Journal of Physical Education and Sport ® (JPES), 17 Supplement issue 5, Art 227, pp. 2188 - 2196, 2017
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Factor structure of the integral readiness of aerobics athletes (women)

ZHANNETA KOZINA[1], TATYANA SHEPELENKO[2], ANDREY OSIPTSOV[3], VIKTOR KOSTIUKEVYCH[4], OLENA REPKO[1], TATYANA BAZILYUK [5], IRINA SOBKO[6], ANATOLII GUBA[1], ANDRII PROKOPENKO[1], MIKOLA TRUBCHANINOV[1], IVAN STASIUK[7], KATERINA MULIK[8]
[1]Kharkiv National Pedagogical University, Ukraine
[2] Ukrainian State University of Railway Transport, Ukraine
[3] Mariupol State University, Ukraine
[4] Mykhailo Kotsyubynskyi Vinnitsa State Pedagogical University, Ukraine
[5] Kiev National University of Technology and Design, Ukraine
[6] Kharkov National Economic University, Ukraine
[7]Kamyanets-Podolsky National University named after Ivan Ogienko
[8]Kharkov State Academy of Physical Culture

Published online: November 24, 2017
(Accepted for publication November 15, 2017
DOI:10.7752/jpes.2017.s5227

Abstract

The aim of the work is to develop the principles of team completion in sports aerobics using methods of factor and cluster analysis.

Material and methods. *Participants in the study*. The study involved 24 aerobics athletes (women) – members of the national team and its reserve for sports aerobics in Kharkov.

*Methods of research: A*erobics athletes were performed complex examination to determine the functional state of the body of athletes (arterial pressure, parameters of pulsometry, testing on the treadmill), psychophysiological state (determination of the time of a simple and complex reaction in various modes of signal delivery). Physical development, vestibular stability and physical readiness were also determined. For the processing of data, methods of mathematical statistics were applied the computer programs "EXEL" and "SPSS". Mathematical and visual models of aerobics of each group were constructed.

Results. Using factor analysis in the structure of the complex preparedness of women, four main factors were identified: 1 - The factor "Parasympathicotonia"; 2 - Factor "Mobility of the nervous system "; 3 - Factor "Force"; 4 - Factor "A sense of time". The individual factor structure of athletes' preparedness was revealed, for which the percentage values of the severity of each factor in each athlete were determined. All athletes have a different severity of various factors, indicating that there are significant individual differences. On the basis of the data obtained, groups of athletes can be formed for appearances in various competitive categories.

Conclusions. Factor analysis allows to determine the overall and individual structure of athletes' preparedness. The data obtained with regard to the individual preparedness structure can be used for associations of athletes in groups for participation in different competitive categories.

Key words: individual, algorithm, aerobics, factor, analysis.

Introduction

Sports aerobic is one of the youngest sports that is still being formed. In this sport there are many unsolved problems (Andreu, JMP., 2015; Chen, H. X., 2014). This is due to the fact that the main contingent of athletes was provided by an influx from other sports (Giovanelli, N, Taboga, P, Rejc, E, Lazzer, S., 2017; Mayorga-Vega, D, Montoro-Escano, J, Merino-Marban, R, Viciana, J., 2016). Therefore, the training of athletes in aerobics is built by analogy with the training in other types of gymnastics (Nyberg, G, Meckbach, J., 2017; Sindiani, M, Eliakim, A, Segev, D, Meckel, Y., 2017). However, in the process of increasing competition, this approach to the training of athletes can no longer provide high-level achievements.

Currently in the scientific literature, much attention is paid to aerobics as a means of improving health and improving the functional state of people.

Gurieieva A.M., Klopov R.V. (2014) described the factor structure of the physical state of female students at the beginning of the academic year and proposed a rational balance of methods of developing physical skills necessary for drawing up a program of recreational aerobics for women students in higher education. The authors managed to determine the most important factors affecting the health status of freshmen. Factor analysis allowed to indicate the ratio of methods used in the program of recreational aerobics, which are designed to develop physical skills in active leisure. Golod N. R. (2015) singled out the main provisions of the comprehensive program of physical rehabilitation for students of a special medical group on the basis of motor impairment. The program of rehabilitation of students included: changing the way of life; morning hygienic

Corresponding Author ZHANNETA KOZINA, E-mail: zhanneta.kozina@gmail.com

gymnastics; kinesitherapy (use of yoga, functional training); Aerobic exercises (swimming, Nordic walking, jogging, health aerobics); massage. Thus, a number of scientific developments on recreational aerobics closely intersect with the problems of sports aerobics and can be used in the training process of aerobic athletes. However, the problems of sports aerobics are only beginning to be considered in depth in scientific research.

Nehra N. K. (2014) analyzed the causes and precautions for sports injuries in sports aerobics. The author points out that irrational movements, non-standard grounds and unreasonable methods of teaching lead to injuries. Among injuries, the most common are muscular and ligamentous deformities, injuries of the ankle and knee joint. Injuries to the hip muscles are the most common. The author also points out that the main cause of sports injuries is an inadequate warm-up.

Nunez R. A. et al. (2013) found that the most common injuries are limb injuries. The author points out that there is little scientific basis in this sport. The greatest amount of research on the sports aspect of aerobics is concentrated in Spain. Qiu Q. E. et al. (2012) conducted an experimental study of the mechanical properties of the only sports shoes used in aerobics. The anti-skid properties of Reebok and Huakang shoes were also studied, and the mechanical effect of sports shoes for aerobics was evaluated.

Chen L. Y. (2017) proposed a method for reconstructing movements in aerobics, based on a three-dimensional vision of motion. The author suggests the use of computer visual recognition technology to extract the characteristic image point of the body of an athlete-aerobist. This makes it possible to obtain the main features of the outline contour edge, and then the motion is evaluated from four positions in three-dimensional space. The results of the simulation show that the proposed method, which is used to extract images of body positions for processing a three-dimensional evaluation of the shape of the body of athletes, can significantly improve the efficiency of motion estimation, as well as its correction during training.

Fan C. (2014) showed that one of the main elements in sports aerobics are jumps. In this case, not only the height of the jump, but also the speed of jumping and the position in the air is of great importance. The author suggests a technique for teaching aerobics, which involves not only the use of jumping exercises to improve skills in the performance of the relevant elements, but also the use of other special exercises to improve the ability to control the body in the air, jumping techniques, etc. The technique proposed by the author was used in the experimental group and has shown its effectiveness.

Hu C. F. and Y. Xiang (2013) point out that the main purpose of aerobics is to show people the beauty of art and movement, to give the opportunity to enjoy the beauty of motor movements. Jiang G. P. et al. (2012) investigated jumping with obstacles in sports aerobics. The authors showed that in the take-off phase there are two peak phases of manifestation of the maximum strength of the thigh and shin. The peak phase of the hip muscle strain manifests itself in the preparatory phase of the jump, and the shin - at the stage of repulsion. In the phase of flight, various segments of the body have a different effect on the effect of rotation. In the landing phase, the maximum rotational moment of the hip joints is much larger than that of the other joints. The author recommends using the received data when teaching the technique of jumping movements in aerobics.

Li A. (2014) analyzes the physiological and psychological characteristics of high-class athletes in sports aerobics that have been injured and suggests appropriate rehabilitation measures to develop scientific foundations for building a training process in sports aerobics and rehabilitation after sports injuries. The author points out that the causes of sports injuries are complex and multifaceted. The author analyzed the psychological causes of sports injuries, which makes it possible to facilitate effective rehabilitation of athletes.

Zarebska A. (2016) found that dance aerobics, one of the most common practices in the world of adult fitness, provides sufficient incentives for training to increase the explosive force necessary to increase the jump height. The author reveals the genetic conditionality of the training effect of jumping. Yan F. F. (2016) proposed a method for the decoration of complete sets of competitive aerobics with three participants. The author points out that competitive aerobics is a kind of sports object, combined with music, sets of movements, technical complexity and self-efficacy, which is characterized by fitness, strength and physical beauty. The trio is one of the categories of sports aerobics. The author has realized the influence of performances in threes on the development of competitive aerobics. The results show that competitive aerobics has the following aspects: sportswear, temperament, body shape, physical quality and others. Xiang F. F. and P. Shi (2016) analyzed the importance of strength for maintaining the body's position in aerobics. The paper offers functions and warnings for strength training in aerobics. In the aerobic position of the body during the whole process of movement, the correct body posture is the action of the factor "health, strength, beauty". Important is the speed, rhythm, amplitude, position of the center of gravity. The pose can reflect the artistic achievements of athletes, affects the overall judge's evaluation. In motor postures, the referee pays more attention to movements. The authors analyzed the importance of developing strength in terms of body position.

Thus, there are problems in the construction of the training process in sports aerobics. The greatest attention is paid to physical training of athletes, problems of traumatism and rehabilitation after trauma, analysis of the biomechanical structure of various movements, the use of interactive technologies. However, the problem of determining the factor structure of the athletes' complex preparedness remains practically unlighted. The purpose of the work is to determine the factor structure of the preparedness of aerobic athletes (women).

Materials and methods

Participants. 24 aerobic athletes (women) participated in the study - members of the national team and its reserve for sports aerobics in Kharkov.

Methods of research: Athletes (aerobics athelet) underwent a comprehensive examination to determine the functional state of the body of athletes (blood pressure, indicators of variation pulsometry, testing on the treadmill), psychophysiological state (determination of the time of a simple and complex reaction in various modes of signal delivery). They also determined physical development and physical readiness; vestibular stability. For the processing of data, methods of mathematical statistics using the computer programs "EXEL" and "SPSS" were applied. Mathematical and visual models of aerobics of each group were constructed.

For the analysis of vegetative regulation of cardiac activity, variational heart rate (Variability of the rhythm of the heart)

The signal was recorded on a portable cardiographic device called "Cardiolab +" (Computer electrocardiograph "Cardiotest" allows to register 12 channels standard ECG, ECG in the lead system by Neb and Frank, Dialog box "Complex" Dialog box "Lens" http://www.dx-sys.com.ua/en/products/). Its basis is 3; 6; 12-channel cardiograph + phonocardiograph Cardio CE + on the basis of a handheld computer (or pocket personal computer) PAQ 3870 with a module for wireless transmission of Bluetooth information. A continuous heart rate monitor of the Polar model with the appropriate software was also used. The recording was carried out for 5 minutes in the supine position after a 5-minute rest.

The subsequent processing of cardio intervals allowed to determine a number of statistical characteristics of heart rate variability [19]: From the parameters of the heart rhythm determined:

1. Mo (the modality of the duration of the RR-intervals) is the most common interval between the teeth RR (c);

2. AMo (amplitude of the mode of the duration of RR intervals) is the percentage expression of the number of intervals that are most often encountered, to the total number of measured intervals (in this case 100 RR intervals were used) (%);

3. Delta x is the variation in the duration of the RR-intervals, that is, the difference between the largest and the smallest value of the RR-intervals (s);

4. The stress index (cu) of regulatory mechanisms (IN) was determined by the formula

$$IN = AMo / 2Mo \bullet \Delta x \quad (1),$$

where:

Δx is the value of the variation span of the duration of the RR-intervals (s),

Mo is the value of the mode of the duration of the RR-intervals (s),

AMo is an indicator of the mode amplitude of the duration of the RR-intervals (%).

When analyzing the parameters of the heart rhythm, we were guided by the fact that these heart rate indicators reflect the different contribution of the sympathetic and parasympathetic parts of the autonomic nervous system to the process of regulation of cardiac activity. The mode (Mo) of the duration of the RR-intervals indicates the resultant effect of regulatory influences, reflects the most stable level of functioning in the given conditions. The variation range reflects the range of possible deviations of the random process variant and is determined mainly by the severity of the respiratory fluctuations of the heart rhythm, therefore this indicator is considered an indicator of the activity of the autonomous mechanism of the regulation of the heart rhythm. The amplitude of the mode (AMo) of the duration of the RR intervals allows one to judge the activity of the central mechanism of the regulation of the heart rhythm, since an increase in the number of identical cardiac cycles is a consequence of stabilization of the heart rhythm, a decrease in the spread of values, i.e. indicates a decrease in the effects of autoregulation. Thus, an increase in the AMo indices of the duration of the RR-intervals and IN indicates an increase in the tone of the sympathetic part of the autonomic nervous system, and an increase in the variation span of the duration of the RR-intervals increases the effect of the parasympathetic division of the autonomic nervous syste.

In our study, testing was also conducted to determine the time of simple and complex reactions to sound and visual incentives. The time of a complex reaction was determined in the test mode with feedback. The time of a complex visual-motor reaction in the mode of determining with feedback, the latent period of the reaction time, the standard deviation, the number of errors, the minimum exposure time, and the time of attainment to the minimum exposure were determined. In determining the strength and mobility of the nervous system, the following provisions were adhered to: the fewer errors in sub-modes of a complex visual-motor reaction with feedback, the higher the strength of the nervous system; the shorter the time in the modes of a complex visual-motor reaction with feedback, the higher the mobility of the nervous system (Korobeynikov, G., Mazmanian, K., Korobeynikova, L., Jagiełło, W., 2010).

The vestibular stability was determined with the help of the mechanical Barany chair. The rotation was performed manually for 20 s at a speed of 2 revolutions per second. Every 2 seconds, heart rate was recorded using a photocell. The heart rate was recorded after completion of rotation for 10 seconds every 2 seconds. The increase in heart rate after the beginning and the end of rotation was regarded as an adequate reaction to rotation, which is the inclusion of the sympathetic part of the autonomic nervous system, the decrease in heart rate after the beginning and the end of rotation was regarded as an inadequate reaction to rotation, which is activation of

the parasympathetic part of the autonomic nervous system (motion sickness). When processing data using factor analysis, the heart rate was selected in the second second after the start of rotation and the heart rate at the second second after the end of rotation (Pomeshchikova, I., Iermakov, S., Bartik, P., Shevchenko, O., Nosko, M., Yermakova, T., & Nosko, Y., 2016).

Statistical analysis. The digital material was processed using traditional methods of mathematical statistics. For each indicator, the arithmetic mean, the standard deviation S (standard deviation) were determined.

When processing the primary materials of this study, in addition to calculating primary statistics, a factor analysis of the test indicators was carried out. The received data were processed by the generally accepted methods of mathematical statistics with the help of Microsoft Excel programs, SPSS. Differences were considered significant at a significance level at $p<0.05$.

Results

With the help of factor analysis, carried out by the method of the main components, in the structure of the complex preparedness of women – aerobics athletes, four main factors were identified by Kettel's "rocky oscillation" method. To characterize each factor, the indicators included in it were analyzed.

The following indicators were included in the first factor (32.5% of the total dispersion) (Table 1): heart rate for 2 seconds with rotation on the Barany chair (r = -0.96), heart rate for 90 seconds with recovery after performing the standard load on; the rhythm of the RR intervals (r = -0.93), the RR-interval fashion (r = -0.88), the rotational heart rate on the armchair (r = -0.86), Heart rate of rest (r = -0.78); the heart rate immediately after the rotation on the Barany chair (r = -0.73).

In the factor structure of the preparedness of women to the first factor included indicators that are identical to the factor structure of the preparedness of men (Shepelenko, T., Kozina, Z., Cieślicka, M., Prusik, K., Muszkieta, R., Sobko, I., Ryepko, O., Bazilyuk, T., Polishchuk, S., Osiptsov, A., & Kostiukevych, V., 2017). But it should be noted that these indicators came with the opposite sign of correlation in comparison with men. In addition, the first factor in women included indicators such as "Variation width RR intervals" (r = 0.93), "Fashion RR intervals" (r = -0.88), "Heart Rate" (r = -0.78). All these indicators reflect the level of regulation of autonomic balance from the central nervous system. So, the decrease in the heart rate of rest, the average index of resting heart rate, the increase in heart rate at the start and immediately after the end of rotation on the Barany chair, reducing the mode of RR intervals and increasing the variational scope of RR intervals indicate the activation of the parasympathetic part of the autonomic nervous system. That is, in women, as in men, the first factor included indicators of autonomic balance regulation by the central nervous system. But in women, the number of these indicators is greater, and they, unlike men, show the activity of the parasympathetic part of the nervous system. Perhaps this is due to the fact that in a state of rest women are more relaxed in comparison with men. Based on the foregoing, the first factor was called "Parasympathicotonia" (Fig. 1).

The second factor (27.6% of the total dispersion) included indicators such as the response time of the reaction in the mode of determining with feedback (r = -0.97), the total test response time in the feedback mode (r = - 0.93), the minimum exposure time of the signal in the feed reaction in the mode of determining with feedback (r = -0.81), the mean value of the reaction time of the choice (r = -0.74), the mean time of the reaction to sound (r = -0, 64). It should be noted, that to this factor included indicators that reflect the mobility of nerve processes. The lower the values of these indicators, the greater the mobility of the nervous processes. Since in this factor all these indicators came with a negative correlation coefficient, we can conclude that this factor reflects the mobility of the nervous processes. Therefore, the second factor was called "Mobility of the nervous system."

To the third factor (22.14% of the total dispersion) in the structure of the complex preparedness of women included the following indicators: jump height (r = -0.95), the number of errors in the test for the response rate in the reaction in the mode of determining with feedback (r = -0 , 85), body weight (r = 0.82), brush strength (r = 0.71), degree strength (r = 0.69), body length (r = 0.66) (Table 1). It should be noted that the indicators included in the third factor, mainly reflect the level of development of power capabilities, in particular, explosive force, absolute force, as well as the strength of the nervous system. This factor included the strength of the nervous system (the number of errors when performing the test on the response rate in the feedback mode) (r = -0,93). Since the strength of the nervous system correlates with the indicators of physical strength, it can be noted that in women, as in men (Shepelenko, T., Kozina, Z., Cieślicka, M., Prusik, K., Muszkieta, R., Sobko, I., Ryepko, O., Bazilyuk, T., Polishchuk, S., Osiptsov, A., & Kostiukevych, V., 2017), the strength of the nervous system and physical strength are integral manifestations of the overall psychophysical structure of the body. Based on the received data, the third factor was called "Strength" (Fig. 1).

The fourth factor (16.06% of the total dispersion) included such indicators as the error of reproduction of time intervals 1 s (r = 0.94), age (r = -0.52) (Table 1). The main factor that created this factor is an error when playing back a time slot of 1 s. since this indicator entered the fourth factor with a negative correlation sign, it can be noted that the smaller the error, the less time to play the time interval. The age of athletes also entered this factor with a negative correlation sign. This suggests that athletes of the younger age tend to accelerate in the subjective sense of time. According to the characteristics of the indicators, the fourth factor was called "A sense

of time" (Fig. 1). Then, an individual factor structure of athletes' preparedness was revealed, for which the percentage values of the severity of each factor in each athlete were determined (Table 2).

Table1 - Return matrix of components of aerobic athlete testing (women) (n=24)

Name of metrics	Factor number, contribution to the general variance			
	1 32,5%	2 27,6%	3 22,14%	4 16,06%
HR with a rotation on the Barany chair, beats·min^{-1}	-0,96			
HR repeat after 90 seconds after work, beats·min^{-1}	-0,95			
Variation of RR intervals, s	0,93			
Mo RR intervals, s	-0,88			
HR after turning on the Barany chair after 10 seconds, beats·min^{-1}	-0,86			
HR rest, beats·min^{-1}	-0,78			
HR after turning on the Barany chair, beats·min^{-1}	-0,73			
The time of the selection reaction in the mode of determining with feedback, ms		-0,97		
Reaction selection reaction in the mode of determining with feedback, total time test run, ms		-0,93		
The time of response on the minimum exposure in the test of the reaction in the mode of determining with feedback, ms		-0,81		
The time of the reaction of choice, the average value, s		-0,74		
Reaction time to sound, average value, s		-0,64		
Jump height, sm			-0,95	
The time of the selection reaction in the mode of determining with feedback, errors, quantity			-0,85	
Body weight, kg			0,82	
Brush force, kg			0,71	
Strength force, kg			0,69	
Body length, sm			0,66	
Error playing time intervals 1 s, s				-0,94
Age, year				-0,52

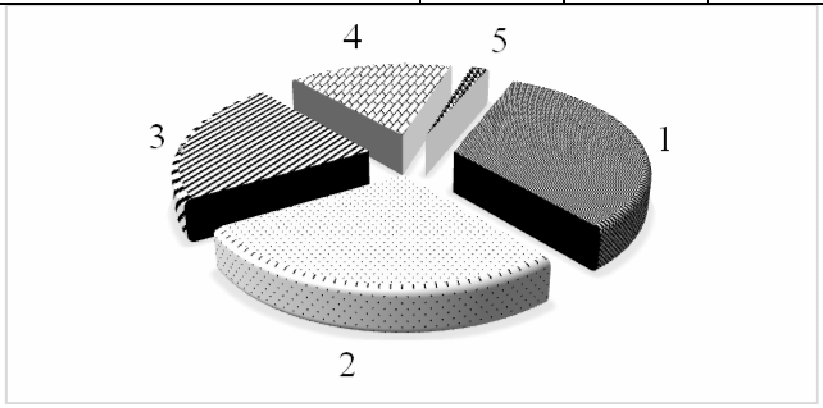

Fig. 1. Factor structure of aerobic athletes (women) (n = 24) (4 factors are distinguished):
1 - "Parasympathicotonia", 32.5%;
2 - "Mobility of the nervous system", 27,6%;
3 - "Strength"; 22.14%;
4 - "A sense of time"; 16.06%
5 - Other factors; 1.7%

Table 2 shows that all athletes have a different severity of various factors, indicating that there are significant individual differences. Like men (Shepelenko, T., Kozina, Z., Cieślicka, M., Prusik, K., Muszkieta, R., Sobko, I., Ryepko, O., Bazilyuk, T., Polishchuk, S., Osiptsov, A., & Kostiukevych, V., 2017), this should be manifested in different styles of performances and the need to use individual programs for the preparation of aerobics athletes.

As can be seen from Table 1 and Figure 1, the greatest contribution to the total variance is made by the first and second factors, from which it is logical to conclude that the most significant in the structure of fitness of aerobics athletes are indicators of vegetative balance, reflected in the parasympathetic tone, and indicators of

mobility of the nervous system. Less significant, though important enough, are indicators of strength and a sense of time that can be explained by the peculiarities of the female body.

Table 2 - Individual expressiveness of factors in the structure of fitness of aerobics athletes (women) (% of maximum expressiveness factor in the sample) (n = 24)

№ athletes	Parasympathicotonia	Mobility of the nervous system	Strength	A sense of time
1	87,14	25,34	11,15	34,14
2	63,12	50,18	98,97	57,43
3	65,11	55,17	65,14	65,42
4	82,54	79,81	69,34	32,34
5	54,76	85,43	53,13	45,65
6	75,11	35,34	27,13	44,17
7	100	62,15	27,15	65,18
8	53,12	84,26	54,23	41,47
9	43,23	69,15	64,44	100
10	85,34	25,43	21,11	86,98
11	96,53	61,23	23,43	67,78
12	55,45	55,16	66,65	33,33
13	76,14	39,19	26,17	21,11
14	67,18	57,16	35,56	14,44
15	34,13	75,46	46,67	55,56
16	78,97	100	77,78	46,67
17	74,14	14,87	92,22	68,89
18	85,13	27,87	100	24,44
19	84,23	24,67	11,11	32,22
20	85,46	51,34	67,78	43,11
21	44,16	78,65	48,89	51,16
22	34,16	78,65	48,89	51,16
23	76,14	97,45	56,17	54,24
24	72,53	19,43	84,13	66,27

Discussion

This study is based on the concept of individualization training athletes (Zhanneta, K., Irina, S., Tatyana, B., Olena, R., Olena, L., & Anna, I., 2015; Kozina, Zh.L., Prusik, Krzysztof, & Prusik, Katarzyna, 2015; Kozina, Z., Sobko, I., Yermakova, T., Cieslicka, M., Zukow, W., Chia, M., . . . Korobeinik, V., 2016; Korobeynikov, G., Mazmanian, K., Korobeynikova, L., Jagiełło, W., 2010). The concept involves the use of an algorithm, which consists of the following stages:

- testing of athletes, including a set of tests of at least 10;
- definition of the general structure of preparedness of sportsmen by the factorial analysis. Identification of the main factors and drawing up their characteristics;
- conducting a hierarchical cluster analysis of test scores;
- determination of individual factor values.
- on the basis of individual factor values and cluster analysis, the compilation of individual characteristics of athletes.

According to this concept, multidimensional analysis methods were used, in particular, factor analysis to determine the structure of the preparedness of athletes and to identify the leading qualities of athletes and the distribution of aerobic athletes in groups according to individual features of the functional state, complex preparedness and psychophysiological characteristics.

The testing was carried out on functional and psychophysiological parameters of women aerobics athletes.

Using factor analysis, carried out by the method of the main components, in the structure of the complex preparedness of men, four main factors were distinguished by Kettel's "rocky oscillation" method. To characterize each factor, the indicators included in it were analyzed. Factors in the structure of aerobic fitness athletes were named as follows: 1 - Factor "Parasympatheticotonia"; 2 - Factor "Force"; 3 - Factor "Mobility of the nervous system"; 4 - Factor "A sense of time". Then, an individual factor structure of athletes' preparedness was revealed, for which the percentage values of the severity of each factor in each athlete were determined. All athletes have a different severity of various factors, indicating that there are significant individual differences.

To determine the best options for combining aerobic athletes in groups for performances in different competitive categories, factor analysis can be supplemented by cluster analysis of test indicators (Kozina, Z., Shepelenko T., Cieślicka M., Prusik K., Muszkieta R., Osiptsov A., Kostiukevych V., Bazilyuk T., Sobko I.N., Ryepko O.A, Polishchuk S.B., & Ilnickaya A.S., 2017). Results of cluster analysis are compared with individual factor values, profiles of athletes are being compiled. On the basis of the data obtained, groups of athletes can be formed for appearances in various competitive categories.

In our work, the process of teamwork in sports aerobics is based on the determination of individual factor structure of the preparedness of each athlete and the results of cluster analysis of the distribution of athletes to groups for performances in different categories of competition (Kozina, Z., Shepelenko T., Cieślicka

M., Prusik K., Muszkieta R., Osiptsov A., Kostiukevych V., Bazilyuk T., Sobko I.N., Ryepko O.A, Polishchuk S.B., & Ilnickaya A.S., 2017). In our study, the methods of multivariate analysis for these purposes were not used, and therefore the creation of the algorithm for the completion of teams in aerobic exercise is the first developed problem. The analysis of literary data (Arziutov, G., Iermakov, S., Bartik, P., Nosko, M., & Cynarski, W. J., 2016; Boichuk, R., Iermakov, S., & Nosko, M., 2017; Kriventsova, I., Iermakov, S., Bartik, P., Nosko, M., & Cynarski, W. J., 2017; Nosko, M., Razumeyko, N., Iermakov, S., & Yermakova, T., 2016; Osipov, A. Y., Kudryavtsev, M. D., Iermakov, S. S., & Jagiełło, W., 2017) showed that most authors in determining the basic principles of constructing a training process one of the main consider the principle of combining team training and individualization. At the same time, if cyclic and gaming sports already have some work on specific recommendations for the construction of a training process for each team (Pomeshchikova, I., Iermakov, S., Bartik, P., Shevchenko, O., Nosko, M., Yermakova, T., & Nosko, Y., 2016; Zhanneta, K., Irina, S., Tatyana, B., Olena, R., Olena, L., & Anna, I., 2015), then sports aerobics is just beginning to develop the theoretical, methodological and organizational foundations of the unity of team and individual approach to the training process of athletes. In this regard, our work is a new direction in which the principle of unity of command and individualization of the preparation of aerobists is transformed into a system that has its structure, algorithms, mathematical apparatus.

From the analysis of literary data (Kozina, Zh.L., Prusik, Krzysztof, & Prusik, Katarzyna, 2015; Kozina, Z., Sobko, I., Yermakova, T., Cieslicka, M., Zukow, W., Chia, M., . . . Korobeinik, V., 2016; Korobeynikov, G., Mazmanian, K., Korobeynikova, L., Jagiełło, W., 2010) it was discovered that the problem of individual differences has a rich history and goes far beyond the scope of a particular science, including – the theory and methods of physical education and sports. From this perspective, our work is an extension and complement of existing knowledge about the individual nature of people and the possibility of using the individual characteristics of athletes to create different groups depending on the tasks of the training process.

In particular, in our work we used the methodology presented in the works of Kozina Z. (2015, 2016, 2017) for individualization in gaming sports. From this point of view, the system of combining team and individual approach to the process of preparation of aerobic athletes, presented in our work, is an extension and complement of knowledge, presented in the works of Kozina Z. (2016). In our work we present the planning of the training process taking into account the individual characteristics of the factor structure of athletes' preparedness, their psycho-physiological and functional characteristics. The most widespread problem of individualization is presented in psychology and psychophysiology (Korobeynikov, G., Mazmanian, K., Korobeynikova, L., Jagiełło, W., 2010). In psychology distinguish different types of higher nervous activity according to the properties of the nervous system. Individual differences of people are most fully covered in differential psychology (Korobeynikov, G., Mazmanian, K., Korobeynikova, L., Jagiełło, W., 2010). At the same time, many authors note that none of the known properties of the nervous system is not exclusively dependent on the genotype, since it is to some extent influenced by the environment.

The mentioned authors consider the problem of individual differences solely from the point of view of psychological differences and do not concern the problem of individualization from the standpoint of human analysis as a system that combines a set of different indicators (Korobeynikov, G., Mazmanian, K., Korobeynikova, L., Jagiełło, W., 2010). Therefore, from this point of view, our work represents a certain novelty. It should be noted, however, that some authors (Nosko, M., Razumeyko, N., Iermakov, S., & Yermakova, T., 2016) try to give an integral assessment of individuality, taking into account a wide range of indicators. These indicators include the properties of the nervous system in conjunction with the predominance of one of the cognitive types and the development of certain physical qualities and psychophysiological abilities. However, in this case, the characteristic of individual differences is given for each group of indicators separately, without their mutual integration. This is how the individual differences in sport are evaluated when schemes of an individual structure of preparedness or competitive activity for each group of indicators are created separately, and this structure consists of individual indicators, rather than factors, each of which includes a set of interrelated indicators, as suggested in our study. In this regard, we propose an algorithm for constructing individual models of complex preparedness, which allow us to evaluate individual differences in individual indicators, but in a holistic manner, combining all measurable indicators into a single system.

In sports physiology and sports medicine, individual differences are classified according to the peculiarities of the response to cardiovascular and nervous system loading. Our system and its emerging methods and algorithms for the construction of individual programs allow combining physiological, psychological and psychophysiological indicators into a single integral assessment of the individual characteristics of athletes.

In sports aerobics, athletes are combined into groups for performances in various competitive categories. From the optimal selection of such teams depends on the success of the competitions. It should be noted that in the presence of recommendations for the preparation of athletes in aerobics, the issues of individual differences relating to other individual characteristics (psychological, physiological, psychophysiological) of athletes are not covered, although this question is important for ensuring the success of competitions. Therefore, the proposed algorithms for determining the leading factors that include a wide range of the analyzed indicators in the structure of athletes' preparedness, seems a new approach to the problem of individualization of training.

Conclusions

1. Testing was performed on the functional and psychophysiological characteristics of women aerobic athletes. Using factor analysis in the structure of the complex preparedness of women aerobic athletes, four main factors were identified: 1 - The factor "Parasympathicotonia"; 2 - Factor "Mobility of the nervous system"; 3 - Factor "Strength"; 4 - Factor "A sense of time".

2. The individual factor structure of athletes' preparedness was revealed, for which the percentage values of the severity of each factor in each athlete were determined. All athletes have a different severity of various factors, indicating that there are significant individual differences.

3. On the basis of the data obtained, groups of athletes may be formed for performances in various competitive categories.

References

Andreu, JMP. (2015). Sport and personal variables in the occurrence of sports injuries. Differences between individual and team sports. *Retos-Nuevas Tendencias En Educacion Fisica Deporte Y Recreacion*, 28, 21-25.

Arziutov, G., Iermakov, S., Bartik, P., Nosko, M., & Cynarski, W. J. (2016). The use of didactic laws in the teaching of the physical elements involved in judo techniques. *Ido Movement for Culture, 16*(4), 21-30. doi:10.14589/ido.16.4.4

Boichuk, R., Iermakov, S., & Nosko, M. (2017). Pedagogical conditions of motor training of junior volleyball players during the initial stage. *Journal of Physical Education and Sport, 17*(1), 327-334. doi:10.7752/jpes.2017.01048

Boichuk, R., Iermakov, S., Nosko, M., & Kovtsun, V. (2017). Special aspects of female volleyball players' coordination training at the stage of specialized preparation. *Journal of Physical Education and Sport, 17*(2), 884-891. doi:10.7752/jpes.2017.02135

Chen, H, Sun HC, Dai, J, Griffin, M. (2017). Relationships Among Middle School Students' Expectancy Beliefs, Task Values, and Health-Related Fitness Performance. *Journal of Teaching in Physical Education*. 36(1), 40-9.

Chen, H. X. (2014). *SWOT Analysis Deeply Promote Aerobics Market-orientation Development Under China Sport Service Certification*. *7th International Symposium on Education Innovation Location: Henan Polytechn Univ, Beijing*, 289-94.

Fan, C. (2014). Biomechanical Study of Jump Ability for Aerobics Sports based on Single Chip Technology. In W. J. Du & M. Ma (Eds.), *Green Power, Materials and Manufacturing Technology and Applications Iii, Pts 1 and 2* (Vol. 484-485, pp. 408-412).

Giovanelli, N, Taboga, P, Rejc, E, Lazzer, S. (2017). Effects of strength, explosive and plyometric training on energy cost of running in ultra-endurance athletes. *European Journal of Sport Science*. 17(7), 805-13.

Golod, N. R. (2015). Principles of developing a well-rounded program of physical rehabilitation for female students in the special medical group with consideration of physical activity impairment. *Pedagogics, Psychology, Medical-Biological Problems Of Physical Training And Sports, 19*(5), 9-15. doi:10.15561/18189172.2015.0502

Gurieieva, A.M., & Klopov, R.V. (2014). Factor structure of physical state of female students of higher education institution. *Pedagogics, Psychology, Medical-Biological Problems Of Physical Training And Sports, 18*(7), 7-11. doi:10.6084/m9.figshare.1015378

Hu, C. F., & Xiang, Y. (2013). Analysis the Relationship of System Theory and Aesthetics of the Aerobics. In G. Lee (Ed.), *2013 2nd International Conference on Education Reform and Management Innovation* (Vol. 45, pp. 101-104).

Jiang, G. P., Ji, Z. Q., Li, X. L., & Guo, L. L. (2012). *Biomechanical Analysis on Free Falls and Straddle Jump to Push up Difficulty Elements in Sports Aerobics*.

Korobeynikov, G., Mazmanian, K., Korobeynikova, L., Jagiełło, W. (2010). Psychophysiological states and motivation in elite judokas. *Archives of Budo, 6*(3), 129-136.

Kozina, Z, Prusik, K, Görner, K, Sobko, I, Repko, O, Bazilyuk, T, Kostiukevych, V, Goncharenko, V, Galan, Y, Goncharenko, O, Korol, S, & Korol, S. (2017). Comparative characteristics of psychophysiological indicators in the representatives of cyclic and game sports. *Journal of Physical Education and Sport*, 17(2), 648 – 655.

Kozina, Z., Shepelenko T., Cieślicka M., Prusik K., Muszkieta R., Osiptsov A., Kostiukevych V., Bazilyuk T., Sobko I.N., Ryepko O.A, Polishchuk S.B., & Ilnickaya A.S. (2017). Acquisition of commands in sport aerobics on the basis of application of methods of multidimensional analysis. *Physical Education of Students, 2017, 21*(6), 354-362.

Kozina, Z., Repko, O., Kozin, S., Kostyrko, A., Yermakova, T., & Goncharenko, V. (2016). Motor skills formation technique in 6 to 7-year-old children based on their psychological and physical features (rock climbing as an example). *Journal of Physical Education and Sport, 16*(3), 866-874. doi:10.7752/jpes.2016.03137

Kozina, Z., Sobko, I., Yermakova, T., Cieslicka, M., Zukow, W., Chia, M., . . . Korobeinik, V. (2016). Psychophysiological characteristics of female basketball players with hearing problems as the basis for the technical tactic training methodic in world level teams. *Journal of Physical Education and Sport, 16*(4), 1348-1359. doi:10.7752/jpes.2016.04213

Kozina, Zh.L., Prusik, Krzysztof, & Prusik, Katarzyna (2015). The concept of individual approach in sport. *Pedagogics, psychology, medical-biological problems of physical training and sports, 3,* 28-37. http://dx.doi.org/10.15561/18189172.2015.0305

Kriventsova, I., Iermakov, S., Bartik, P., Nosko, M., & Cynarski, W. J. (2017). Optimization of student-fencers' tactical training. *Ido Movement for Culture, 17*(3), 21-30. doi:10.14589/ido.17.3.3

Li, A. (2014). An Analysis of Physiological and Psychological Rehabilitation from Injuries of Sport Aerobics Athletes. In G. Lee (Ed.), *2014 4th International Conference on Education and Education Management* (Vol. 63, pp. 206-209).

Mayorga-Vega, D, Montoro-Escano, J, Merino-Marban, R, Viciana, J. (2016). Effects of a physical education-based programme on health-related physical fitness and its maintenance in high school students: A cluster-randomized controlled trial. *European Physical Education Review*. 22(2), 243-59.

Nehra, N. K. (2014). Causes and Precautions of Sports Injuries in Competitive Aerobics. *International Symposium 2014 - Common Development of Sports and Modern Society*, 249-252.

Nosko, M., Razumeyko, N., Iermakov, S., & Yermakova, T. (2016). Correction of 6 to 10-year-old schoolchildren postures using muscular-tonic imbalance indicators. *Journal of Physical Education and Sport, 16*(3), 988-999. doi:10.7752/jpes.2016.03156

Nunez, R. A., Gutierrez-Sanchez, A., & Santana, M. V. (2013). AEROBIC GYMNASTICS INJURIES. REVIEW ARTICLE. *Revista Internacional De Medicina Y Ciencias De La Actividad Fisica Y Del Deporte, 13*(49), 183-199.

Nyberg, G, Meckbach, J. (2017). Exergames "as a teacher' of movement education: exploring knowing in moving when playing dance games in physical education. *Physical Education and Sport Pedagogy*. 22(1), 1-14.

Osipov, A. Y., Kudryavtsev, M. D., Iermakov, S. S., & Jagiełło, W. (2017). Topics of doctoral and postdoctoral dissertations devoted to judo in period 2000-2016 – the overall analysis of works of russian experts. *Archives of Budo, 13,* 1-10.

Pomeshchikova, I., Iermakov, S., Bartik, P., Shevchenko, O., Nosko, M., Yermakova, T., & Nosko, Y. (2016). Influence of exercises and games with ball on vestibular stability of students with muscular-skeletal apparatus disorders. [Utjecaj vježbi i igara sa loptom na vestibularnu stabilnosti učenika s poremećajem mišićno-skeletnog sustava] *Sport Science, 9*(1), 75-83.

Qiu, Q. E., Hu, Q. L., Gu, Y. D., & Liu, G. P. (2012). Experimental Study on Mechanical Properties of Sole materials of Aerobics sports shoes *Material and Manufacturing Technology Ii, Pts 1 and 2* (Vol. 341-342, pp. 77-79).

Shepelenko, T., Kozina, Z., Cieślicka, M., Prusik, K., Muszkieta, R., Sobko, I., Ryepko, O., Bazilyuk, T., Polishchuk, S., Osiptsov, A., & Kostiukevych, V. (2017). Factor structure of aerobics athletes preparation. *Pedagogics, psychology, medical-biological problems of physical training and sports. 2017, 21*(6), 345-352.

Sindiani, M, Eliakim, A, Segev, D, Meckel, Y. (2017). The effect of two different interval-training programmes on physiological and performance indices. *European Journal of Sport Science*. 17(7), 830-7.

Sobko I. (2015). An innovative method of managing the training process of qualified basketball players with hearing impairment. *Journal of Physical Education and Sport*, 15(4), 640–645: doi:10.7752/jpes.2015.04097

Xiang, F. F., & Shi, P. (2016). The Role of Core Strength in Body Posture of Aerobics. In G. Lee (Ed.), *2016 5th International Conference on Education and Education Management* (Vol. 92, pp. 97-100).

Yan, F. F. (2016). Artistic Arrangement of Complete Sets of Competitive Aerobics Taking the Three - Person Aerobics as an Example. In G. Lee (Ed.), *2016 the 6th International Conference on Information, Communication and Education Application* (Vol. 94, pp. 334-339).

Zarebska, A., Jastrzebski, Z., Moska, W., Leonska-Duniec, A., Kaczmarczyk, M., Sawczuk, M., . . . Cieszczyk, P. (2016). The AGT Gene M235T Polymorphism and Response of Power-Related Variables to Aerobic Training. *Journal of Sports Science and Medicine, 15*(4), 616-624.

Zhanneta, K., Irina, S., Tatyana, B., Olena, R., Olena, L., & Anna, I. (2015). The applying of the concept of individualization in sport. *Journal of Physical Education and Sport, 15*(2), 172-177. doi:10.7752/jpes.2015.02027