and muscular components.

Statistical analysis. All obtained data were processed by means of Microsoft Excel with the calculation of the following indicators: arithmetic mean (X); an error of the mean (S); t – the criterion of the significance of normal distribution. The standard units of measure of the International System of Units SI (SI) were applied in research.

Results

It was carried out primary comparative analysis of indicators which characterize the level of physical and functional fitness in females of both groups. It was determined the relative uniformity of control and the experimental group at the beginning of the forming experiment (tab. 1).

The females of control and experimental groups had the low value of 30 m run test; below the average value of indicators: PWC170, Rufie index, 4x9 m shuttle run, body bends; the average level of Romberg’s test.

The females of both groups had a low level of static force value; below an average – in indicators of explosive strength and force of back muscles. All females had the average level of dynamic force and force of press muscles.

Indicators of the blood circulatory system corresponded to the physiologic age norm (tab. 2). The value of Robinson index was registered at the average level. The analysis of initial values of indicators of external breathing system demonstrated the following (tab. 2): at the beginning of

<table>
<thead>
<tr>
<th>Indicators</th>
<th>EG</th>
<th>CG</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWC170, kgm·min⁻¹</td>
<td>546,23±13,08</td>
<td>540,22±13,68</td>
</tr>
<tr>
<td>Working capacity index, c.u.</td>
<td>8,97±0,53</td>
<td>9,86±0,33</td>
</tr>
<tr>
<td>Right hand dynamometry, kg</td>
<td>18,05±0,89</td>
<td>19,02±0,73</td>
</tr>
<tr>
<td>Left hand dynamometry, kg</td>
<td>16,28±1,05</td>
<td>17,09±0,97</td>
</tr>
<tr>
<td>Standing high jump, cm</td>
<td>32,32±0,8</td>
<td>34,13±0,72</td>
</tr>
<tr>
<td>Standing long jump, cm</td>
<td>163,13±3,51</td>
<td>165,47±2,51</td>
</tr>
<tr>
<td>Push-ups, times</td>
<td>19,5±1,7</td>
<td>20,35±1,24</td>
</tr>
<tr>
<td>4x9 m shuttle run, s</td>
<td>11,76±0,2</td>
<td>12,02±0,17</td>
</tr>
<tr>
<td>30 m run, s</td>
<td>6,14±0,07</td>
<td>6,10±0,07</td>
</tr>
<tr>
<td>Romberg’s test, s</td>
<td>23,34±4,65</td>
<td>24,05±1,83</td>
</tr>
<tr>
<td>Bends, cm</td>
<td>15,18±1,26</td>
<td>17,32±0,76</td>
</tr>
<tr>
<td>Abdominal strength, times</td>
<td>38,39±1,38</td>
<td>39,51±1,02</td>
</tr>
<tr>
<td>Back muscular strength, times</td>
<td>24,15±1,54</td>
<td>24,89±1,03</td>
</tr>
</tbody>
</table>

Note: the significant difference is absent.
the research females of both groups had indicators value below the physiologic norm; the value of hypoxia index corresponded the average level.

At the beginning of the research, the main part of females of both groups had the average level of a functional condition of the cardiovascular system. Also, female students had the level below an average of functional condition of external breathing system and physical health level.

There weren't female students with high and above an average level of physical health in both groups at the beginning of the forming experiment. At the beginning of the forming experiment, all females had a very good type of body type. There weren't female students with the low type of a body type in general.

The uniformity of the obtained data was a basis for objective assessment of the efficiency of our developed technique. The analysis of the efficiency of applied the fitball aerobics means was carried out on the basis of studied features of indicators' dynamics of physical and functional fitness. Results of the comparative analysis at the end of a research were especially convincing. It was determined significantly higher gain rates of practically all indicators in the experimental group in comparison with control group (fig. 1). Rates of a gain level of physical working capacity in the experimental group were one third higher than in control group of females. Rates of a gain level of coordination abilities, the force of muscles of abdominal strength and back muscles, were 1,2-1,5 times higher.

It was determined significantly more favorable values of relative changes of indicators of functional fitness in females of the experimental group (fig. 2). The

**Table 2.** Indicators of functional fitness at girls of experimental (EG) and control (KG) of groups to the forming experiment.

<table>
<thead>
<tr>
<th>Indicators</th>
<th>EG</th>
<th>KG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart index (l \cdot \text{min}^{-1} \cdot \text{m}^{-2})</td>
<td>2,84±0,07</td>
<td>3,01±0,06</td>
</tr>
<tr>
<td>Robinson index, c.u.</td>
<td>86,71±2,43</td>
<td>87,48±1,46</td>
</tr>
<tr>
<td>Hypoxia index, c.u.</td>
<td>0,37±0,03</td>
<td>0,39±0,02</td>
</tr>
<tr>
<td>Skibinsky index, c.u.</td>
<td>805,56±70,2</td>
<td>882,84±57,86</td>
</tr>
<tr>
<td>LFScs, points</td>
<td>67,72±1,43</td>
<td>65,16±1,4</td>
</tr>
<tr>
<td>LFSrs, points</td>
<td>44,72±3,3</td>
<td>45,42±3,47</td>
</tr>
<tr>
<td>LPH, points</td>
<td>39,6±2,45</td>
<td>38,65±1,63</td>
</tr>
<tr>
<td>Body type, points</td>
<td>15,37±0,48</td>
<td>15,72±0,44</td>
</tr>
</tbody>
</table>

Note: the significant difference is absent.

**Fig. 1.** The gain of physical fitness indicators in females at the end of the research, % Note: 1 – PWC170; 2 – working capacity index; 3 – right hand dynamometry; 4 – left hand dynamometry; 5 – standing high jump; 6 – standing long jump; 7 – push-ups; 8 – 4x9 m shuttle run; 9 – 30 m run; 10 – Romberg’s test; 11 – bends; 12 – abdominal strength; 13 – back muscular strength; * \(P<0,05\), ** \(P<0,01\), *** \(P<0,001\) in comparison with indicators of females from CG at the end of the research.
received results demonstrated that representatives of the experimental group had higher rates of Robinson index decrease and heart index. It was also determined the higher rates of increase in hypoxia indexes and Skibinsky index. The results were higher rates of improvement of a functional condition of the blood circulatory systems, external breathing, level of physical health.

It is rather indicative all these changes are demonstrated in the analysis of the intragroup distribution of females (fig. 3). It was increased the number of females of EG with the average levels of physical working capacity and flexibility (in 1,5 times). It was increased the number of females with high levels of explosive and dynamic strength (in 1,2-1,5 times). It was increased the number of females with the high level of coordination abilities (by 1,2 times). It was increased the percent of females with the level above an average functional condition of the cardiovascular system and the system of external breath has increased (almost in 1,2 times). It was increased the number of females with the average level of physical

Fig. 2. The gain of indicators of functional fitness in females at the end of the research, %: Note: 1 – heart index; 2 – Robinson index; 3 – hypoxia index, c.u.; 4 – Skibinsky index, c.u.; 5 – LFSCs; 6 – LFSrs; 7 – LPH; 8 – body type evaluation; * P<0,05, ** P<0,01, *** P<0,001 001 in comparison with indicators of females from CG at the end of the research.

Fig. 3. Intragroup distribution of females of experimental (EG) and control (CG) groups by integrated indicators of physical and functional fitness at the end of the research, %: Note: IC – index of physical capacity; LFH – the level of physical health; LFSCs – the level of functional state of the cardiovascular system; LFSrs – the level of functional state of the respiratory system; CG – control group; EG – experimental group.
health in 1.2 times. It was increased in a third the number of females with a different type of a body type (fig. 4). All determined positive changes were observed due to the transition of females with the lowest functional classes in higher. Practically all indicators of the females of experimental group corresponded to the higher functional classes than females of the control group.

More detailed analysis of the submitted data allowed to confirm that the most essential were positive changes in females of the experimental group in flexibility, coordination abilities, dynamic force, abdominal strength and back muscles, general physical working capacity, functional condition of the blood circulatory systems, external breathing, level of physical health.

**Discussion**

According to the obtained results appeared the need for physical training system optimization of female students of non-sporting specialties. It is connected with the insufficient efficiency of the traditional fitness program.

It coincides with data of other authors [4, 7, 9]. Researchers confirmed low level of physical health of modern female students and stated a discoordination in a functional condition of the blood circulatory systems and external breathing in females of this age. It is also confirmed with our researches which testified the low level of physical and functional fitness of female students.

We developed the experimental program of fitball aerobics training considering specific physiologic features of an organism. The program considers the recommendations of other researchers [19, 22, 23]. The optimum improving effect is observed only in the application of physical exercises which: rationally balanced on orientation, intensity and volume; correspond individual opportunities of the female organisms. For this purpose, we offered technique of training structure with the distribution of physical activities of different orientation in a microcycle. The structure of a microcycle of fitball aerobics training for 2 weeks included 4 training.

In researches of a number of authors [4, 8, 20] is defined that application of aerobic means promotes optimization only of separate components of a physical condition. Our research expanded data about the influence of fitball aerobics means on an organism of 18-19-year-olds females. The efficiency of our developed program was estimated by complete, complex monitoring of physical fitness indicators and functional fitness of leading physiologic systems of an organism. It is created a basis of scientific justification of a fitball aerobics means introduction in the physical training system of female students of this age contingent.

Our results allow to claim that introduction of a fitball aerobics means in the system of physical training of 18-19-year-olds female students promotes the significant improvement of all components of physical and functional fitness of their organism. We have realized an integrated approach to the assessment of changes in the current physical and functional state of female students. It was conducted the comprehensive examination of females with simultaneous determination of parameters of physical fitness, the functional fitness of cardiovascular and respiratory systems, physical health and body type. Experimental data were obtained on the basis of the parallel application of modern methodical approaches. It allowed to determine the level of physical fitness, a functional condition of the cardiorespiratory system, physical health and body type. We confirmed results of other researches concerning the importance of the application of different types of physical exercises in the increase in the general physical condition of student’s youth.

The added data relatively: physiologic changes in an organism of 18-19 year olds females as a result of systematic physical activities [21]; possibilities of application of modern kinds of aerobics in the system of physical training of students of non-sporting specialties [13]; need of introduction in educational process of such types of physical exercises which are equitable in the greatest measure to interests and motives of students and enjoys popularity [8]. It is expanded scientific data concerning change dynamics of physical condition level of students of 18-19-year-olds in the course of their physical training in a higher educational institution.

**Conclusions**

Results of the research allowed to confirm the high efficiency of the developed program of physical training of 18-19-year-olds female students with the application of a fitball aerobics means. Application of the program promoted the significant improvement of physical

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![Fig. 4. Intragroup distribution of females of experimental (EG) and control (CG) groups by a body type at the end of a research, %:](image-url)
fitness, physical working capacity, physical health, a functional condition of the leading physiologic systems (cardiovascular and respiratory) and to improvement body type.

It is determined that before the end of the forming experiment females of the experimental group of 18-19-year-olds had significantly (p<0.05; p=0.01; p<0.001) higher values of practically all parameters of physical and functional fitness level.

We consider prospects of the subsequent researches studying of opportunities of application of a fitball aerobics means in the course of physical training of senior courses students.

Conflict of interests
The author declares that there is no conflict of interests.

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