

Effectiveness of innovative methods in improving the special physical fitness of qualified athletes in aerobic gymnastics

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Abstract:

Purpose. Recently, in the methodology of training qualified athletes in various sports, more and more attention is paid to attracting innovative methods of physical and functional training to the organization of the educational and training process. In particular, they began to widely use the technologies of functional and conditioned training, borrowed from health-improving fitness training. The purpose of this study is to substantiate the feasibility of using innovative methods of physical training borrowed from health-improving types of fitness aerobics to improve the special physical fitness of qualified athletes in aerobic gymnastics. Materials and methods. The study involved 24 athletes the national aerobic gymnastics team of Ukraine aged 18 to 26 years. Qualification of athletes: 5 – Masters of sports of international class; 13 – Masters of sports of Ukraine; 6 – candidates for Master of sports of Ukraine. Indicators of special physical fitness of the participants of the experiment were recorded. The reliability of intra - and inter-group differences between the average arithmetic values of special physical fitness indicators was determined according to test standards approved by the Federation of Ukraine for aerobic gymnastics and fitness. **Results.** Indicators of special physical fitness of female athletes under the influence of the latest methods of functional and physical training are determined: TRX; HIIT; Functional Step; Tabata; 6-D Sliding; M.A.X. It is confirmed that in terms of their structure and content, the selected methods meet the main requirements for competitive activities of qualified athletes in aerobic gymnastics. Data on well-known means of improving and controlling the parameters of special physical fitness in aerobic gymnastics have been supplemented. The effectiveness of using innovative methods borrowed from health-improving fitness training in the construction of the educational and training process for physical training of qualified athletes in aerobic gymnastics is proved. In a cross-experiment, the effectiveness of the selected methods was tested and the main hypothesis of the study was confirmed. **Conclusion.** Both experimental blocks of exercises borrowed from health-improving fitness training and the corresponding innovative methods of practical implementation of these tools have fully confirmed their effectiveness. The expediency of using the methods of TRX, HIT, Functional Step, Tabata, 6-D Sliding, M.A.X. in the program of physical and functional training of qualified athletes in aerobic gymnastics during the preparatory periods of the annual training cycle is experimentally proved.

Key words: aerobic gymnastics, element, technique, complexity, control, methodology.

Introduction.

It is well known that the achievement of the desired sporting result by qualified athletes occurs due to a complex combination of all components of their physical, technical, tactical, psychological and functional fitness. Many well-known specialists in the training of qualified athletes in Olympic and professional sports (Kokareva S.M., 2017; Cunanan AJ et al., 2018; Shepelenko T.V. et al., 2018; Platonov V.N., 2015, 2019) emphasizes that it is the physical and functional readiness of athletes to achieve maximum results that is the basis on which all other types of training are based.

In modern sports, the physical training of athletes has reached an extremely high level. Further improvement of its indicators is an extremely difficult task, except for people with innate phenomenal initial physical parameters. Physical training of athletes is usually divided into general and special. It is indisputable that general physical training is always an actual component of the educational and training process. It is extremely important in the process of preparing athletes in the competitive season. However, all experts in the field of theory and practice of Sports Training know that during the competition season (macrocycle), the share of total physical fitness should be significantly reduced. Therefore, most scientists agree that the physical training of qualified athletes at certain stages of training should be specialized. This is primarily due to specific adaptive changes that occur under the influence of training

loads. Accordingly, the physical abilities of an athlete must be adequately formed in order to master their chosen sports activity (Todorova V.G. et al., 2018; Pasichnaya T.V. et al., 2019; Platonov V.N., 2022).

As you know, general physical training is mainly focused on the harmonious development of motor qualities, physical development and creation of the functional potential of the athlete's body. In turn, special physical training (SPT) is primarily aimed at developing its dynamic motor qualities, which are inherent only in the specifics of a particular sport and the peculiarities of competitive activity in it. The functional potential of the body acquired by an athlete in the process of general physical training (GPT) is only a necessary condition for its improvement in a particular sport. By itself, it cannot ensure the achievement of high athletic results without further adjustment of the functional base by means of special physical training (Kokareva S.M., Kokarev B.V., 2017; Sosina V. et al., 2019; Platonov V.N., 2022).

Modern aerobic gymnastics does not stand aside from World Scientific Research and trends in the development of Olympic and professional sports. As a type of modern gymnastics, it is becoming more and more dynamic from year to year, requiring all athletes to be extremely accurate in performing elements of complexity. Most of these elements are exercises related to the maximum manifestation of strength abilities. Therefore, the authors of scientific papers on aerobic gymnastics and high-level coaches are confident that the growth of sports achievements of qualified athletes in this sport is possible only on the basis of studying and analyzing theoretical and practical data that allow on a scientific basis to improve training programs and methods, to ensure rational management of the process of sports training (Kokareva S.M., 2017; Kozina Z. et al., 2017; Kaufmann S. et al., 2019).

In this regard, according to Ukrainian experts (Kokarev B.V., 2015; Todorova V.G. et al., 2018; Shepelenko T.V. et al., 2018; Sosina V. et al., 2019; Pasichnaya T.V. et al., 2019; Kozina Z. et al., 2019), the following technical criteria will be decisive in the current Olympic cycle for the development of aerobic gymnastics: increasing the complexity of competitive programs; increasing the virtuosity of performing technically complex motor actions; including choreographic movements and their connections of various structural complexity in competitive compositions; growth of technical and executive skills by achieving elegance, plasticity, grace and high virtuosity of performing movements. At the same time, in comparison with the previous cycle, such criteria as: introduction and design of new original connecting and transition elements; execution of pyramids and supports have somewhat lost their importance. In their research of recent years, they have convincingly proved that to ensure the desired result, it is special physical fitness that is crucial, as a result of implementing technical actions.

The high intensity of competitive wrestling significantly increases the requirements for the quality and stability of physical fitness. In this regard, special attention has recently been required to implement the process of physical training, and this problem is urgent in aerobic gymnastics at all stages of training: from the sports Reserve to qualified athletes. Actually, our research is devoted to solving the problem of improving the methods and means of physical training of qualified athletes in aerobic gymnastics.

Material and Methods.

Analysis of scientific and methodological literature on research issues; pedagogical observations of training sessions; pedagogical experiment; testing; methods of Mathematical Statistics.

To achieve the research goal, we have defined the following tasks::

1. Determine the parameters of special physical fitness that meet the main requirements of competitive activity in aerobic gymnastics in terms of structure and content;
2. Determine the effectiveness of the proposed means and methods of physical training of qualified athletes in aerobic gymnastics in the conditions of direct preparation for high-rank competitions.
3. Supplement well-known means and corresponding methods of special physical training in aerobic gymnastics;

The experimental part of the study was organized on the basis of two institutions of Higher Education in Zaporozhye, namely: Zaporozhye National University and the National University "Zaporozhye Polytechnic". The study (Stage 1) began after the end of the 2021 World Aerobic Gymnastics Championships in Baku (Azerbaijan). The study involved 24 athletes representing the national team of Ukraine in aerobic gymnastics. They consisted mainly of students aged 18-26 who study at Ukrainian universities and have a sports qualification not lower than "candidate for Master of sports" and an international athlete license of the International Gymnastics Federation (FIG, 2020). The second stage of the study was considered to be the period of direct pre-competition training and participation of the Ukrainian national team in the 2022 World Aerobic Gymnastics Championships in Guimaraes (Portugal).

Both groups included 12 female athletes who engaged in all types of training, except physical and functional, in accordance with the requirements of the classical training program (Sosina V. et al., 2019; Pasichnaya T.V. et al., 2019). At the first stage of the experimental study, the team of Zaporozhye National University (control group, CG) was engaged in physical and functional training using specially developed sets of exercises and using TRX training devices according to the Izumi Tabata method (Dr. Izumi Tabata) and M.A.X. The main focus was on functional TRX loops. The TRX training device (derived from the phrase training Resistance Extender) is used both in training the fitness contingent and in training professional athletes. This tool increases (mainly) the strength and speed-strength indicators of the muscles of the arms and legs. Features of the method of using a training device help to increase the level of speed and strength endurance. At the same time, the increase in muscle mass is insignificant,

which is especially valuable for athletes specializing in complex coordination sports (Cerrah Ali et al., 2016; Kozina Z. et al., 2017; Moeskops S., et al., 2019; Charmi Salot et al., 2020).

At the moment, there are no scientific and methodological bases for the use of training devices in the physical training of highly qualified athletes, whose specialization is related gymnastic disciplines, the team of National University "Zaporozhye Polytechnic" (experimental group, EG) at the first stage of the experimental study was engaged in physical and functional training according to the traditional training program recommended by the Federation of Ukraine for aerobic gymnastics and fitness (Pasichnaya T.V. et al., 2019; Sosina V. et al., 2019). In our pedagogical observation of the indicators of special physical fitness of qualified athletes in aerobic gymnastics, control exercises were used, the methodological essence and purpose of which are shown in Table 1.

Table 1. **List and essence of control exercises for determining the SPT parameters of qualified athletes in aerobic gymnastics**

Control exercises	Units of measurement	The physical quality that this exercise develops
Amplitude swings of the legs forward alternately right and left	times	Speed
Block of flexibility tests	points	Flexibility
Straddle L-support	seconds	Static power endurance
Feet Lifting until your toes touch the rail in 20 sec	centimeters	Speed and power
Push Ups in 30 sec	points	Speed and power
Long jump from a standstill	centimeters	Explosive power, coordination abilities
Squats on the Right (Left), Left (Right) forward - "gun" in 60s	points	Speed and power endurance

At the second stage of the experimental study, a cross-sectional experiment was performed. According to its conditions, now the control group used traditional exercises inherent in the classical training program in physical training classes. The experimental group, on the contrary, trained using specially developed sets of exercises using innovative methods inherent in fitness training, namely: Functional Step, 6-D Sliding, HIIT (Kokareva S.M., Kokarev B.V., 2017; Federer N., Aagaard M., 2016; Girard J, Feng B. & Chapman C., 2018; Turner T. et al., 2019; Engel F.A. et al., 2019; Seemann-Sinn A. et al., 2022).

Video registration of performances and training sessions took place during training camps for the 2021 World and European Championships and international forums themselves. The determination of indicators of special physical fitness of qualified athletes engaged in aerobic gymnastics was carried out using tests that essentially correspond to the structure and content of competitive activities. Well-known means of monitoring special physical fitness were supplemented with control exercises developed by US, based on existing methods, to determine the characteristics of special qualities of qualified athletes in aerobic gymnastics. All research results are processed using mathematical statistics methods. Classes in both groups were held 5-6 times a week for 2-2,5 hours for 3 months.

Results.

As a result of the first part of the pedagogical experiment based on the use of innovative fitness training techniques to improve the physical fitness of participants in the experimental group who were engaged in special physical training (SPT) according to the author's program proposed by us, we can state the following (Table 2).

Table 2. **Results of control tests with SPT of experimental (n=12) and control (n=12) groups of highly qualified athletes in aerobic gymnastics at the end of the 1st stage of the study, ($\bar{X} \pm S$)**

Test	Experimental group (EG)				Control group (CG)			
	Start of the study	End of the study	$\Delta\%$	p	Start of the study	End of the study	$\Delta\%$	p
Amplitude swings of the legs forward alternately right and left, times	142,30±1,26	151,83±2,1	6,7	<0,05	139,80±2,31	144,83±2,33	3,6	>0,05
Block of flexibility tests, points	9,50±0,16	10,0±0,20	5,6	<0,05	9,25±0,25	9,62±0,25	4,0	>0,05
Straddle L-support, seconds	23,20±2,39	25,89±2,37	11,6	<0,01	21,70±2,22	23,13±2,41	6,6	<0,05
Feet Lifting until your toes touch the rail in 20 seconds	10,40±0,65	11,76±1,90	13,1	<0,01	10,30±0,50	10,94±0,41	6,2	<0,05
Push Ups in 30 seconds	20,50±0,82	22,22±0,95	8,4	<0,01	20,00±0,85	20,78±0,78	5,5	<0,05
Long jump from a standstill, centimeters	203,00±2,70	214,17±4,27	5,5	<0,05	199,10±3,95	207,66±3,89	3,9	>0,05
Squats on the Right (Left), Left (Right) forward - "gun" in 60 seconds	48,30±1,83	51,78±1,94	7,2	<0,05	48,00±2,11	50,06±2,12	4,3	>0,05

After the 1st stage of the experiment, it is noticeable that the results of tests with SPT of participants in the experimental group have significant statistical differences in relation to the initial indicators for all control tests ($p < 0.05$; $p < 0.01$). The most significant changes were found in the tests: "Straddle L-support" (+11.6%, $p < 0.01$); "Lifting the legs to touch the rail with the toes in 20 seconds" (+13.1%, $p < 0.01$); "Push Ups in 30 seconds" (+8.4%, $p < 0.01$). For the remaining Tests, the statistical difference was noted at the level of $p < 0.05$.

The test results of the control group also had positive, but less pronounced dynamics. Thus, the most pronounced, having statistical significance ($p < 0.05$) in relation to the initial values, we see changes in SPT indicators for the same tests as in the experimental group, namely: "Straddle L-support" (+6.6%); "Lifting the legs to touch the rail with the toes in 20 seconds" (+6.2%); "Push Ups in 30 seconds" (+5.5%). For the remaining control tests, no statistically significant changes in indicators were recorded (> 0.05). However, there is a steady trend towards improving results.

Thus, we can conclude that the process of improving physical conditions in both groups has a positive trend. At the same time, it is noticeable that the improvement of results in athletes of the experimental group after the end of the 1st stage of the experiment looks more convincing, that is, the method of special physical and functional training of the experimental group confirmed its higher effectiveness compared to the traditional program.

Recall that at the second stage, according to the terms of organizing the study, a cross-experiment was conducted. Now the control group was engaged in the experimental SPT program, and the experimental group – in the traditional one. The results of this stage of the study allowed us to establish the following (Table 3).

Table 3. Results of control tests with SPT of experimental (n=12) and control (n=12) groups of highly qualified athletes in aerobic gymnastics at the end of the 2nd stage of the study, (cross-experiment, $\bar{X} \pm S$)

Test	Experimental group (EG)				Control group (CG)			
	Start of the study	End of the study	$\Delta\%$	p	Start of the study	End of the study	$\Delta\%$	p
Amplitude swings of the legs forward alternately right and left, times	151,83±2,12	154,1±0,96	0,18	>0,05	144,83±2,33	150,40±2,33	3,85	>0,05
Block of flexibility tests, points	10,0±0,20	11,10±0,11	11,0	<0,01	9,62±0,25	11,04±0,20	14,76	<0,001
Straddle L-support, seconds	25,89±2,37	29,30±2,18	13,17	<0,01	23,13±2,41	27,70±2,37	19,76	<0,001
Feet Lifting until your toes touch the rail in 20 seconds	11,76±1,90	13,30±0,67	13,1	<0,01	10,94±0,41	12,40±0,63	13,35	<0,01
Push Ups in 30 seconds	22,22±0,95	23,90±0,67	7,56	<0,05	20,78±0,78	23,50±0,95	13,09	<0,01
Long jump from a standstill, centimeters	214,17±4,27	214,4±3,34	0,11	>0,05	207,66±3,89	213,60±4,27	2,9	>0,05
Squats on the Right (Left), Left (Right) forward - "gun" in 60 seconds	51,78±1,94	53,70±1,63	3,71	>0,05	50,06±2,12	51,60±1,93	3,08	>0,05

It is shown that both at the beginning of the study and at the end of it, the dynamics of changes in the results of control tests with SPT in both groups (in the intra-group aspect) is similar. We can observe positive changes (from $p < 0.05$ to $p < 0.001$) for most control standards in both groups. Indicators of physical fitness continued to grow both for the already specified tests and for other indicators. But, according to the tests "Amplitude swings of the legs forward alternately right and left", "Squats on the Right (Left), Left (Right) forward - "gun" in 60 seconds", "Long jump from a standstill" (in both groups) they did not acquire statistical significance ($p > 0.05$). It is noteworthy that this time in the control group, most of the positive changes in test results have a more pronounced, positive dynamics than in the experimental group.

Quite interesting is the final comparison of changes in the average results of control tests of both groups of athletes who took part in the experimental study. After it was completed, we observed the following picture (Table 4).

At the end of the 1st stage of the study, most of the indicators of physical fitness of athletes in the experimental group revealed statistically significant changes in relation to the participants of the control group. In general, an improvement of 5-10% from the initial result ($p < 0.05$; $p < 0.01$) at the end of Stage 1 makes this quite possible. Positive changes are noticeable according to the results of the tests "Amplitude swings of the feet forward alternately right and left" (+4.8%), "Straddle L-support" (+10.7%); "Lifting the legs to touch the rail with the toes in 20 seconds" (+7.0%); "Push Ups in 30 seconds" (+6.5%). According to the remaining Tests, we can only state a tendency to improve the results, because the rather short period of conducting this phase of the experiment (1 month) allows us to say so.

After conducting a cross-sectional experiment (corresponding to the 2nd Phase of the experiment), the statistical picture took on a hypothetically expected character.

Table 4. Comparative analysis of the results of control tests with SPT between female athletes experimental (n=12) and Control (n=12) groups at the beginning and end of the study, ($\bar{X} \pm S$)

Test	Group	After the 1st stage	$\Delta\%$	p	After the 2nd stage	$\Delta\%$	p
Amplitude swings of the legs forward alternately right and left, times	EG	151,83±2,12	4,8	<0,05	154,1±0,96	2,4	>0,05
	CG	144,83±2,33			150,40±2,33		
Block of flexibility tests, points	EG	9,50±0,16	2,6	>0,05	11,10±0,11	0,5	>0,05
	CG	9,25±0,25			11,04±0,20		
Straddle L-support, sec	EG	25,89±2,37	10,7	<0,01	29,30±2,18	5,5	<0,05
	CG	23,13±2,41			27,70±2,37		
Feet Lifting until your toes touch the rail in 20 sec	EG	11,76±1,90	7,03	<0,05	13,30±0,67	6,7	<0,05
	CG	10,94±0,41			12,40±0,63		
Push Ups in 30 sec	EG	22,22±0,95	6,5	<0,05	23,90±0,67	1,7	>0,05
	CG	20,78±0,78			23,50±0,95		
Long jump from a standstill, centimeters	EG	214,17±4,27	3,04	>0,05	214,44±3,34	0,39	>0,05
	CG	207,66±3,89			213,60±4,27		
Squats on the Right (Left), Left (Right) forward - "gun" in 60 sec	EG	51,78±1,94	3,3	>0,05	53,70±1,63	3,9	>0,05
	CG	50,06±2,12			51,60±1,93		

So, only according to the tests "Straddle L-support" (+0.5%) and "Lifting the legs to touch the rail with the toes in 20 seconds" (+6.7%) we still see a significant ($p < 0.05$) difference in the results of the experimental group in comparison with the control group, with a small advantage of the former. However, there is a clearly noticeable alignment of the results. The explanation, again, can serve as the duration of the 2nd Phase-1 month.

If the experiment time is longer, we can expect greater positive changes in the results of the control group, and therefore more equal final results at the end of the experimental study. The difference in the results of other tests when comparing groups with each other was at the level of statistical error (> 0.05). In percentage terms, no more than 4%: from 0.4% on the test "Long jump from a standstill" to 3.9% on the test "Squats on the right (left) leg, left (right) forward - "pistol" in 60 seconds".

Thus, the results of repeated testing according to SPT standards in the experimental and control groups showed almost complete absence of significant inter-group differences at the end of the experiment.

Discussion.

It is obvious that only a rational form of building the training process within individual stages and periods of the annual training cycle can ensure a high level of overall fitness of athletes and their achievement of high sports results at competitions of various levels. From a significant variety of options for building and organizing the training process of highly qualified athletes, it is necessary to focus on the most optimal ones, taking into account the rationality of combining the volume and intensity of training loads, the ratio of specific and non-specific training tools, the features of socio-economic conditions in which the training process takes place.

The analysis of scientific and methodological literature on the research topic allows us to state that aerobic gymnastics is an Independent Sport that is rapidly developing. At the same time, the success and speed of growth of athletes' skills in aerobic gymnastics depends not only on material, technical, socio-economic factors, but also on the development of methodological approaches to building the training process at various stages of long-term training, in particular, at the stage of maximum realization of individual capabilities (Girard J, Feng B. & Chapman C., 2018; Sosina V. et al., 2019; Platonov V.N., 2019; Dorrell H, Smith M, Gee T., 2020).

In connection with the above, a rather promising direction in solving this problem is the direction that is associated with the generalization of data from special literature and practical experience in implementing innovative fitness technologies in the training process of highly qualified athletes specializing in aerobic gymnastics. The experience of training athletes in related sports (sports and rhythmic gymnastics, acrobatic gymnastics, figure skating, etc.) in developing new programs for building the training process, taking into account the latest achievements of sports science, has become a qualitative basis for conducting both current and new complex experimental studies.

The development of new programs for building the training process of highly qualified athletes in aerobic gymnastics involves, first of all, studying the features of changes in the main indicators of their physical

and functional fitness within the framework of the annual training cycle under the influence of existing training programs. It is obvious that knowledge of such patterns in general, as well as at certain stages of the annual training cycle, is a necessary basis for scientifically based correction of the educational and training process, increasing its effectiveness in order to achieve the maximum possible sports results.

This conclusion fully coincides with the opinion of reputable experts in the field of high-performance sports (Kokareva S.M., 2017; Todorova V.G., 2018; Turner T. et al., 2018; Platonov V.N., 2022; Seemann-Sinn A., 2022). They believe that the development of a system of objective modern criteria for monitoring the physical fitness of athletes for high-ranking competitions based on the study of the dynamics of their general and special physical fitness contributes to improving the skills of athletes, improving their sports results.

It is also very important to develop and apply innovative techniques, new training devices and equipment in the training process that meet modern requirements and will contribute to a more objective assessment of the effectiveness of training sessions and the implementation of appropriate measures on this basis.

Unfortunately, the analysis of scientific and methodological literature on the research problem did not allow us to talk about a sufficient degree of development of issues related to the problems of adapting innovations from the field of Health Fitness to the educational and training process of athletes specializing in aerobic gymnastics. Therefore, from this point of view, our work represents a certain novelty.

In this regard, an experimental program for building the training process was developed, taking into account the features of the proposed innovative methods, the characteristics of indicators of general and special physical fitness of qualified athletes. Physical exercises that are characteristic of the techniques used were combined into a single program designed for 2 mesocycles by creating blocks. The experimental program was developed on the basis of the classical program in aerobic gymnastics for the stage of maximum realization of individual capabilities, approved by the coaching Council and the technical committee of the Federation of Ukraine of Aerobic Gymnastics and Fitness (FUSAF). It was based on the goals and objectives of the stage of maximum realization of individual capabilities, the principles of sports training. The program was developed taking into account the age characteristics of female athletes, the competition calendar, the initial level of fitness, and data from control tests of female athletes at the beginning of the experiment (Pasichnaya T.V, Mohort L.V, Lozenko N.M., 2019).

To achieve the tasks set for each of the 2 stages of the experiment, functional training complexes were developed using innovative equipment, such as the TRX Suspension Professional Trainer training device, and an author's development protected by utility model patents called "Light platform for improving technical skills in aerobic gymnastics and fitness" (Tishchenko V.A., Kokarev B.V., 2014). The training device was used to improve the performance of strength and speed-power endurance. These auxiliary tools were used in the process of direct preparation of athletes for the main competition of the annual cycle – the 2022 World Championships.

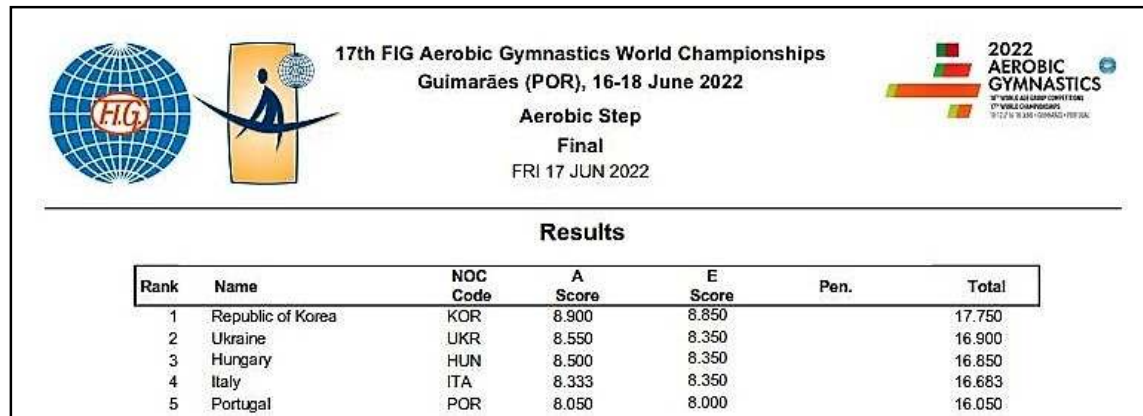
Within the framework of the first part of our experiment, the dynamics of physical fitness indicators of the studied qualified athletes specializing in aerobic gymnastics was studied under the influence of the first block of experimental methods and tools, as well as the classical training program. The results revealed the main patterns of changes in these indicators during the preparatory period of the annual training cycle. We have given a positive assessment of the effectiveness of using the first block of the experimental physical training program by athletes of the experimental group.

It was shown that at the end of the 1st stage of the experiment (which corresponded to the middle of the preparatory period of the annual training cycle), the examined athletes of the experimental group showed significant improvements in the value of indicators of special physical fitness by 5-13% of the initial result ($p<0.05$; $p<0.01$). The achievements of the control group were somewhat more modest – from 3.5% to 6.6%, which in most cases did not allow us to state a significant improvement in the studied SPT parameters.

In order to determine the effectiveness of the experimental physical training program, an analysis of the characteristics of the dynamics of indicators of physical fitness of qualified athletes in aerobic gymnastics was carried out as part of a cross-sectional experiment. Repeated testing, which was carried out after the cross-experiment at the end of the 2nd stage of the preparatory period (which corresponded to the end of the preparatory period of the annual training cycle), also allowed us to additionally record reliable ($p<0.05$) changes in these indicators in both experimental (less pronounced, from 1% to 13%) and control (more pronounced, from 3% to almost 20%) groups. The most pronounced ($p<0.01$; $p<0.001$) were changes in indicators that characterize strength, speed-power abilities, speed-power and static power endurance.

These results allow us to state that the use in the process of physical training of qualified athletes in aerobic gymnastics of innovative means borrowed from health-improving fitness training contributed to an increase in the level of their physical fitness at the end of each of the stages of the experiment. However, traditional means of physical training have also shown quite high effectiveness (Schoenfeld B.J. et al., 2017; Halil Tanir, 2018; Ronca F. et al., 2020; Weakley J. et al., 2021). This also contributed to the optimal level of these indicators throughout the experimental study.

It should also be noted that there are significant positive changes in the results of competitive activity of athletes who participated in the study. At the world and European Championships, all of them entered the final eight in their performance categories, and the best of them, the athletes who made up the experimental group, took 2nd place (silver medals) at the 17th Aerobic Gymnastics World Championships, 2022 in Guimaraes (Portugal) in the Aerobic Step category (Fig. 1). This result was the best sporting achievement in their sports career (<https://www.gymnastics.sport/site/events/detail.php?id=16967#loaded>).



17th FIG Aerobic Gymnastics World Championships
Guimarães (POR), 16-18 June 2022

Aerobic Step
Final
FRI 17 JUN 2022

Results

Rank	Name	NOC Code	A Score	E Score	Pen.	Total
1	Republic of Korea	KOR	8.900	8.850		17.750
2	Ukraine	UKR	8.550	8.350		16.900
3	Hungary	HUN	8.500	8.350		16.850
4	Italy	ITA	8.333	8.350		16.683
5	Portugal	POR	8.050	8.000		16.050

Figure 1. Excerpt from the final protocol of the Aerobic Gymnastics World Championships, 2022 in Category "Aerobic Step"

These results indicate the high efficiency of the developed physical training program, concluded for highly qualified athletes engaged in aerobic gymnastics. The practical application of the program has significantly improved their physical fitness at the end of the preparatory period and maintained a high level of these indicators over a long competitive period. This gives grounds to recommend the developed experimental program for practical use in the process of training qualified athletes in aerobic gymnastics at the stage of maximum realization of individual capabilities.

Thus, these results allowed us to form three groups of data that were obtained through an experimental study of the features of changes in the indicators of physical fitness of qualified athletes specializing in aerobic gymnastics, under the influence of the proposed experimental program for building the training process.

Analysis of the literature data has shown that the majority of authors, including: S.M. Kokareva (2017); T.V. Shepelenko, Z.L. Kozina, M. Cieslicka, K. Prusik, R. Muszkieta, A.V. Osiptsov, A.S. Ilnickaya (2018); V. Sosina, V. Todorova, B. Dolinsky, T. Pasichnaya, Zh. Grashchenkova (2019); Z. Kozina, I. Sobko, L. Ulaeva, D. Safronov, Y. Boichuk, A. Polianskyi & V. Protsevskiy (2019); S. Moeskops, J.L. Oliver,

P.J. Read, J.B. Cronin, G.D. Myer & R.S. Lloyd (2019); S. Kaufmann, M. Ziegler, J. Werner, C. Noe, R. Latzel, S. Witzany, R. Beneke & O. Hoss (2022) considers it insufficient to develop issues of content and organization of the training process in aerobic gymnastics at various stages of long-term training, especially for the stage of maximum realization of individual capabilities.

At the same time, if many sports related to aerobic gymnastics have some experience working with methodological innovations of recent years regarding their use in the educational and training process of highly qualified athletes, then aerobic gymnastics is just beginning to develop the theoretical, methodological and organizational foundations of this direction.

In this regard, our work represents a new area of research (V. A. Tishchenko, 2014; B.V. Kokarev, 2014, 2017; S.M. Kokareva, 2017; A. Seemann-Sinn, 2022) on the effectiveness of using specific training devices in the training process of highly qualified athletes in aerobic gymnastics, etc. the data obtained by us to a certain extent complement the results of studies by I. Stasiuk, K. Mulik (2017), B.J. Schoenfeld, J. Grgic, D. Ogborn and J.W. Krieger (2017), Z. Kozina, T. Shepelenko, A. Osiptsov (2018), P. Schoenmakers, K. Reed, L. Van Der Woude & F.J. Hettinga (2018), Eri Miyamoto-Mikami (2018), J. Weakley, B. Mann, H. Banyard, S. McLaren, T. Scott, and A. Garcia-Ramos (2021) on the possibility of improving various components of the overall fitness of athletes by correcting the volume of training loads of different directions within individual micro- and mesocycles of the annual training cycle.

Our research offers a system that has its own structure, algorithms, mathematical apparatus, advanced data on the improvement and features of changes in the level of physical fitness of high-class athletes within individual stages and periods of the annual macrocycle. They are based on previous research by well-known scientists, such as Todorova V. G. (2018), Platonov V.N. (2015, 2022), Girard J., Feng B. & Chapman C. (2018), Kaufmann S. et al. (2022). So, all of the above allows us to draw the following conclusions.

Conclusions.

The proposed system of physical training, based on the use of innovative means and methods of health-improving fitness training, which in structure and content meets the main requirements of competitive activities in aerobic gymnastics has been successfully tested on the contingent of qualified athletes of the national team of Ukraine during the preparatory period of the annual macrocycle of the sports season 2022.

The complex application of the selected exercises allowed us to obtain reliable information about the special physical fitness of qualified athletes in aerobic gymnastics in various structural formations of the educational and training process (micro -, meso -, macrocycles). Within the framework of the formative experiment, it was proved that the use in the training process of high-class athletes specializing in aerobic gymnastics, innovative methods characteristic of health-improving fitness training contributed to a significant improvement in their physical fitness and increasing the effectiveness of the training process.

To determine the indicators of special physical fitness of highly qualified athletes in aerobic gymnastics, it is advisable to use control exercises that reflect the main requirements for the qualities necessary for successful development of the elements of complexity from the classification part (program) of the rules of aerobic gymnastics competitions FIG – International Gymnastics Federation. Competition Rules 2022 – 2024).

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Conflicts of interest.

The author(s) declared no have conflict of interest concerning this work, authorship, and/or publications of this paper.

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