ORIGINAL ARTICLE

TRENDS in
Sport Sciences
2018; **3**(25): 131-142
ISSN 2299-9590
DOI: 10.23829/TSS.2018.25.3-3

Fitness aerobics as a means of recovery the physical capacity of young volleyball players (boys and girls)

ZHANNETA KOZINA[1], MARIAN CRETU[2], YURII BOICHUK[3], IRINA SOBKO[1], OLENA REPKO[1], TATYANA BAZILYUK[4], IRINA PROKOPENKO[5], NATALIIA TARARAK[6], ANDREY OSIPTSOV[7], ANATOLII GUBA[5], MIKOLA TRUBCHANINOV[8], VIKTOR KOSTIUKEVYCH[9], ANTON POLIANSKYI[10], VIKTORIYA ROSTOVSKA[11], ANDRII DRACHUK[9], MAYA KONNOVA[12]

Abstract

Introduction. Improving the results in sports involves applying loads with significant volumes and intensity. It requires the introduction into the system of preparation of a complex of recovery the physical capacity. The study put forward the hypothesis that the use of fitness aerobics as a means of recovery will positively affect the level of functional capabilities, general and special physical fitness of volleyball players 16-17 years old. Aim of Study. The purpose of the work is to experimentally substantiate the use of fitness with elements of aerobics as a means of recovery physical performance in the training process of volleyball players of 16-17 years (boys and girls). Material and Methods. The study involved athletes engaged in volleyball at The Dvorichansky youth and children's club of physical training "Youth" of the Kharkiv region, in the number of 30 boys and 30 girls (age 16-17 years). Both teams are silver winners of the championship of the Kharkiv region volleyball season 2016--2017 years. The study was conducted from September 2016 to May 2017. During nine months during the regenerative periods, athletes were engaged in fitness with elements of aerobics with a fitness trainer. Duration of lessons was 40 minutes. Lessons were held 2 times a week in the last week of each month. Results. It is established that it is advisable to organize muscular activity, taking into account its directed influence on the body, that involves management of physical capacity and recovery processes. It has been shown that for athletes of 16-17 years of age, it is necessary to use special recovery cycles with a wide inclusion of recovery means with the transition to other types of physical exercises. The effectiveness of the dosed monthly application of aerobics as a means of restoring the efficiency of young volleyball players is substantiated. The developed method positively influences both girls and boys. However, under the influence of the developed technique, the girls improve their recovery. This can be explained by the fact that girls are more emotional, so the use of aerobics with music has a more significant impact on on their body. Conclusion. Conducting fitness classes with elements of aerobics in the training process of young volleyball players helps to recovery physical performance, increases the level of physical fitness and improves the functionality of athletes. The developed method positively influences both girls and boys. Under the influence of the developed technique, the girls improve their recovery.

KEYWORDS: volleyball, fitness, aerobics, recovery, functionality, physical fitness.

Received: 6 June 2018
Accepted: 10 September 2018

Corresponding author: zhanneta.kozina@gmail.com

[1] H.S. Skovoroda Kharkiv National Pedagogical University, Department of Olympic and Professional Sport and Sport Games, Kharkov, Ukraine
[2] University of Piteşti, Faculty of Science, Physical Education and Informatics, Piteşti, Romania
[3] H.S. Skovoroda Kharkiv National Pedagogical University, Department of Human Health and Correctional Education, Kharkov, Ukraine
[4] Kiev National University of Technology and Design, Kiev, Ukraine
[5] H.S. Skovoroda Kharkiv National Pedagogical University, Department of Economical Theory, Kharkov, Ukraine
[6] H.S. Skovoroda Kharkiv National Pedagogical University, Departament of Aesthetic Education, Kharkov, Ukraine

[7] *Mariupol State University, Department of Physical Education and Health, Mariupol, Ukraine*
[8] *H.S. Skovoroda Kharkiv National Pedagogical University, Research Department, Kharkov, Ukraine*
[9] *Mykhailo Kotsiubynsky Vinnytsia State Pedagogical University, Vinnytsia, Ukraine*
[10] *H.S. Skovoroda Kharkiv National Pedagogical University, Department of Criminal Law Disciplines, Kharkov, Ukraine*
[11] *H.S.Skovoroda Kharkiv Nayional Pedagogical University, Department of Scientific Foundation of Management and Psychology, Kharkov, Ukraine*
[12] *Vinnytsia Academy of Continuing Education, Vinnytsia, Ukraine*

Introduction

Improving the results in sports involves applying loads with significant volumes and intensity. It requires the introduction into the system of preparation of a complex of recovery the physical capacity. Modern remedies of recovery greatly improve the athletic performance of sportsmen [9].

The state and development of the theory and practice of world volleyball is characterized by the search for more effective means and methods of restoration of work capacity of skilled athletes and young volleyball players. Excessive workload in the process of sports training leads to significant changes in the body, fatigue, strain and overtraining [8]. At the same time, the educational process of athletes aged 16-17 is aimed at preparing for admission to a higher educational institution. Therefore, the increase in the volume and the increasing complexity of educational information requires them increased attention, concentration, stress of their mental, emotional and physical capabilities. Thus, today the search for new means of restoration of work capacity and adaptation to the conditions of the training process of athletes of 16-17 years is of special urgency.

In recent years, increased interest in the use of fitness and aerobics in various sports. Fitness classes are good for their emotions (due to musical accompaniment and a specific commentary by the coach) and high motor density (due to the current method of conducting). They promote the complex development of all physical qualities, increase physical fitness and functional training. A feature of fitness and aerobics is the ability to accurately dose the intensity of the load throughout the class (due to pulse mode) [19].

To date, a large number of scientific works is devoted to the search for optimal means of restoring the physical performance of athletes.

Delextrat et. al. [2] showed the use of sports massage and water procedures in the competitive period of basketball players. They found that in general, immersion in cold water is more useful than athletic massage in restoring after basketball matches, especially in women.

Singh [20] researched the level of physical fitness in gaming sports. Examines the relationship of physical fitness with physical fitness in women's and men's teams. The author stresses that when the fatigue is reduced and the working capacity increases, there is an increase in functional resources. Also, saving of functional expenses is carried out, coordination of functions of different systems of an organism improves. Therefore, the complex application of various rehabilitation measures contributes to increasing the effectiveness of the training process.

Kilpatrick, Bortzfield, and Giblin [7] determine the relationship between perceived stress. The assessment was conducted before, during and after the aerobic exercise set for general work, but varied in intensity. Researchers point out that the high level of physical fitness of athletes significantly expands their functionality and leads to a reduction in the cost of energy resources of the body.

Kellmann [6] shows the importance of optimizing the state of recovery of physical activity after intense training loads in sport. After all, the peculiarities of the course of restorative processes can be attributed to the progressive increase in fitness and athletic performance. And also cause development of fatigue, syndrome of re-training and in connection with this suspension of growth of sports results. The optimal combination of fatigue and subsequent recovery is the physiological basis of long-term adaptation of the body to physical activity.

Visnes and Bahr [22] show the need for the use of means to restore the body to prevent injuries in volleyball. It was found that anthropometric data of volleyball players of 16-17 years old and high dynamic loads are the main factors of knee injury in this age. The transition from juniors to the professional level of young athletes leads to a sharp increase in the load. At the same time, the risk of developing characteristic pains in the area of ligament overcorrel increases.

Zhanneta et. al. [23] have developed a concept of individualization of the training of athletes, which leads to an increase in their functional and

psycho-physiological capabilities, contributes to the improvement of adaptive abilities, the normalization of vegetative functions. Scientists emphasize that the use of various restorative products is considered as an integral part of the training of athletes. Therefore, it is necessary to study questions aimed at preventing re-training, maximizing recovery after high and excessive loads in sports games.

According to the literature, there are non-traditional means of restoration of work capacity, namely the use of medicinal plants and autogenous training [9, 21]. Scientists argue that the use of mummies, medicinal plants in the training process of basketball players contributes to improving the efficiency of recovery processes and disability. After all, they are based on products close to the human body and do not cause negative side effects. Autogenic training positively influences recovery processes by activating the parasympathetic part of the nervous system and inhibiting the activity of the sympathetic part of the nervous system.

In the modern system of recovery of athletes stand out: pedagogical, hygienic, medical and biological and psychological means [9, 21]. At young athletes the complex use of restorative means is of great importance. Namely, a rational combination in the training process of different microcycles. Application of a hygienically expedient schedule of an athlete's day and rational nutrition. Mandatory use after intense competition or competitive period of special recovery cycles with a wide inclusion of active rest with the transition to other types of physical exercises [17]. That is why we chose fitness aerobics classes as a means restoration of physical ability of volleyball players of 16-17 years.

Thus, modern scientists pay more attention to substantiating, improving and increasing the efficiency of the training and competition processes of volleyball players. Identify the individual characteristics of volleyball players at different stages of preparation [3, 18]. Offering various systems for restoring physical performance of athletes. They note that at the stage of improving the athletic skill, the remedies should be applied according to special schemes by the medical professional, depending on the individual characteristics of the body of the athlete [5, 16]. At the same time, the problem of restoration of work capacity of young volleyball players is considered insufficient, therefore our research is actual and timely.

Aim of Study

The research hypothesizes that the use of fitness aerobics as a means of recovery will positively affect the level of functional capabilities, general and special physical fitness of volleyball players of 16-17 years.

Aim: to experimentally substantiate the use of fitness with the elements of aerobics as a means to restore physical performance in the training process of volleyball players of 16-17 years.

Material and Methods

Participants

The study involved athletes engaged in volleyball at the Dvorichansky youth and children's club of physical training "Youth" of the Kharkiv region, in the number of 30 boys and 30 girls (age 16-17 years). Both teams are silver winners of the championship of the Kharkiv region volleyball season 2016-2017 years.

Organization of research

The study was conducted from September 2016 to May 2017. During nine months during the recovery microcycles, athletes were engaged in fitness with elements of aerobics with a fitness trainer.

In our study, the duration of a fitness training session was 40-45 minutes. Initially, a warm-up was conducted, the purpose of which is to prepare the functional systems of the body for loading. It included exercises whose amplitude and velocity gradually increased. It included breathing exercises, general exercises (various types of walking, movement), exercises for the development of flexibility (static and dynamic stretching of the muscles). Further aerobic exercises were performed, which were accompanied by the consumption of a large amount of oxygen for a long time. The main task of these exercises is the training of the cardiovascular system and the respiratory system, improving the functional state of the body. They were divided into basic, step-platform exercises and dance exercises.

The base included exercises to improve the physical fitness of athletes. Depending on the intensity, different combinations of steps, jumps, running and other exercises were used. The load level increased with the use of encrustation in the form of cuffs, dumbbells, various shock absorbers.

Exercises on step-platforms are a set of choreographic movements accompanied by music. Exercises are designed to train the muscles of the lower and upper parts of the body, as well as the cardiovascular system.

When performing the exercises, the trainer changed the height of the platform, used a different choreography, applied burdening for the hands, changed the pace of music.

Dance exercises included aerobic dance programs of various styles that develop all the components of physical fitness. Duration of dance, tempo, continuity create a good training aerobic effect. Dance compositions allow to develop the general culture of movements, their expressiveness, freedom of orientation in musical rhythms. For each training session the trainer has selected the appropriate musical accompaniment. Preferring musical compositions that have a clear rhythm. It should be noted that in some classes music was used as a background, for the removal of monotony of repetitive motions of the same type. In other music, he set the rhythm, character, and governed the pace of movements. Musical rhythm has organized movements, raised the mood of athletes. Positive emotions caused the desire to perform more energetic movements, which contributed to the improvement of efficiency, improvement, active recreation.

Before and after the experiment, athletes were tested for physical and functional fitness.

Research methods

In the work the theoretical analysis of special literature, methods of mathematical statistics, methods of testing of functional capabilities and physical preparedness were used.

In sports practice, physical fitness is assessed by means of numerous functional tests that involve determining the reserve capacity of the body [17]. We used the Guench and Ruffie samples.

Guench test. The pulse is measured in the standing position for 30 seconds, then the breath is resting on full exhalation, after three breaths at 3/4 depth. During the delay, use a nose clamp. The time is fixed by the stopwatch in seconds. Then you need to measure the pulse in 30 seconds immediately after restoration of the breath. If the delay time is less than 34 seconds, the result is considered unsatisfactory. The result within 35-39 seconds indicates a satisfactory rate, and time over 40 seconds is a good result.

Ruffie test. In the position of lying on the back for 5 minutes, determine the number of ripples for 15 s (P1); then for 45 s, 30 sit-ups are performed. After loading, the number of ripples is recalculated for the first 15 s (P2), and then for the last 15 of the first minute of the recovery period (P3). The assessment of cardiac performance is based on the formula:

Index Ruffie = (4 * (P1 + P2 + P3) – 200) / 10.

Results are evaluated by the index value from 0 to 15. Less than 3 – good performance; 3-6 – average; 7-9 – satisfactory; 10-14 – bad (average cardiac insufficiency); 15 and above (severe heart failure).

We also used a special performance test [15]. The choice of this test is due to the fact that boys and girls aged 16--17 years go to a new stage of improving special physical fitness (for this age, athletes are characterized by the assignment of skill levels). Performing a test allows you to investigate physical performance, special endurance, as well as special physical fitness (execution of attack strike).

Special performance test. First, the heart rate is measured at rest. Next, an attack strike from Zone 4 (2) is performed for 2 minutes 30 seconds (for men) and 2 minutes (for women) with an intensity of 12-14 attacking beats per minute (rush from the line of attack with a fast return after strike to the line of attack). After that, the heart rate is measured immediately after loading, at 1 and 3 minutes of recovery, check for pulse recovery after loading to 120-130 beats per minute. Pulse Rate Rating:

– for 45-90 s – high level of efficiency;
– for 90-120 s – a good level of efficiency;
– for 120-160 s – satisfactory level of efficiency.

We also determined special physical fitness. Evaluated the hit of the ball in two targets 3 × 3 m, marked on the side lines behind the attack line. The beats turn in both targets. The number of ball losses (strikes in a grid, past a target, out) was calculated – one attempt.

Tests of physical fitness – jumping with a rope for 1 min, bending the hands in the emphasis lying in 30 s, lifting the body for 30 s from the position of lying [23].

Statistical analysis

For statistical processing of the obtained data, computer programs Microsoft Excel "Data Analysis", SPSS were used. For each indicator, the average arithmetic value, the mean square deviation S (standard deviation), and the estimation of the probability of discrepancies between the parameters of the initial and final results by the Student t-criterion with the corresponding probability level (p) were determined. Differences and the presence of interrelations were considered reliable at a level of significance $p < 0.05$. An analysis of variance was also used. The influence of sex, the period of testing on the indicators of the athletes' functional fitness was determined.

Results

Our research confirms the positive effect of selected remedies on the functional state of the body of volleyball players (Table 1).

Table 1. Comparative characteristic of functional readiness of volleyball players (boys) (n = 30) and volleyball players (girls) (n = 30) 16-17 years as a result of experiment

Registered metrics	Statistical Indicators															
	Girls						Boys						Girls–boys to Experiment		Girls–boys after Experiment	
	To Experiment		After Experiment		t	p	To Experiment		After Experiment		t	p	t	p	t	p
	$\bar{x}$	s	$\bar{x}$	s			$\bar{x}$	s	$\bar{x}$	s						
Heart rate at rest, beats·min^{-1}	78.2	6.1	77.5	5.9	0.45	>0.05	73.5	5.9	71.2	5.8	1.52	>0.05	3.03	<0.01	4.17	<0.001
Heart rate after loading, beats·min^{-1}	186.6	27.2	180.2	25.5	0.94	>0.05	192.3	28.2	186.4	27.0	0.83	>0.05	0.80	>0.05	0.91	>0.05
Heart rate for 1 min restoration, beats·min^{-1}	174.3	23.4	162.2	21.1	2.10	<0.05	176.2	22.5	160.0	21.1	2.88	<0.05	0.32	>0.05	0.40	>0.05
Heart rate for 3 min restoration, beats·min^{-1}	108.1	19.6	88.2	18.3	4.06	<0.001	110.2	19.2	91.5	18.8	3.81	<0.01	0.42	>0.05	0.69	>0.05
Guench test, s	32.1	12.6	41.1	14.1	2.60	<0.05	38.2	13.4	46.0	16.6	2.03	<0.05	1.81	>0.05	1.23	>0.05
Ruffie test, c.u.	9.3	3.7	4.4	2.2	6.23	<0.001	8.1	3.2	2.5	2.1	8.01	<0.001	1.34	>0.05	3.42	>0.05

As a result of the experiment, reliable differences in heart rate were found at the first minute of recovery in boys (from 176.2 beats per minute to 160 beats per minute; $p < 0.05$), in girls (from 174.3 beats·min^{-1} to 162.2 beats·min^{-1}; $p < 0.05$). Also, there were significant differences in heart rate indices at the third minute of recovery in boys (from 110.2 beats·min^{-1} to 91.5 beats·min^{-1}; $p < 0.01$) and girls (from 108.1 beats·min^{-1} to 88.2 beats·min^{-1}; $p < 0.001$). We improve the results by the fact that the performance of aerobic exercises accelerates the course of restorative processes. Our chosen medium-intensity load activates the activity of the cardiovascular and respiratory systems. Reliable improvement of the results of Guench and Ruffie tests after the experiment shows an increase in the

Table 2. The influence of sex and the period of testing (before applying the application of the developed technique and after applying the developed technique) to the level of functionality of athletes (Heart rate at rest)

Dependent Variable: Heart rate at rest, beats·min^{-1}	Tests of intergroup and externally group effects							
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Powerb
Corrected Model	832.705a	3	277.56	6.367	0.000	0.141	19.101	0.963
Intercept	670029.2	1	670029.185	153690.741	0.000	0.993	15369.741	1.000
Sex	811.2	1	811.20	18.60	0.000	0.138	18.608	0.990
Time_Test	21.505	1	21.505	0.493	0.484	0.004	0.493	0.107
Sex * Time_Test	0	1	0.000	0.000	1.000	0.000	0.000	0.050
Error	5056.909	116	43.594					
Total	675918.8	120						
Corrected Total	5889.615	119						

a. R Squared = 0.141 (Adjusted R Squared = 0.119)
b. Computed using alpha = 0.05

Table 3. The influence of sex and the period of testing (before applying the application of the developed technique and after applying the developed technique) to the level of functionality of athletes (Heart rate after loading)

Dependent Variable: Heart rate after loading, beats·min^{-1}			Tests of intergroup and externally group effects					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Powerb
Corrected Model	2259.856a	3	753.285	3.365	0.021	0.080	10.095	0.750
Intercept	3884617	1	3884616.736	17353.000	0.000	0.993	17353.000	1.000
Sex	1009.2	1	1009.200	4.508	0.036	0.037	4.508	0.558
Time_Test	1250.656	1	1250.656	5.587	0.020	0.046	5.587	0.650
Sex * Time_Test	0	1	0.000	0.000	1.000	0.000	0.000	0.050
Error	25967.59	116	223.859					
Total	3912844	120						
Corrected Total	28227.44	119						

a. R Squared = 0.080 (Adjusted R Squared = 0.056)
b. Computed using alpha = 0.05

level of physical ability of volleyball players ($p < 0.01$, $p < 0.001$) (Table 1).

Reduction of the heart rate in girls as a result of the experiment is reliable with a lower level of significance than in boys ($p < 0.001$ – for girls and $p < 0.01$ – for boys). Proceeding from the received results it is possible to assume, that the developed technique strongly influences restorative processes at girls.

However, the differences between the indicators of girls and boys are reliable only for the heart rate at rest. This is typical both before the experiment and after the experiment. The findings can be explained by the higher emotionality of girls compared to boys. However, under load, these differences disappear.

To more accurately test the influence of the developed technique on girls and boys involved in volleyball, a dispersion analysis was carried out. A significant effect of sex on the value of heart rate at rest was found (in boys this value is lower than in girls) (Table 2).

A significant effect of sex on the value of heart rate after exercise was found (in boys this value is higher than in girls) (Table 3). A significant influence of the test period on the

Table 4. The influence of sex and the period of testing (before applying the application of the developed technique and after applying the developed technique) to the level of functionality of athletes (Heart rate for 1 min restoration)

Dependent Variable: Heart rate for 1 min restoration, beats·min^{-1}			Tests of intergroup and externally group effects					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Powerb
Corrected Model	2112.760a	3	704.253	16.256	0.000	0.296	48.768	1.000
Intercept	3650611	1	3650610.6	84265.77	0.000	0.999	84265.77	1.000
Sex	97.2	1	97.200	2.244	0.137	0.019	2.244	0.318
Time_Test	2015.56	1	2015.560	46.524	0.000	0.286	46.524	1.000
Sex * Time_Test	0	1	0.000	0.000	1.000	0.000	0.000	0.050
Error	5025.419	116	43.323					
Total	3657749	120						
Corrected Total	7138.18	119						

a. R Squared = 0.296 (Adjusted R Squared = 0.278)
b. Computed using alpha = 0.05

Table 5. The influence of sex and the period of testing (before applying the application of the developed technique and after applying the developed technique) to the level of functionality of athletes (Heart rate for 3 min restoration)

Dependent Variable: Heart rate for 3 min restoration, beats·min^{-1}				Tests of intergroup and externally group effects				
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Powerb
Corrected Model	9171.600a	3	3057.2	11.035	0.000	0.222	33.106	0.999
Intercept	908697.6	1	908697.6	3280.020	0.000	0.966	3280.020	1.000
Sex	1153.2	1	1153.2	4.163	0.044	0.035	4.163	0.525
Time_Test	7489.2	1	7489.2	27.033	0.000	0.189	27.033	0.999
Sex * Time_Test	529.2	1	529.2	1.910	0.170	0.016	1.910	0.278
Error	32136.67	116	277.04					
Total	950005.9	120						
Corrected Total	41308.27	119						

a. R Squared = 0.222 (Adjusted R Squared = 0.202)
b. Computed using alpha = 0.05

value of the heart rate after the load was also revealed (after the experiment. lower than before the experiment) (Table 3). A significant influence of the test period on the value of the heart rate on the first minute of recovery after the load was found (after the experiment it is lower than before the experiment) (Table 4). However. this indicator does not affect the sex of the subjects (Table 4).

A significant influence of the test period on the value of the heart rate on the third recovery minute after the load was revealed (after the experiment it was lower than before the experiment) (Table 5). This indicator is also influenced by the sex of the subjects (after the experiment. the recovery of girls in the third minute after the load is better than in boys) (Table 5). These data supplement Table 1 in that the technique used had a somewhat greater effect on the restorative processes of girls compared to boys.

A significant influence of the testing period on the result of the Guench test was revealed (after the experiment the result was higher than before the experiment) (Table 6). This indicator is also influenced by the sex of the subjects (before the experiment and after the experiment. this indicator is higher in boys) (Table 6).

Table 6. The influence of sex and the period of testing (before applying the application of the developed technique and after applying the developed technique) to the level of functionality of athletes (Guench test)

Dependent Variable: Guench test, s				Tests of intergroup and externally group effects				
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Powerb
Corrected Model	3492.600a	3	1164.200	20.190	0.000	0.343	60.570	1.000
Intercept	167731.5	1	167731.541	2908.881	0.000	0.962	2908.881	1.000
Sex	1116.3	1	1116.300	19.359	0.000	0.143	19.359	0.992
Time_Test	2376.3	1	2376.300	41.211	0.000	0.262	41.211	1.000
Sex * Time_Test	0	1	0.000	0.000	1.000	0.000	0.000	0.050
Error	6688.779	116	57.662					
Total	177912.9	120						
Corrected Total	10181.38	119						

a. R Squared = 0.343 (Adjusted R Squared = 0.326)
b. Computed using alpha = 0.05

Table 7. The influence of sex and the period of testing (before applying the application of the developed technique and after applying the developed technique) to the level of functionality of athletes (Ruffie test)

Dependent Variable: Ruffie test, c.u.				Tests of intergroup and externally group effects				
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Powerb
Corrected Model	565.800a	3	188.600	41.182	0.000	0.516	123.547	1.000
Intercept	4032.161	1	4032.16	880.453	0.000	0.884	880.453	1.000
Sex	36.3	1	36.300	7.926	0.006	0.064	7.926	0.797
Time_Test	529.2	1	529.200	115.555	0.000	0.499	115.555	1.000
Sex * Time_Test	0.3	1	0.300	0.066	0.798	0.001	0.066	0.057
Error	531.239	116	4.580					
Total	5129.2	120						
Corrected Total	1097.039	119						

a. R Squared = 0.516 (Adjusted R Squared = 0.503)
b. Computed using alpha = 0.05

A significant influence of the test period on the result of the Ruffie test was revealed (after the experiment the result was higher than before the experiment) (Table 6). This indicator is also influenced by the sex of the subjects (before the experiment and after the experiment. this indicator is higher in boys) (Table 7).

It was found that the heart rate significantly affects the sex, the period of testing (before the experiment, the heart

Table 8. The influence of sex, the period of testing (before applying the application of the developed technique and after applying the developed technique) and measuring period HR (1 – Heart rate at rest; 2 – Heart rate after loading; 3 – Heart rate for 1 min restoration; 4 – Heart rate for 3 min restoration) to the level of functionality of athletes (Heart rate)

Dependent Variable: HR			Tests of intergroup and externally group effects			
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1.14E+06	15	75871.392	516.294	0.000	0.943
Intercept	7990260	1	7990260.21	54372.58	0.000	0.992
Sex	554.7	1	554.7	3.775	0.053	0.008
Time_Test	7347.675	1	7347.675	50	0.000	0.097
HR_1_2_3_4	1123694	3	374564.654	2548.859	0.000	0.943
Sex * Time_Test	132.3	1	132.3	0.9	0.343	0.002
Sex * HR_1_2_3_4	2516.1	3	838.7	5.707	0.001	0.036
Time_Test * HR_1_2_3_4	3429.247	3	1143.082	7.779	0.000	0.048
Sex * Time_Test * HR_1_2_3_4	396.9	3	132.3	0.9	0.441	0.006
Error	68186.59	464	146.954			
Total	9196518	480				
Corrected Total	1206257	479				

R Squared = 0.943 (Adjusted R Squared = 0.942)
HR_1_2_3_4 – measuring period HR (1 – Heart rate at rest; 2 – Heart rate after loading; 3 – Heart rate for 1 min restoration; 4 – Heart rate for 3 min restoration)

Table 9. Post Hoc Tests for the measuring period Heart rate

Multiple Comparisons						
HR_rest_Load_rest_1_rest_3 Bonferroni					95% Confidence Interval	
(I) HR_1_2_3_4	(J) HR_1_2_3_4	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
1	2	–105.1983*	1.57	0.000	–109.35	–101.05
	3	–99.6950*	1.57	0.000	–103.84	–95.55
	4	–12.2967*	1.57	0.000	–16.44	–8.15
2	1	105.1983*	1.57	0.000	101.05	109.35
	3	5.5033*	1.57	0.000	1.36	9.65
	4	92.9017*	1.57	0.000	88.76	97.05
3	1	99.6950*	1.57	0.000	95.55	103.84
	2	–5.5033*	1.57	0.000	–9.65	–1.36
	4	87.3983*	1.57	0.000	83.25	91.55
4	1	12.2967*	1.57	0.000	8.15	16.44
	2	–92.9017*	1.57	0.000	–97.05	–88.76
	3	–87.3983*	1.57	0.000	–91.55	–83.25

Based on observed means. The error term is Mean Square (Error) = 146.954.
* The mean difference is significant at the 0.05 level.
HR_1_2_3_4 – measuring period HR (1 – Heart rate at rest; 2 – Heart rate after loading; 3 – Heart rate for 1 min restoration; 4 – Heart rate for 3 min restoration)

rate is higher than after the experiment), and the period of measurement of heart rate (at rest, after a load, in the first minute of recovery, in the third recovery minute) (Table 8). But there was no 3-factor effect (Sex * Time_Test * HR_1_2_3_4), so we can assume that in girls and boys the two-factor effects ”Time × HR” does not differ. This lack of differences can also be seen in Table 1, that is, the relationships before starting work for different HR measurements are similar for girls and boys, that is, both girls and boys do not have ”reliable” differences in the first two dimensions of the pulse and significant differences in the remaining measurements of the heart rate before the start of the study. In other words, the differences in girls and boys in two-factor interactions ”Time × HR, 1,2,3,4” do not matter.

From the data obtained, it follows that the developed technique has a positive effect on both girls and boys. However, under the influence of the developed technique, the girls improve their recovery. This can be explained by the fact that girls are more emotional, so the use of aerobics with musical accompaniment has a more significant impact on their body.

As a result of the experiment volleyball players experienced an increase in physical fitness (Figure 1). This is evidenced by a significant improvement in the

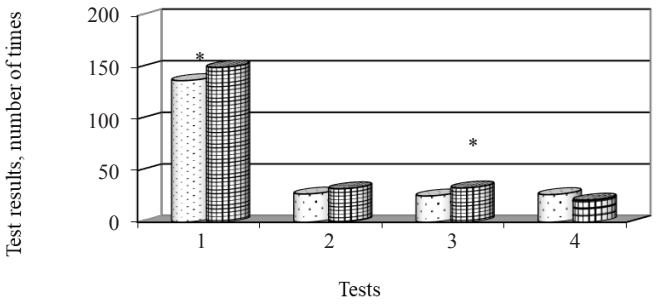

Figure 1. Indicators of physical fitness volleyball players (n = 30) 16-17 years as a result of the experiment:

to the experiment
after the experiment
1 – jumps with a rope for 1 min, number of times;
2 – bending of hands in an emphasis lying for 30 s, number of times;
3 – lifting of the body for 30 s from the lying position, the number of times;
4 – attack strike, number of losses;
* the differences are reliable at $p < 0.05$

results of the test "jump in 1 minute, number of times" the number of jumps has increased from 137.12 times to 150.01 times ($p < 0.05$), as well as the test "lifting the body for 30 s from the position lying, number of times" from 25.4 times to 33.2 times ($p < 0.05$).

Significant improvement in the results of physical fitness (Figure 2) in volleyball players showed the tests "bending hands in the emphasis lying in 30 seconds, the number of times" and "lifting the body for 30 s from the lying position, the number of times" from 29.45 times to 38.12 times ($p < 0.05$) and from 25.3 times to 31.22 times ($p < 0.05$), respectively. After the experiment, the number of ball losses in the test with the performance of the attack strike significantly decreased from 19.1 times to 11.0 times ($p < 0.05$).

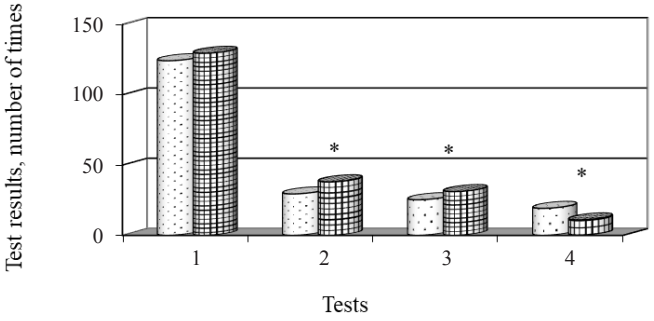

Figure 2. Indicators of physical fitness volleyball players (boys) (n = 30) 16-17 years as a result of the experiment:

to the experiment
after the experiment
1 – jumps with a rope for 1 min. number of times;
2 – bending of hands in an emphasis lying for 30 s. number of times;
3 – lifting of the body for 30 s from the lying position. the number of times;
4 – attack strike. number of losses;
* the differences are reliable at $p < 0.05$

In general, the increase in the results of physical fitness in athletes due to the correct selection of exercises. After all, the compositions we selected consisted of a large number of amplitude direct jumps and jumps with rotations. Which, in turn, allowed to increase the coordination and jumping endurance of volleyball players.

The data obtained from the experiment show improvements in the fitness of athletes and increased physical fitness, as well as the rate of recovery of the body after loading.

Discussion

The results of our study confirmed the data of scientists [8, 20] that in the preparation of athletes adolescents and adolescents excessive passion for large training loads leads to a relatively rapid exhaustion of physical and mental capacity of the body. The obtained data confirm the opinion of Singh [20], that the decline in performance is accompanied by a subjective sense of fatigue, which is directed against the depletion of the functional potential of the central nervous system. The tiredness of working muscles is due to lack of oxygen, clogging of products of decay or depletion of energy resources. To improve the efficiency of workout, the work of the body of athletes should be of such intensity and duration, in which the required energy balance is maintained. Therefore, it is important to devote enough time to restore the body after loading. We agree with the authors of Delextrat et. al. [2] and confirmed this study, using the remedies, the growth of functional resources is increasing, coordination of functions of different systems of the organism improves. Under the influence of new physical exercises there are functional structural changes in the muscles and the corresponding nerve centers located at the segmental level in the brain. There is a stimulation of the morpho-functional and energy possibilities of tissues, which provide their activity muscle contractions and on this basis, the expansion of the range, reactivity of the organism.

A significant role in the fight against fatigue and increased efficiency include a sauna, autogenous training, water procedures, the use of L-tryptophan [5, 9, 21]. But all these means are related to hygienic, medical, biological and psychological means. We propose in our study to pay more attention to pedagogical means, because our study involved teenagers aged 16-17 years. For them, emotional mood is very important during volleyball [1, 14], and fitness with elements of aerobics is most suitable for this [4]. After such classes more intensive processes of recovery, which promote the increase of muscular performance at a higher level than the original position.

The results of our work complement the data of other authors [3, 5, 9] that fatigue, injuries, illness and burnout in sports interfere with the improvement of the quality of the training process. Therefore, the right combination of loads and rest at all stages of long-term training of athletes is necessary. The use of fitness aerobics during regenerative microcycles helps to maintain the health-training effect, not only excessive loads, but also from small loads. This is confirmed by the results of our study, since after the experiment we received an increase in physical fitness indicators.

We agree with other authors [22], who emphasize the need to use the means of restoration of the body to

prevent injuries in volleyball. During an injury, the athlete will stop training and his motor activity will be severely limited. This, in turn, affects the general state of work of the individual. To restore the previous state of work, you need to undergo a certain course of treatment and rehabilitation. We, in turn, offer classes in fitness aerobics, which promote the complex development of all physical qualities, increase physical fitness.

Kozina et. al. [23] developed a concept of individualization of athletes' training, which leads to an increase in their functional and psycho-physiological capabilities, contributes to enhancement of adaptive abilities, normalization of vegetative functions. They emphasize that the use of different remedies is considered an integral part of the training of athletes. Therefore, it is necessary to study issues aimed at preventing overtraining, maximizing recovery after high and excessive loads in sports games. In our work, it is also emphasized that the use of different restorative devices is considered as an integral part of the training of athletes. But our experiment is aimed at researching the renewable effect of fitness with elements of aerobics at athletes aged 16-17, engaged in volleyball. And in this study we received quite reliable results, which testifies to the relevance of the problem that we have been considering during our work.

The obtained data are consistent with the data of other authors [1, 9, 14] on the need to find new ways to improve the overall fitness level of athletes and the physical ability of athletes to play sports.

In practical work, trainers often use gymnastic, acrobatic exercises, mobile games, relay races for the development of agility at young athletes [3]. As a rule, exercises on different types of sports and motor activity are used in the preparatory period of the training process (running, skiing, jumping, throwing) [11, 13]. Using fitness with elements of aerobics, we propose to introduce a training program for each renewed class during the annual cycle, because this is a new means of restoring the physical capacity of young volleyball players. Because fitness with elements of aerobics contributes not only to the restoration, but also to the increase of functional resources of the organism, improves the coordination of movements that are so important for the preparation of athletes 16-17 years. Musical accompaniment, which is used during fitness classes, also helps to create a positive emotional background in the training process of young volleyball players, rhythm classes and intervals of rest affect the training of the cardiovascular and respiratory systems [10, 14]. This is confirmed by the results of our study and is the new data in the training of young volleyball players of 16-17 years.

Conclusion

1. Significant differences in the rates of heart rate regeneration in boys and girls have been found. Reliable improvement of the results of the "jump jump test for 1 min." And the test "lifting of the body for 30 s from the lying position" was revealed. After the experiment, the number of ball losses in the test has been reliably reduced with the impact of the attacker.
2. Fitness exercises with elements of aerobics in combination with music is a comprehensive means of restoring the performance of young volleyball players. As a result of the use of fitness with elements of aerobics in the training process of volleyball players of 16-17 years, the level of functional capabilities and indicators of physical fitness has significantly increased.
3. The developed method positively influences both girls and boys. Under the influence of the developed technique, the girls improve their recovery.

Acknowledgements

The research is conducted according to:

- the research work of Ministry of Education and Science of Ukraine for 2013-2014. „Theoretical and methodical bases of application the information, pedagogical and medical-biological technologies for formation of healthy lifestyle" (№ of the state registration 0113U002003);
- 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 Science of Ukraine for 2017-2018. „Theoretical and methodical bases of application of information, medicalbiological and pedagogical technologies for realization of individual physical, intellectual and spiritual potential and formation of healthy lifestyle" (№ of the state registration 0117U000650).

The author declares that there is no conflict of interests.

References

1. Aoki MS, Arruda AF, Freitas CG, Miloski B, Marcelino PR, Drago G, et al. Monitoring training loads, mood states, and jump performance over two periodized training mesocycles in elite young volleyball players. Int J Sports Sci Coach. 2017; 12(1): 130-137.
2. Delextrat A, Calleja-González J, Hippocrate A, Clarke D. Effects of sports massage and intermittent cold-water

immersion on recovery from matches by basketball players. J Sports Sci. 2012; 31(1):11-19. DOI: 10.1080/02640414.2012.719241.
3. Fernandez-Echeverria C, Gil A, Moreno A, Claver F, Moreno P. Analysis of the variables that predict serve efficacy in young volleyball players. Int J Perform Anal Sport. 2015; 15(1): 172-186.
4. Ghoul N. Tabben M. Chamari K. Tourny C. Effect of Cooling on Postmatch Recovery in Elite Volleyball Players in Warm Conditions. Med Sci Sports Exerc. 2017; 49(5): 1074-1075.
5. Javierre C, Segura R, Ventura JL, Suárez A, Rosés JM. L-Tryptophan supplementation can decrease fatigue perception during an aerobic exercise with supramaximal intercalated anaerobic bouts in young healthy men. Int J Neurosc. 2010; 120(5): 319-327. DOI: 10.3109/ /00207450903389404.
6. Kellmann M. Preventing overtraining in athletes in high-intensity sports and stress recovery monitoring. Scand J Med Sci Sports. 2010; 20(2): 95-102.
7. Kilpatrick MW, Bortzfield AL, Giblin LM. Impact of aerobic exercise trials with varied intensity patterns on perceptions of effort: an evaluation of predicted, in-task, and session exertion. J Sports Sci. 2012; 30(8): 825-832. DOI: 10.1080/02640414.2012.671954.
8. Kozina ZhL, Cieslicka M, Prusik K, Muszkieta R, Sobko IN, Ryepko OA, Bazilyuk TA, Polishchuk SB, Osiptsov AV, Korol SA. Algorithm of athletes' fitness structure individual features' determination with the help of multidimensional analysis (on example of basketball). Phys Edu Students. 2017; 21(5): 225-238. DOI: 10.15561/20755279.2017.0505.
9. Kozina Z. Recovery functional condition of sportsmen using individual non-traditional means of rehabilitation. JPES. 2015; 15(4): 634-639. DOI: 10.7752/jpes.2015.04096.
10. Kozina Z, Iermakov S, Bartík P, Yermakova T, Michal J. Influence of self-regulation psychological and physical means on aged people's functional state. J Hum Sport Ex. 2018; 13(1): 99-115. DOI: 10.14198/jhse.2018.131.10.
11. Kozina Z, Iermakov S, Crełu M, Kadutskaya L, Sobyanin F. Physiological and subjective indicators of reaction to physical load of female basketball players with different game roles. JPES. 2017, 17(1): 378-382. DOI: 10.7752/ jpes.2017.01056.
12. Kozina Z, Kalinicenko V, Cretu M, Osiptsov A, Kudryavtsev M, Polishchuk S, Ilnickaya A, Minenok A. Influence of music on the level of physical fitness of the students practicing rugby (rugby players students). Phys Edu Students. 2018; 22(3): 120-126. https://doi.org/10.1 5561/20755279.2018.0302.
13. Kozina Z, Prusik K, Görner K, Sobko I, Repko O, Bazilyuk T, et al. Comparative characteristics of psychophysiological indicators in the representatives of cyclic and game sports. JPES. (17)2: 648-655.
14. Marques NK, Oliveira A. Level of subjective perception of the muscle soreness of a double female volleyball after two types of recovery interval. Revista Inclusiones. 2017; 4(1): 92-107.
15. Nascimento TA, Verlengia R, Crisp AH, Cesar MC, Ferrari HG, Sindorf MA, Pelligrinotti ÍL. Evaluation of physical capacity in athletic female volleyball players using the TW 20meters test. Gazzetta Medica Italiana Archivio per le Scienze Mediche. 2013; 172(6): 449-455.
16. Pion J, Segers V, Fransen J, Debuyck G, Deprez D, Haerens L, Vaeyens R, Philippaerts R, Lenoir M. Generic anthropometric and performance characteristics among elite adolescent boys in nine different sports. Eur J Sport Sci. 2014; 15(5): 357-366. DOI: 10.1080/17461391.2014.944875.
17. Platonov VN. The system of training athletes in the Olympic sport. General theory and its practical applications. Kiev: Olympic literature; 2015 (in Ukrainian).
18. Popov AN. The structure of physical fitness and its correlation analysis at young players aged 16-17 years at the stage of basic training. Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports. 2014; 12: 54-57. DOI: 10.15561/18189172.2014.1210.
19. Shepelenko TV, Kozina ZhL, Cieslicka M, Prusik K, Muszkieta R, Sobko IN, Ryepko OA, Bazilyuk TA, Polishchuk SB, Osiptsov AV, Kostiukevych VM. Factorial structure of aerobics athletes' fitness. Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports. 2017; 21(6): 291-300. DOI: 10.15561/18189172.2017.0606.
20. Singh H. Comparative study on selected physical fitness and physiological variables between volleyball and handball players. Eur J Phys Culture Sports. 2015; 10(4): 206-211. DOI: 10.13187/ejpe.2015.10.206.
21. Sobko I. Efficiency of application of non-traditional means of restoration of work efficiency in the training process of basketball players of high class. Theory Meth Phys Edu. 2007; 7: 31-34.
22. Visnes H, Bahr R. Training volume and body composition as risk factors for developing jumper's knee among young elite volleyball. Scand J Med Sci Sports. 2012; 23(5): 607-613. DOI: 10.1111/j.1600-0838.2011.01430.
23. Zhanneta K, Irina S, Tatyana B, Olena R, Olena L, Anna I. The applying of the concept of individualization in sport. JPES. 2015; 15(2): 172-177. DOI: 10.7752/ jpes.2015.02027.