

**NATIONAL SPORTS ACADEMY**

**"VASIL LEVSKI"**

**DEPARTMENT OF GYMNASTICS**

**MILENA DIMITROVA TARNICHKOVA**

**DYNAMICS AND DEVELOPMENT  
OF SPECIAL PHYSICAL PREPARATION  
IN SPORTS AEROBICS**

**A B S T R A C T**

of the dissertation for the award of the educational and scientific degree "Doctor"  
in the scientific specialty "Theory and methodology of sports science", professional  
field 7.6 Sport

**Scientific Supervisor:**

Assoc. prof. Georgi Sergiev, Ph.D.

**Reviewers:**

Prof. Bonka Mikhailova Dimitrova, Ph.D.

Assoc. Prof. Nelly Nikolova Tankusheva, Ph.D.

Prof. Galina Petrova Dyakova, Ph.D.

Assoc. Prof. Dimka Borisova Nestorova, Ph.D.

Assoc. Prof. Anna Tihomirova Bozhkova, Ph.D.

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The dissertation contains 209 standard typewritten pages. It is illustrated with 20 tables, 67 figures and 3 appendices. The bibliography includes 204 literature sources, of which 181 in Cyrillic and 23 in Latin, as well as 12 Internet sites.

The work was discussed and scheduled for public defense by the Department of Gymnastics at the National Sports Academy "Vasil Levski". The scientific board of the department was expanded by order of the Rector of NSA "Vasil Levski" №1629 from 23.11.2020 with three habilitated lecturers.

The defense of the dissertation will take place on 16.03.2021 from 14.00 in hall A 3 of NSA "V. Levski".

## **INTRODUCTION**

The development of sports and high sports achievements are a natural result of the continuous improvement of the efficiency of the training process. The improvement of the material and technical base for sports training and the rapid pace of development of scientific and technical progress are a prerequisite for the continuous development of sports worldwide. Achieving high sports results depends on the organization, structure and methodology of training and coaching. This requires coaches in the field of gymnastic sports to constantly improve the organization and methodology of the training process.

Aerobic gymnastics also proves its place in the "Gymnastic Family". Mastering the many specific skills requires many years of training. In turn, in order for the training process to be effective, a plan must be prepared in advance, which is aimed at achieving high performance, developing functional capabilities, improving motor skills and achieving the best sports form.

The application of in-depth scientific research and systematic analysis of the entire training process provide an opportunity for timely optimization of its various aspects of training. This will effectively help the timely realization of the personal potential of each athlete and the achievement of high sports mastership.

One of the most important components of sports training in aerobic gymnastics is physical training. Its specificity, place and role in the annual training process is important for entering and maintaining a high level of fitness.

The specific dynamics of competitive combinations in aerobic gymnastics demands the development of certain physical qualities, such as dynamic strength of the lower and upper limbs, spatial coordination abilities and specific speed and strength endurance.

Clarification of the specific nature of physical training in sports aerobics, its focus in the various stages of annual training process, as well as a system of tools and methods to be applied in the weekly microcycle, are matters of paramount importance for the development and enrichment of theory and practice. That is why we have focused our research in this area.

## **WORKING HYPOTHESIS**

We assume that the preparation of specialized sets of exercises and their application during the various stages of training process will increase the level of significant motor skills of athletes in sports aerobics.

## **I. PURPOSE, TASKS, ORGANIZATION AND METHODOLOGY OF THE RESEARCH**

**I.1. The aim** of the research is to optimize the methodology for the development of special physical training in sports aerobics.

### **I.2. RESEARCH TASKS:**

1. To establish and analyze the place of special physical training in the year-round training process in sports aerobics.
2. To establish the level of development of some sport-specific physical qualities in the age aspect.
3. To develop an experimental methodology for the development of special physical training in sports aerobics training for age groups AG 12-14 and AG 15-17 years old.
4. To test in practice the developed methodology for both age groups and to establish its effectiveness.
5. To prepare a qualitative assessment of the level of development of physical training and model characteristics (profile) of the studied traits for both age groups.

### II.3. OBJECT, SUBJECT AND CONTINGENT OF RESEARCHERS

OBJECT of the study is physical training in sports aerobics.

SUBJECT of the research are specific for sports aerobics motor qualities.

The contingent of our study are 168 athletes in sports aerobics, as follows: EG – experimental group, CG – control group (Fig. 1).

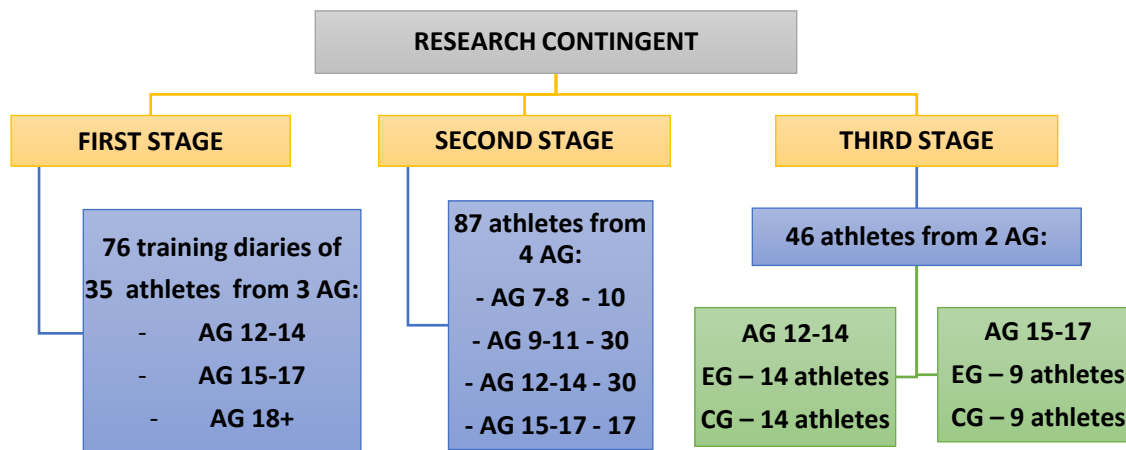


Fig. 1

### II.4. ORGANIZATION OF THE STUDY:

FIRST STAGE - 2009 - 2019 - Analysis of literature sources.

SECOND STAGE - (PRELIMINARY) - 2003 - 2013 - Processing of data on the training load, as well as the level of physical training of athletes in sports aerobics from different age groups.

THIRD STAGE - (MAIN) - 2009 - 2010 - Conducting the first testing, processing and analysis of the results in order to establish the initial levels of development of motor skills of athletes in sports aerobics from AG 12-14 and AG 15-17, before the main experiment.

FOURTH STAGE (MAIN EXPERIMENT) - 2009 - 2010 - preparation and application of an experimental methodology for improving the specific motor skills of athletes in sports aerobics in the AG 12-14 and AG 15-17.

FIFTH STAGE - 2010 - 2020 - Conducting a second test, analysis of results, conclusions and overall layout.

### II.5. RESEARCH METHODS

#### II.5.1. THEORETICAL METHODS AND ANALYSIS

a / Theoretical and logical analysis of literature sources.

Using this method an analysis of the available literature was made, concerning the problems of:

- Content of the combinations in sports aerobics and what are the necessary motor qualities for its individual components.
- Motor skills in gymnastic disciplines and specific ones for sports aerobics.
- Physical training in the annual training process.
- Means for control of physical training.

b / Systematic analysis of documentary sources.

Through it we processed plans, diaries and results from the training and competition activities of the athletes from 2003 to 2013.

c / Internet analysis of information about the leading trends in the field of sports training and the development of physical qualities from the world wide web.

d / Theoretical-synthetic method for summarizing all the personal information from knowledge accumulated over the years and our experience.

## II.5.2. EXPERIMENTAL METHODS

a / Sports and pedagogical research.

- Sports-pedagogical observation - through this method we performed systematic observations of individual training sessions of the athletes from the two control groups (AG 12-14 and AG 15-17) in order to get acquainted with and describe their content, which we entered in the prepared special protocol (Appendix 1).
- Sports-pedagogical testing - to determine the level of physical training and the dynamics of development in terms of age, and to determine the level of physical qualities before and after the applied experimental methodology for both age groups (AG 12-14 and AG 15-17).

The test battery includes 12 tests to control various specific qualities. It was approved by the Bulgarian Aerobic Union management in 2005, as it has prepared normative tables and a point system for assessment of physical training. (Annexes 2 and 3).

The exercises from the test battery are conditionally divided into six groups:

- For speed and strength endurance of upper limbs, abdominal and back muscles - Test 1 (Dynamic supports), T2 (Abdominal presses), T3 (Back presses) and T4 (Lifting the knees from the occipital height);
- For static-strength endurance - Test 6 (a\Angular height) and T7 (Straddle support);
- For dynamic strenght of lower limbs - Test 8 (Long jump) and T9 (Vertical rebound);
- For speed endurance - Test 5 (Shuttle running);
- For speed - T10 (Occipital position, Squat, Air jump) and Test 11 (Running in place with high knees);
- For mobility of the spine - Test 12 (Slope in depth).

The testing of the athletes for tracking the dynamics of the development of their physical qualities in terms of age was conducted in October 2005, and those before and after the application of our experimental methodology as follows (Table 1):

**Table. 1**

First testing		Second testing			
AG 12-14	AG 15-17	AG 12-14		AG 15-17	
9.01.2010	28.11.2009	CG	EG	CG	EG
		25.03.2010	26.03.2010	24.03.2010	

The content of the test battery and the methodical instructions for the implementation of the exercises in it are presented in detail in the dissertation.

- Pedagogical experiment to establish the effect of the set methodology in the training in sports aerobics for AG 12-14 and AG 15-17.

The preparation of the sets of exercises included in our experimental methods for both age groups was completely subordinated to the current practical need to improve some of the most characteristic physical qualities, which relate to our research stage:

- For AG 12-14 - speed-stranght endurance and jump endurance;
- For AG 15-17 - -stranght, speed-f-stranght and static--stranght endurance.








The duration of application of the experimental methodology for both age groups is as follows:

- For AG 12-14 - 2 months or 9 weeks (from 18.01.2010 to 21.03.2010)
- For AG 15-17 - almost 4 months or 15 weeks (from 7.12.2009 to 21.03.2010)

### CONTENTS OF THE EXPERIMENTAL METHODOLOGY FOR THE AG 12-14:

A) A set of exercises to improve speed and strength endurance, the relevant methodological instructions for its performance and the minimum dosage of each exercise, rest time and number of series (Table 2):

Table 2

A) A COMPLEX OF EXERCISES FOR SPECIAL SPEED-FORCE ENDURANCE - AG 12-14	
<p>The exercises are performed one after the other from 1 to 6, after which we run back to the beginning for re-performance.</p>	
	
1.	 <p>ROLL</p>
2.	 <p>JUMP AND FREE FALL</p>
3.	 <p>PUSH UPS WITH CLAPING (или с пляскане)</p>
<p>4. ВЪВМЯТ ДО ТИЛЕН ЛЕГ - (след експлозивно отгласкване с ръцете тялото се свива и краката преминават напред между ръцете без да докосват пода)</p> 	
5.	 <p>3 time КОРЕМНИ ПРЕСИ „ЧУПКА“ (pike position)</p>
6.	 <p>Stand up &amp; 5-6 time long jump</p>
<p>7. Return by running to the starting position</p>	
<p><b>Methodical instructions:</b></p> <ol style="list-style-type: none"> <li>1. Dosage in one series: 6-8 repetitions.</li> <li>2. Rest between sets: 4-5 min.</li> <li>3. Number of series: 3-4.</li> </ol>	

В) A set of exercises to improve jumping endurance, the relevant methodological instructions for its performance and the minimum dosage of each exercise, rest time and number of series (Fig. 2):

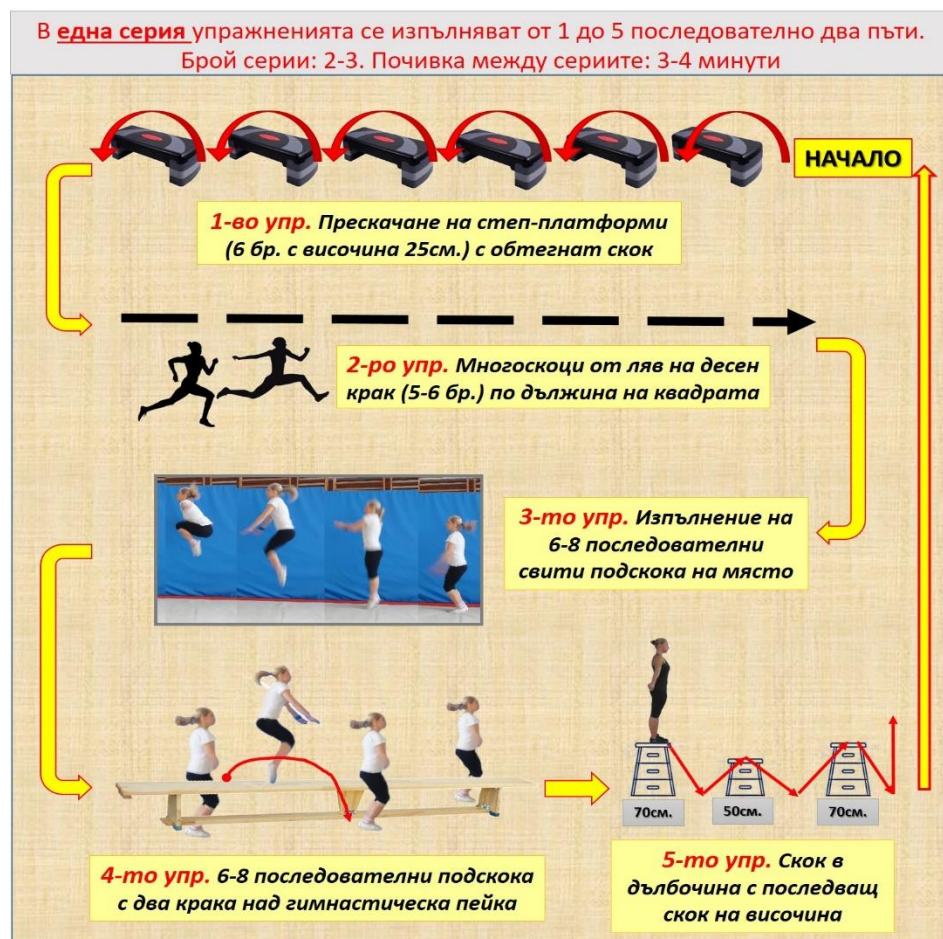


Fig. 2

С) Scheme for application of the experimental complexes in the weekly microcycle from the special-preparatory stage (Fig. 3).

### SCHEME FOR APPLICATION OF THE EXPERIMENTAL COMPLEXES IN THE WEEKLY MICROCYCLE OF THE SPECIAL-PREPARATORY STAGE OF THE TRAINING OF SPORTS AEROBICS COMPETITORS - AG 12-14.

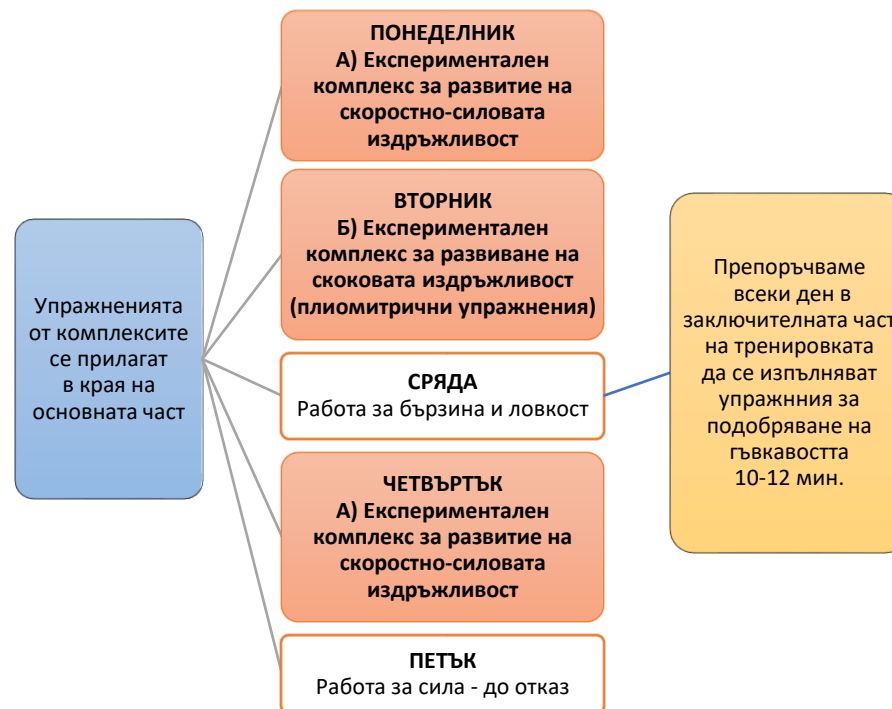


Fig. 3

D) General methodical instructions for conducting the experimental methodology:

- The complexes are applied at the end of the main part of the training on the specified training day (Monday and Thursday – speed-strength endurance and Tuesday - jumping).
- For the days Wednesday and Friday we have given instructions only for the purpose of the physical training, without specifying the means. They are personal coach's creativity.
- At the end of the training we recommend performing exercises to develop or maintain the level of flexibility, but without giving specific exercises, but only fix the desired time for them.
- Our proposed training scheme includes five training days (Monday to Friday). However, this does not limit the athletes in their regime if they train 6 days a week or even twice a day.
- The duration for application of the experimental methodology is 2 months or 9 weeks (from 18.01.2010 to 21.03.2010).

E) During the period of the experimental methodology, which was set by us, the athletes from the control group (CG) apply the following methodology for conducting their training sessions:

- The number of workouts in the weekly microcycle is 5.
- The training sessions are conducted according to a standard scheme for this period of preparation - preparatory part (Warm-up), main part (Improvement of the exercises from the competitive routines, study of the choreography of the routine and work for general physical training), final part - Stretching).
- The content of the individual trainings is focused entirely on the study of the competitive routines and improving the technique of execution of difficult elements.
- The time spent for physical training and the focus of the exercises are different for each individual athlete, depending on the development of the individual qualities

#### **CONTENTS OF THE EXPERIMENTAL METHODOLOGY FOR THE AG 15-17:**

A) Complexes of exercises to improve the strength endurance of individual muscle groups through exercises with external resistance (Tables 3, 4 and 5).

The presented complexes include 4 exercises in 3 series. All methodical instructions for their execution are described in Fig. 3.



Table 3

## FIRST SERIES - STRENGTH ENDURANCE - AG 15-17




I.1.		Извивки в ляво и дясно с тежка топка.
I.2.		Коремни на гимнастическа стена с тежести на глезените - от тилан вис краката се повдигат обтегнати до хвата, след, което се разтварят и снемат през страни до долу /външен полу кръг/
I.3.		Изпълнение на полуклек с тежък лост на раменете от И.П. разкрачен стоеж. При клякането таза трябва да е малко над височината на коленете. Гърба изправен.
I.4.		Упражнение с ластик - с гръб към точката на окачване – свиване и обтягане на ръцете зад главата (трицепсово свиване)

Table 4

## SECOND SERIES - STRENGTH ENDURANCE - AG 15-17

II.1.		Странични наклони в дясно и ляво с тежка топка от И.П. разкрачен стоеж, ръце свити пред гърди.
II.2.		От И.П. Лег на скрин се изпълнява повдигане на краката с тежести на глезените.
II.3.		Клекове в напречно-разкрачен стоеж с тежък лост на раменете /в ходом - крачка, клек, крачка, клек и тн./
II.4.		Упражнение с ластик - пак с гръб към точката на окачване - отваряне и събиране на ръцете /от И.П. напад, ръце напред/

Table 5

THIRD SERIES - STRENGTH ENDURANCE – AG 15-17	
III.1.	 <p>Изпълнение на лицеви кръгове с тялото от И.П. разкрачен стоеж с тежка топка.</p>
III.2.	 <p>От ИП опорен разкрачен седеж, напречно върху 3-4 стъп платформи се изпълнява повдигане и снемане на краката с тежести на глезените.</p>
III.3.	 <p>Качване върху 2-3 стъп платформи и повдигане на коляното поне до хоризонтала с тежък лост на раменете. Краката се редуват на всяко качване.</p>
III.4.	 <p>Упражнение с ластик. От ИП. тилен лег на пода или върху стъп платформа, ръце горе /с гръб към точката на окачване/ се изпълнява снемане на ръцете през страни до долу и връщане през напред до горе.</p>

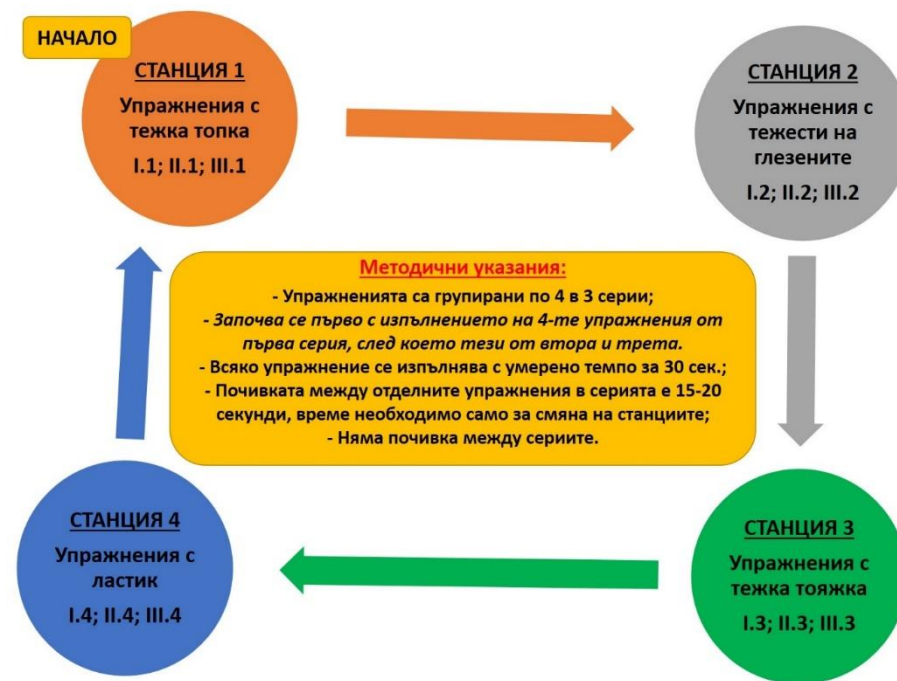









Fig. 3

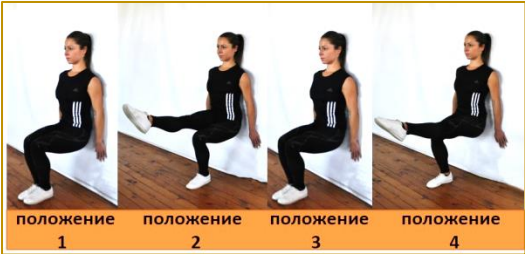
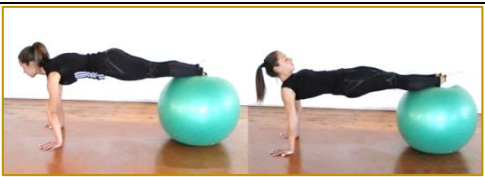



B) A set of exercises to improve speed and strength endurance, the relevant methodological instructions for its execution and the minimum dosage of each exercise, rest time and number of series (Table 6):

**Table 6**

The exercises are performed one after the other from 1 to 7, after which we run back to the beginning for re-performance.		
1.		<b>ROLL AND JUMP WITH ½ TURN</b>
2.		<b>FREE FALL</b>
3.		<b>3 time pushups with clapping</b>
4. ВЪВМЯТ ДО ТИЛЕН ЛЕГ - (след експлозивно оттласкване с ръцете тялото се свива и краката преминават напред между ръцете без да докосват пода)		
		
5. 3 time abdominal presses (tuck, pike & straddle)		
		
6. ½ turn to support		
		
7.		<b>5-6 time Long jump - forward</b>
7. Return by running to the starting position.		
<b>Methodical instructions:</b> <ol style="list-style-type: none"> <li>1. Dosage in one series: 6-8 repetitions.</li> <li>2. Rest between series: 4-5 min.</li> <li>3. Number of series: 3-4.</li> </ol>		

C) A set of exercises to improve the static-strength endurance, the relevant methodological instructions for its performance and the minimum dosage of each exercise, rest time and number of series (Table 7):

**Table 7**

<p>1.</p> 	<p>Stay 10 seconds in each position 1, 2, 3 and 4. A total of 40 seconds. No rest.</p>
<p>2.</p> 	<p>Stay 15 seconds in each position 1 and 2. A total of 30 seconds. No rest.</p>
<p>3. БГЛОВИ ОПОРИ – с пазене</p> 	<p>Stay 4 seconds in each position 1, 2 and 3. A total of 12 seconds. No rest.</p>
<p>4. ЗАДЪРЖАНЕ В ЛЕЖАЩ ВИС НА СВИТИ РЪЦЕ</p> 	<p>Stay 12-15 seconds. The body is straight and tight. Hands bent as much as possible.</p>
<p>5. ЗАДЪРЖАНЕ В ЛЕГ И ТИЛЕН ЛЕГ</p> 	<p>Stay 12-15 seconds in each position 1 and 2. A total of 30 seconds. No rest.</p>
<p><b>Methodical instructions:</b></p> <ol style="list-style-type: none"> <li>1. In one series all exercises from 1 to 5 are performed.</li> <li>2. The break between exercises - just the time to change them.</li> <li>3. Number of series - 3.</li> <li>4. Rest between sets for 2-3 minutes.</li> </ol>	

D) Schemes for application of the experimental complexes in the weekly microcycle of the preparation period (Fig. 4 and 5).

**SCHEME FOR APPLICATION OF THE EXPERIMENTAL COMPLEXES IN THE WEEKLY MICROCYCLE OF THE GENERAL PREPARATORY STAGE OF THE PREPARATION OF COMPETITORS IN SPORTS AEROBICS - AG 15-17**



Fig. 4

**SCHEME FOR APPLICATION OF THE EXPERIMENTAL COMPLEXES IN THE WEEKLY MICROCYCLE OF THE SPECIAL-PREPARATORY STAGE OF THE COMPETITION OF COMPETITORS IN SPORTS AEROBICS - AG 15-17**



Fig. 5



E) General methodical instructions for conducting the experimental methodology (AG 15-17):

- The complexes are applied at the end of the main part of the training on the designated training day:

- For the general preparatory stage (Tuesday - Strenght with weights and Friday - Static strenght endurance)
  - For the special-preparatory stage (Tuesday - Strenght with weights, Thursday - Speed-Strenght endurance and Saturday - Static strenght endurance).
- The duration for application of the experimental methodology is almost 4 months or 15 weeks (from 7.12.2009 to 21.03.2010).

F) During the period of the experimental methodology set by us, the athletes from the control group (AG 15-17) apply the following methodology for conducting their training sessions:

- The number of workouts in the weekly microcycle is 6.
- The training sessions are conducted according to a standard scheme for this period of preparation, as the content of the individual trainings is focused entirely on the study of the competitive routines and improvement of the technique of performing the difficulty elements.
- The time spent for physical training and the focus of the exercises are different for each athlete according to development of individual qualities..

**Expert assessment** - As a long-time coach in sports aerobics, a lecturer at NSA and an international judge, I used this method to determine the content of the competitive routines and determine the leading specific motor skills for each of its components. Also, during all the tests there was an expert commission of three members (the official Coaching Commission of the Bulgarian Aerobics Union - Milena Tarnichkova, Dimitrina Kandeveva and Margarita Stoyanova), which monitored the proper technical performance of the exercises from the test battery.

b / Mathematical-statistical methods and indicators.

The results obtained by us were subjected to statistical processing with the computer programs Excel 2013 and SPSS Statistics 22, which are specialized in processing and analysis of statistical information, both parametric and non-parametric criteria.

Depending on the specific research tasks, the following statistical methods were used:

- variation analysis - Variation analysis, aiming to establish the limits of change of the studied indicators and the extent to which the distribution of these values is within the normal range.
- analysis of variance;
- graphical analysis - to illustrate the calculated values in different types of tables and figures.

The following criteria and coefficients were also applied - **Student's t-test** for dependent and independent samples; **Z-score**.

## II. RESULTS ANALYSIS

### II.1. Analysis of the duration of the training session in sports aerobics and its parts during the different stages and periods of preparation

Our research includes a 10-year period of recording and reporting the training load in sports aerobics (from 2003 to 2013).

During the different years our research is partial for separate stages and periods of the preparation of the athletes in sports aerobics. Almost all athletes are part of the national teams for three age groups - AG 12-14, AG 15-17 and AG 18+.

For the purposes of our study, we have processed one of the general indicators of training load, and that was the time spent on a training session. We have also followed how this time is distributed for the individual parts of the training (preparatory, basic and final), and the most important for us is the time spent for physical training and what is its percentage of the whole training. All empirical data were processed, divided and analyzed by age groups (AG 12-14; AG 15-17 and AG 18+) and main periods and stages of annual training (general preparatory stage, special preparatory stage, pre-competition stage, competition period and competitive microcycle).

In the dissertation work are processed and analyzed in detail the data from the studied stages and periods of preparation of the competitors.

To draw our conclusions, we summarized all the values from our study and presented them in the following graph (Fig. 6).

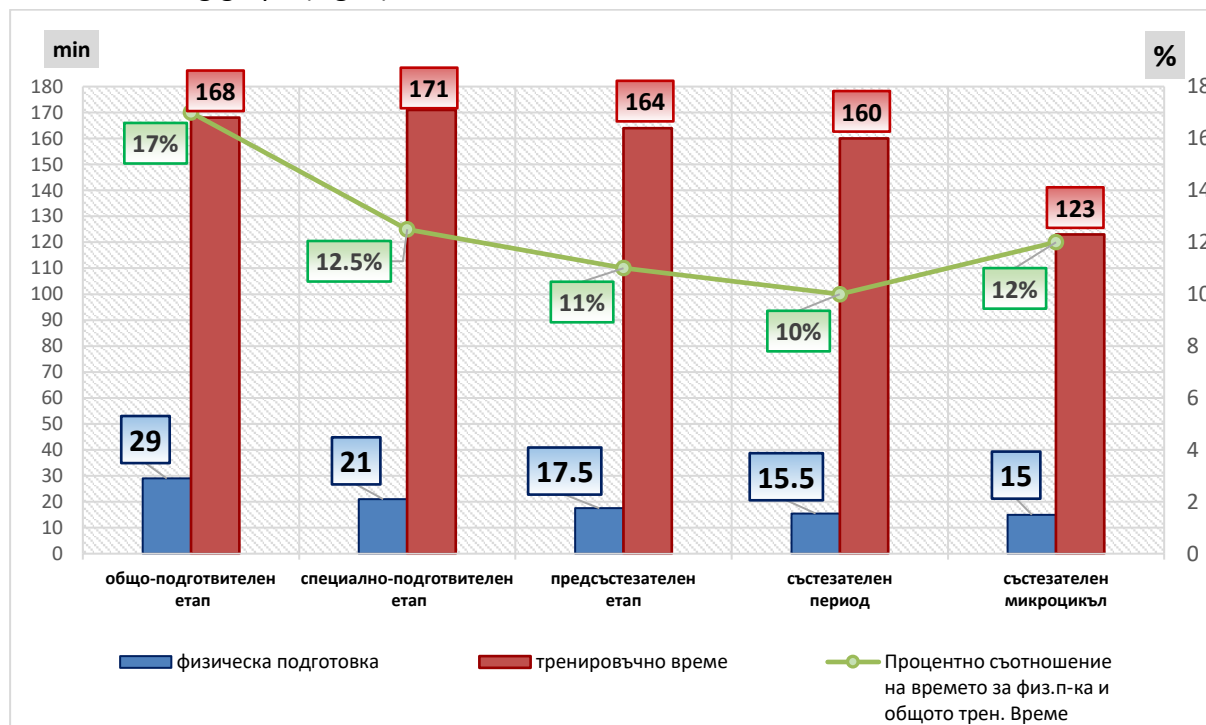


FIG. 6. Average duration of training sessions and the time spent for physical training during the separate stages and periods of training in sports aerobics

The graph shows the average values of time spent on physical training during the individual stages and periods of training, as well as their percentage of the total training time. In our opinion, the values of the chart follow their logical change, as they are naturally the highest in the general preparatory stage - 29 minutes and decrease gradually towards the competition period - 15 minutes. However, the total training time is very close - from 160 to 170 minutes, while during the competitive microcycle it only drops sharply to 123 minutes.

## II.2. Dynamics of development of the signs of special physical fitness

For the needs of the research, it is extremely important to follow the dynamics of development of the main signs of special physical fitness in the age aspect. This will allow to determine the state of the studied traits in the different age groups (AG 7-8, AG 9-11, AG 12-14, and AG 15-17) and, on this basis, to determine the accents in the future school -training work with the athletes from each group.

To solve this problem in 2005 a finding experiment was conducted to reveal the peculiarities of special physical fitness in terms of age.

The results of the variational processing of the initial data for each of the studied sets are presented in Table 8.

**Table 8**

Mean levels of the studied traits of special physical fitness in each of the observed populations

Nº	tests	AG 7-8	AG 9-11	AG 12-14	AG 15-17
<b>T1</b>	pushups	<b>28.70</b>	<b>23.47</b>	<b>31.10</b>	<b>30.00</b>
<b>T2</b>	Abdominal presses	17.40	18.60	22.63	24.76
<b>T3</b>	Back presses	27.20	28.27	28.57	30.94
<b>T4</b>	in height Lifting the knees to the chest	<b>27.80</b>	<b>23.70</b>	<b>25.13</b>	<b>26.41</b>
<b>T5</b>	Shuttle running	35.20	37.70	40.73	43.29
<b>T6</b>	in height holding the legs forward	4.80	7.50	12.37	19.65
<b>T7</b>	straddle support	12.50	12.20	18.10	26.94
<b>T8</b>	Long jump	144.40	155.03	180.47	199.94
<b>T9</b>	Vertical jump	26.60	24.50	32.50	39.71
<b>T10</b>	from lying down, standing up and straight jump	41.20	40.57	37.57	35.71
<b>T11</b>	Running with high knees - on the spot	<b>5.70</b>	<b>5.67</b>	<b>5.23</b>	<b>5.12</b>
<b>T12</b>	Lean forward	13.40	13.83	21.43	24.00

The analysis of the table shows that, in general, the observed traits develop in a positive direction and at the end of the observed period (in AG 15-17) the increments in most of the average values of the indicators are significant. This is quite natural, given the difference of 2-3 years between each of the studied populations. Evidence for this finding are the values of Student's comparative *t*-test (Fig. 7).



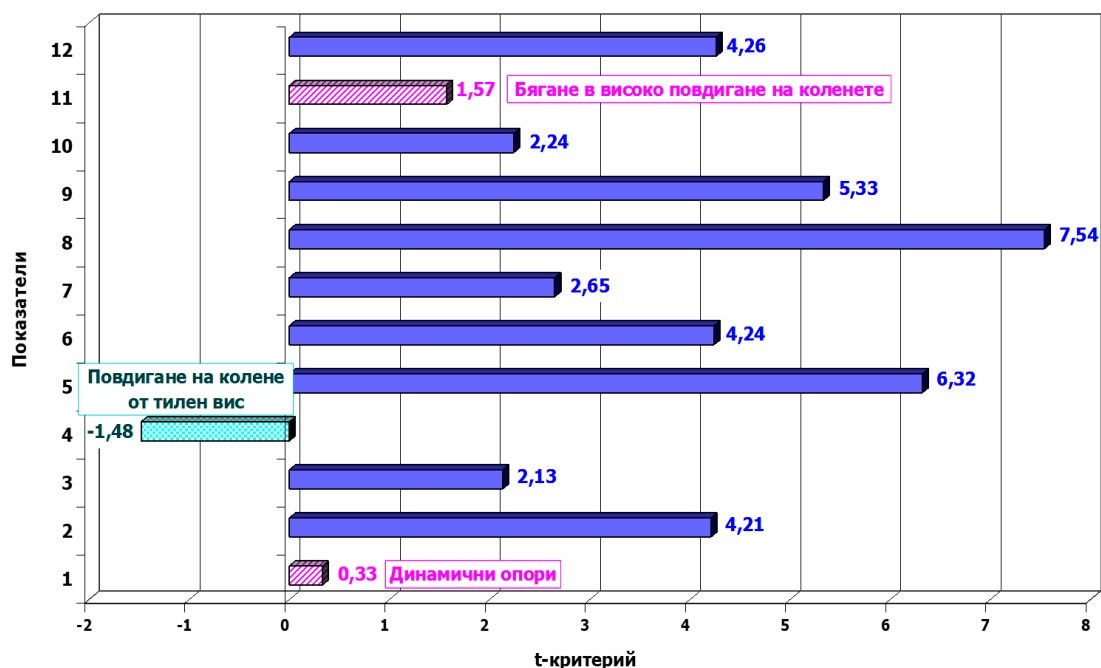


FIG. 7. Significance of the differences between the average levels of the studied traits at the beginning and at the end of the observed period

At the same time, however, as can be seen from the figure, the dynamics with which the signs of the special physical fitness are developing varies in a different extent in some of them. Presented in FIG. 8 lines of development allow to get an idea of the age dynamics of the signs of speed and strength endurance of both the upper limbs and the abdominal and back muscles. The analysis shows, for example, that the Speed-Strength endurance of the abdominal muscles (indicator 2 - Abdominal presses) increases gradually and from an average of 17.40, performed abdominal presses in AG 7-8, reaches 24.76 for AG 15-17. The largest increase (by 4.03) was observed in the period between the ages of 11 and 14 years.

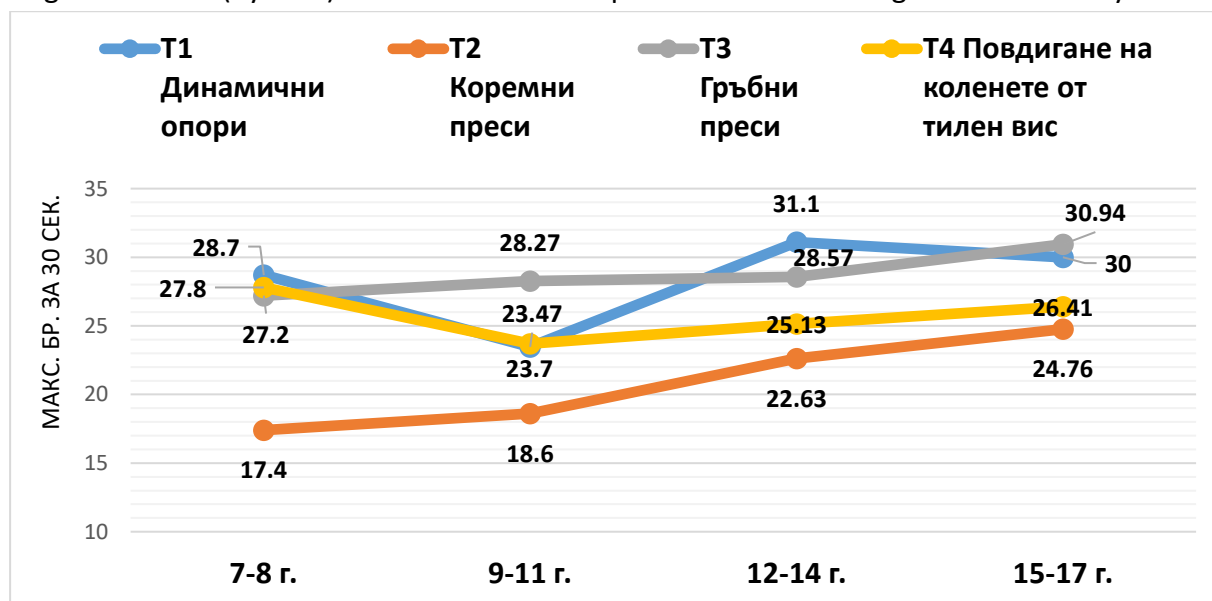


FIG. 8. Dynamics of development of the average levels of the signs of the Speed-Strength endurance of the upper limbs, abdominal and back muscles

As a final result, as can be seen from fig. 15, the value of the comparative  $t$ -test for this indicator is 4.21. This gives grounds, with a high guarantee probability ( $P_t \geq 95\%$ ), to claim that as a result of the applied training effects and the normal physiological development of the studied athletes in sports aerobics, at the end of the observed period there is a significant increase in the level of development. of the speed-strength endurance of the abdominal muscles.

A similar dynamics of development is observed in indicator 3 (Back presses), although in the period between 11 and 14 years of age the development of this quality is quite slow. As a final result, however, an increase of about 4 back presses is a guarantee for a significant improvement in the Speed and Strength endurance of the back muscles ( $t_3 = 2.13$ ).

The same cannot be said for the special Speed-Strength endurance of the upper limbs (indicator 1) and that of the abdominal muscles, but measured in the height position (indicator 4).

As can be seen from fig. 16, the average results of 9-11-years-olds are significantly lower than those of 7-8-years-olds, followed by a period of positive development. The decrease in the values at the end of the period gives grounds, with a high guarantee probability ( $P_t \geq 95\%$ ), to accept as correct the zero hypothesis, according to which the changes in the level of development for indicators 1 and 4 are insignificant and can be explained by accidental reasons. Evidence of this are the values of  $t$  ( $t_1 = 0.33$  and  $t_4 = -1.48$ ), which are lower than the critical value ( $t_{\text{tabl}} = 2.06$ ) (Fig. 15).

In the dissertation we have analyzed all the other studied features, their dynamics of development in terms of age and the significance of the differences.

### **II.3. Average level and variability of the signs of physical fitness in 12-14-years-old athletes during the special training stage**

To solve the purpose and tasks of the study, as indicated in the methodology, a sports-pedagogical experiment was conducted with athletes from the group of 12-14-years-olds. The accents in the experimental methodology developed by us were determined on the basis of the results of the preliminary study made above to reveal the peculiarities of special physical fitness in different age groups (AG 7-8, AG 9-11, AG 12-14, and AG 15 -17) and are aimed primarily at developing special speed-power and jumping endurance.

In order to establish the initial levels of special physical qualities, at the beginning of the sports-pedagogical experiment was conducted testing of athletes from both groups - Control and Experimental).

The results of the variational processing of the initial data from the testing of the competitors from the Experimental group are presented in Table 9, those of the competitors from the Control group - in Table 10.

**Table 9**

Mean values and variability of the studied traits in 12-14-years-olds at the beginning of the sports-pedagogical experiment - Experimental group

Nº	tests	X	S	V	min	max
1.	pushups	31.71	6.83	21.54	21,00	47,00
2.	Abdominal presses	24.79	3.64	14.68	20,00	32,00
3.	Back presses	30.29	5.38	17.76	18,00	39,00
4.	in height Lifting the knees to the chest	22.79	3.62	15.88	15,00	28,00
5.	Shuttle running	41.93	3.83	9.13	35,00	47,00
6.	in height holding the legs forward	18.82	14.93	79.33	2,00	50,00
7.	straddle support	25.90	13.94	53.82	9,00	62,00
8.	Long jump	184.93	17.65	9.54	158,00	228,00
9.	Vertical jump	36.07	6.68	18.52	27,00	49,00
10.	from lying down, standing up and straight jump	38.34	4.62	12.05	46,30	30,00
11.	Running with high knees - on the spot	5.04	0.69	13.69	6,60	4,40
12.	Lean forward	19.50	5.11	26.21	28,00	10,00

**Table 10**

Mean values and variability of the studied traits in 12-14-years-olds at the beginning of the sports-pedagogical experiment - Control group

Nº	tests	X	S	V	min	max
1.	pushups	34.64	9.10	26.27	18,00	48,00
2.	Abdominal presses	24.07	3.89	16.16	17,00	30,00
3.	Back presses	32.93	3.08	9.35	29,00	39,00
4.	in height Lifting the knees to the chest	25.21	3.68	14.60	14,00	29,00
5.	Shuttle running	42.57	3.16	7.42	36,00	46,00
6.	in height holding the legs forward	17.43	12.75	73.15	4,40	43,00
7.	straddle support	24.82	12.99	52.34	7,50	56,00
8.	Long jump	190.57	17.08	8.96	153,00	217,00
9.	Vertical jump	30.29	7.70	25.42	10,00	40,00
10.	from lying down, standing up and straight jump	36.71	4.31	11.74	47,00	30,30
11.	Running with high knees - on the spot	4.96	0.67	13.51	6,00	4,00
12.	Lean forward	22.39	4.89	21.84	11,00	32,00

For a more accurate analysis of the results, they are divided into groups, depending on the special physical quality for which they carry information and are appropriately illustrated.

In FIG. 9 presents the average values of the two groups of competitors in the tests determining the initial level of their speed and strength qualities.

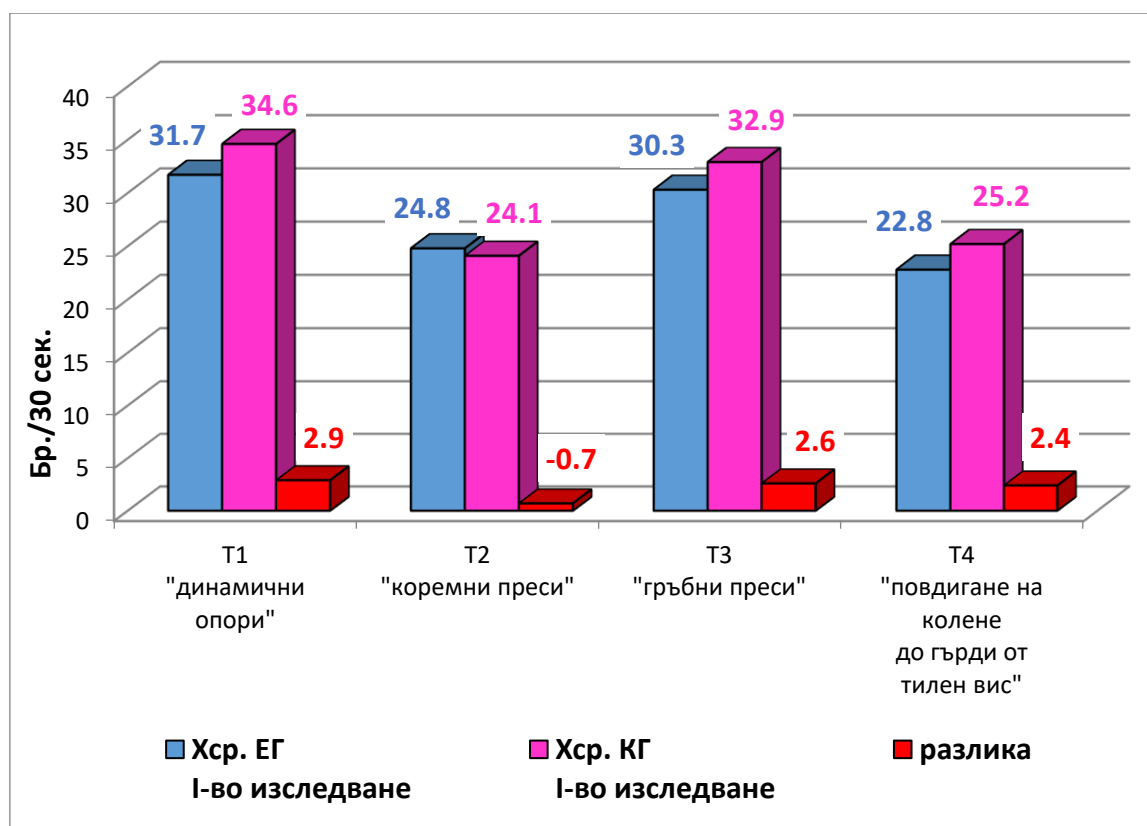


FIG. 9. Average levels of the studied traits of Speed-Strength endurance at the beginning of the experiment - AG 12-14.

As can be seen from the figure, the competitors from the Control group have a slight advantage in the average values of three of the tests (1st "Dynamic supports" - 2.9 pieces; 3rd "Bback presses" - 2.6 pieces and 4- you "Lifting the knees to the chest from the nape of the neck" - 2.4 pieces). In the test for speed-strength endurance of the abdominal muscles (indicator 2) the two groups show almost the same average values, as the difference of 0.7 in favor of the experimental one is insignificant.

In the dissertation we have illustrated and analyzed in detail the data from the variational analysis of all studied traits of the two groups (CG and EG) before the start of the experimental methodology. in sports aerobics, established at the beginning of the experiment shows that the differences obtained are relatively small, with the Control group showing a slight advantage in eight of the tests, and the experimental - in four.

\* \* \*

## RESULTS FROM THE SECOND SPORTS AND PEDAGOGICAL TESTING

After the applied experimental methodology with the 12-14-years-old athletes in sports aerobics, a second sports-pedagogical testing was conducted. The data from it were processed by variation analysis (Table 11 and Table 12), which allows to establish and compare the average levels of all studied traits at the end of the experiment for the athletes from both groups.

**Table 11**

Mean values and variability of the studied traits in 12-14-years-olds at the end of the sports-pedagogical experiment - experimental group

Nº	tests	X	S	V	min	max
1.	pushups	37.07	5.30	14.30	28,00	46,00
2.	Abdominal presses	28.50	2.14	7.51	25,00	32,00
3.	Back presses	34.21	3.81	11.14	28,00	42,00
4.	in height Lifting the knees to the chest	26.64	1.08	4.05	25,00	29,00
5.	Shuttle running	44.29	2.13	4.81	41,00	49,00
6.	in height holding the legs forward	21.06	8.89	42.21	7,00	40,90
7.	straddle support	33.07	12.73	38.49	14,80	59,00
8.	Long jump	202.86	13.48	6.64	186,00	234,00
9.	Vertical jump	46.86	5.55	11.84	38,00	58,00
10.	from lying down, standing up and straight jump	35.27	4.85	13.75	42,90	28,00
11.	Running with high knees - on the spot	4.34	0.24	5.53	4,72	4,00
12.	Lean forward	23.82	3.86	16.20	16,00	29,00

In both tables and fig. 10 presents the average values obtained in the second testing of the experimental and control groups, characterizing the Speed-Strength endurance of the competitors at the end of the experiment.

**Table 12**

Mean values and variability of the studied traits in 12-14-year-olds at the end of the sports-pedagogical experiment - Control group

Nº	tests	X	S	V	min	max
1.	pushups	34.79	9.78	28.11	18,00	48,00
2.	Abdominal presses	26.07	5.47	20.98	17,00	35,00
3.	Back presses	32.07	3.65	11.38	26,00	39,00
4.	in height Lifting the knees to the chest	24.43	3.06	12.53	18,00	29,00
5.	Shuttle running	43.50	3.96	9.10	36,00	49,00
6.	in height holding the legs forward	18.10	10.93	60.39	6,00	41,00
7.	straddle support	24.27	12.50	51.50	7,50	54,00
8.	Long jump	195.93	19.77	10.09	153,00	221,00
9.	Vertical jump	31.93	8.35	26.15	10,00	42,00
10.	from lying down, standing up and straight jump	36.71	5.24	14.27	47,00	28,00
11.	Running with high knees - on the spot	4.75	0.73	15.37	6,00	4,00
12.	Lean forward	22.11	4.80	21.71	11,00	29,00

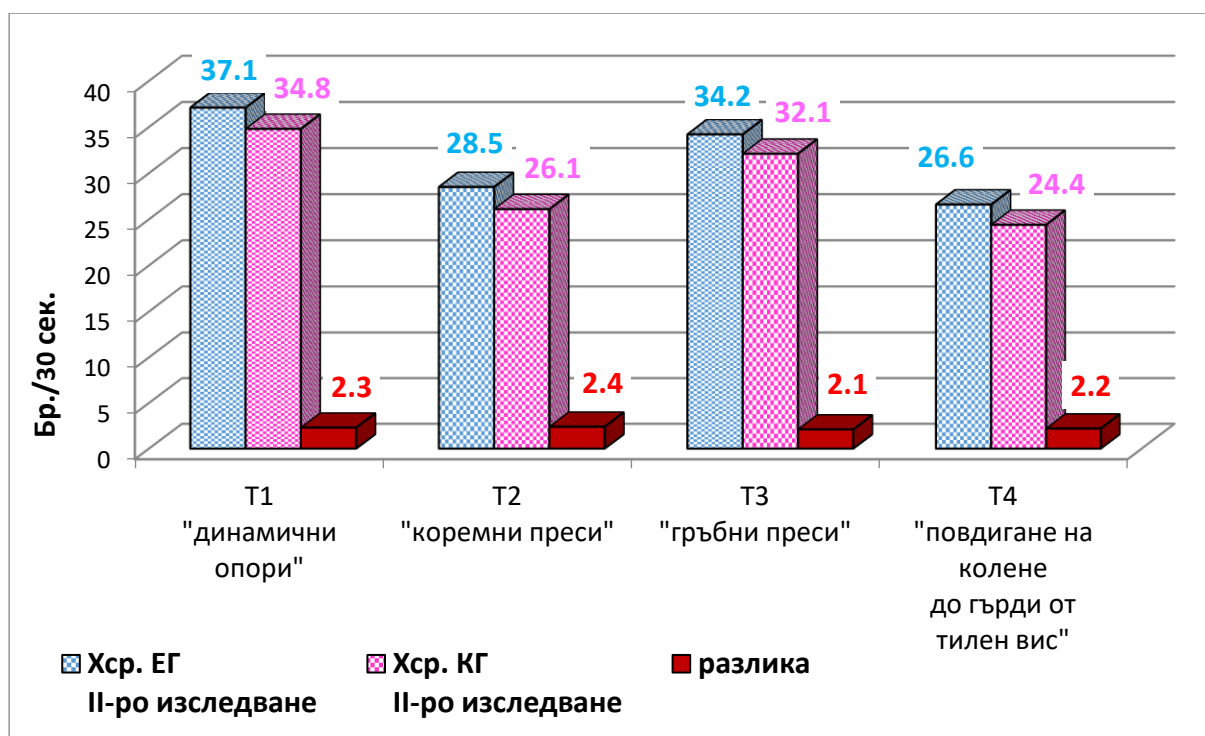


FIG. 10. Average levels of the studied signs of Speed and Strength endurance at the end of the experiment - AG 12-14

As can be seen, in all four studied traits the average values of the experimental group are higher than those of the control group. The comparative analysis shows that after the application of the experimental methodology the advantage of the experimental group over the control in terms of Speed and Strength endurance of the upper limbs, abdominal and back muscles is within 6%, 14% and 8.42%, respectively.

The analysis of the results also shows that during the experiment the Experimental group marked a positive increase in all four tests. The relative share of gains ranges between 12.94% for indicator 3 (Back presses) and 16.90% - for indicator 1 (Dynamic supports).

In the athletes from the Control group, an increase was observed only in test 2, related to the performance of the maximum number of "Abdominal presses" for 30 s. In the test "Dynamic supports" (indicator 1) the growth of the control group is extremely small, only 0.15 supports, and in the "Back presses" and "Lifting the knees to the chest from the occipital axis" the average values at the end of the experimental period even decrease ( $d_3 = -0.86$ , and  $d_4 = -0.78$ ).

In the dissertation we made a detailed analysis of the differences between the level of development of all studied features, both before and after the applied experimental methodology.

## II. 4. Checking the effectiveness of the experimental methodology in 12-14-years-old athletes

The analysis made so far allowed to reveal the average levels and variability of the studied signs of physical fitness in both groups (Experimental and Control), participants in the experiment both at the beginning and at the end. It is clear from the analysis that all indicators show certain differences between the average levels of the two groups. However, this does not give grounds to draw serious conclusions and conclusions before the validity of these differences is established.

For this purpose, as indicated in the methodology, the comparative *t*-test of Student was applied, and the data presented in fig. 19 allow establishing the significance of the differences between the average levels of the studied traits at the beginning of the experiment.

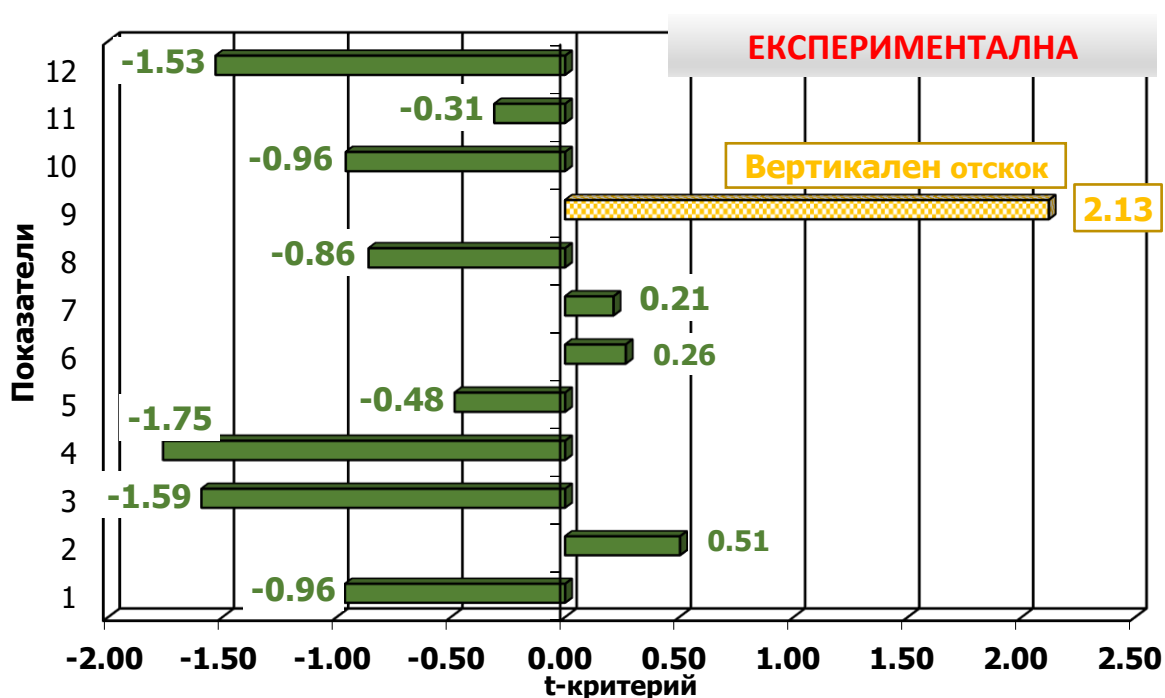


FIG. 11. Significance of the differences between the average levels of the studied traits at the beginning of the experiment between the two groups (EG, CG) - AG 12-14

The figure shows that in 8 indicators the Control group has higher results than the experimental one. A closer look at the values of *t* shows that in all indicators  $t_{\text{emp}}$  is less than  $t_{\text{critical}}$  ( $t_{\text{critical}} = 2.05$ ). This gives grounds with a high guarantee probability ( $P_t \geq 95\%$ ) to confirm the null hypothesis, according to which the observed advantage of the competitors from the Control group is insignificant and can be explained by random reasons.

This finding also applies to most of the indicators in which the advantage is in favor of the Experimental group.

The only exception here is indicator 9 (Vertical rebound).

As can be seen from the figure, in this indicator *t* has a value of 2.13, which gives grounds, in terms of the level of development of explosive strenght of the lower limbs in vertical

muscular effort, to reject the null hypothesis and to accept the alternative, according to which the experimental group is superior to the control on the above grounds.

Nevertheless, the results show that at the beginning of the observed research period the level of the two groups is equal. This is a guarantee of correctness at the start of the experiment.

For the needs of the research at the end of the research period a second testing was conducted according to the above indicators.

In FIG. 12 presents the results of the comparative analysis of the indicators in the experimental group after the applied experimental methodology.

As can be seen from the figure, in most of the tests  $t$  takes values between 2.23 and 4.65. This is a proof of the reliability of the observed gains in the competitors from this population.

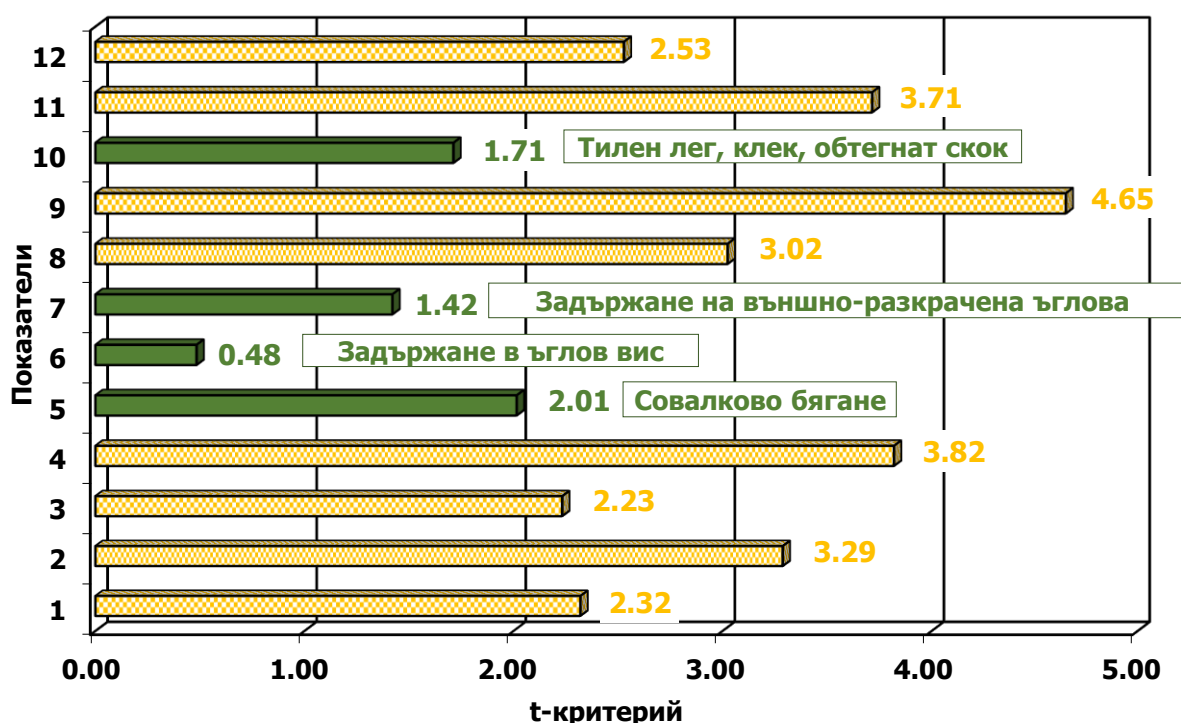


FIG. 12. Significance of the increments in the average levels of the studied traits in the experimental group at the end of the experiment - AG 12-14

The figure also shows, however, that in four of the tests the values of  $t$  are lower than the critical one ( $t_{critical} = 2.05$ ). This gives grounds, with a high guarantee probability ( $P_t \geq 95\%$ ), in terms of the ability of the competitors to stay in the "Angular height" (indicator 6) and in the Straddle support (indicator 7) to be accepted zero, which means that during the experiment there were no significant differences in the achievements of the competitors. The same applies to indicators 5 and 10, which carry information about speed endurance and speed.

The study conducted at the end of the experiment with the competitors from the Control group shows that during the experiment they also changed the level of the studied traits, but despite the observed positive gains, with a high guarantee probability it can be said that for all indicators in the Control group the null hypothesis is valid. This means that under the



influence of the performed training work there have been no significant improvements in the level of special physical qualities of the athletes from this population.

## **II.5. Average level and variability of the traits of physical fitness in 15-17-years-old athletes during the preparation period**

To solve the goal and tasks of the research, as indicated in the Methodology, a sports-pedagogical experiment was conducted with the athletes from the older age group (AG 15-17). The accents in the experimental methodology developed by us were determined on the basis of the longitudinal study for revealing the peculiarities of the special physical fitness in the different age groups (AG 7-8, AG 9-11, AG 12-14, and AG 15-17) and are aimed at developing mainly the strenght, special speed-strenght and special static-strenght endurance.

The results of the variational processing of the initial data from the testing conducted at the beginning of the sports-pedagogical experiment are presented in Table. 13.

**Table 13**

Mean values and variability of the studied traits in 15-17-years-olds at the beginning of the sports-pedagogical experiment - Experimental group

<b>Nº</b>	<b>tests</b>	<b>X</b>	<b>S</b>	<b>V</b>	<b>min</b>	<b>max</b>	<b>As</b>	<b>Ex</b>
<b>1.</b>	pushups	28,44	6,91	24,30	16,00	36,00	-0,95	-0,16
<b>2.</b>	Abdominal presses	25,56	2,01	7,86	23,00	29,00	0,55	-0,66
<b>3.</b>	Back presses	31,44	3,43	10,91	26,00	38,00	0,56	0,89
<b>4.</b>	in height Lifting the knees to the chest	20,00	3,74	18,70	14,00	24,00	-0,61	-1,42
<b>5.</b>	Shuttle running	40,67	4,66	11,46	31,00	47,00	-0,95	1,60
<b>6.</b>	in height holding the legs forward	16,11	2,42	15,02	13,00	19,00	0,11	-1,46
<b>7.</b>	straddle support	21,13	7,14	33,79	11,00	30,00	-0,14	-1,43
<b>8.</b>	Long jump	198,56	8,29	4,18	187,00	208,00	-0,40	-1,51
<b>9.</b>	Vertical jump	33,33	4,30	12,90	25,00	40,00	-0,56	1,02
<b>10.</b>	from lying down, standing up and straight jump	39,46	3,65	9,25	45,00	35,00	0,05	-1,42
<b>11.</b>	Running with high knees - on the spot	5,43	0,64	11,79	6,00	4,60	-0,23	-2,60
<b>12.</b>	Lean forward	22,33	5,27	23,60	11,00	30,00	1,16	2,52

The analysis of the table shows that at the start of the experiment the participants in the Experimental group performed an average of 28.44 Dynamic supports, 26.56 Abdominal presses, 31.44 Back presses and 20.00 Knee lifts from the occipital height. All these indicators carry information about the Speed and Strength endurance, respectively of the upper limbs, abdominal and back muscles. However, the table shows that in the group of 15-17-years-olds there are athletes who have much lower results than the best. Proof of this are the minimum ( $X_{\min}$ ) and maximum ( $X_{\max}$ ) values of X (the achievement). For example, properly performed dynamic supports take values between 16 and 26, liftings from the occipital leg are between 14 and 24, and so on. These statistical deviations from the

arithmetic mean, according to the norms of sports statistics, affect the homogeneity of the studied population (Fig. 13).

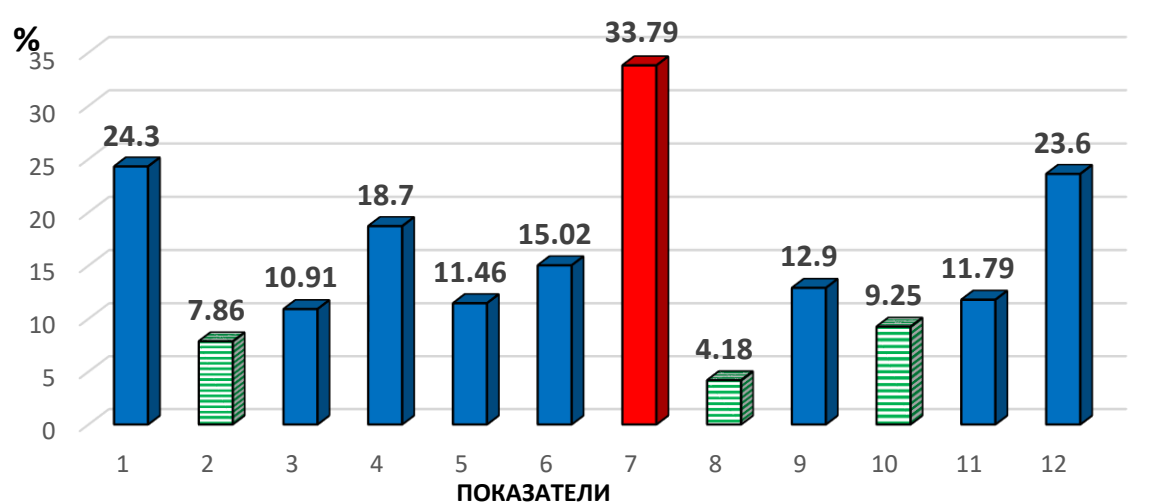


FIG. 13. Dispersion (V%) of the studied traits in 15-17-year-olds at the beginning of the sports-pedagogical experiment - experimental group

The figure shows that the lowest values of the coefficient of variation  $V$  are observed at indicators № 8 ( $V_8 = 4.18\%$ ), № 2 ( $V_2 = 7.86\%$ ) and № 10 ( $V_{10} = 9.25\%$ ). It is known, according to the norms of sports statistics, that the scattering of individual cases around the average level within 10% gives reason to believe that the relevant indicators are stable and the studied population - homogeneous in terms of the traits for which these indicators carry information. Therefore, with a high guarantee probability ( $P_t \geq 95\%$ ) it can be confirmed that during the initial testing the group of AG 15–17 athletes in sports aerobics was homogeneous in terms of the dynamic strength of the lower limbs during muscular efforts in the horizontal plane (indicator 8), the speed-strength endurance of the abdominal muscles (indicator 2) and the speed of the athletes when performing the combination "Occipital position - Squat - Air jump" (indicator 10).

As can be seen from fig. 21, for 8 of the studied indicators the values of the coefficient of variation range between 10.91% for indicator 3 and 24.30% for indicator 1. According to sports statistics, dispersion between 10% and 30% means that the respective indicators are relatively stable, and the studied population - approximately homogeneous on the grounds for which these indicators carry information. The reason for this relatively high dispersion is the observed larger differences between the achievements of the studied athletes from the experimental group. For example, the above-mentioned difference of 20 dynamic supports between the best and the weakest achievement, the difference of 19 cm on the slopes in depth, etc.

The only exception here is indicator 7 (Straddle support). As can be seen from the figure, the coefficient of variation on this indicator is the highest ( $V_7 = 33.79\%$ ), which puts it in the zone of unstable (over 30%). This gives grounds to claim that the Experimental group of AG 15-17 at the start of the experiment is highly heterogeneous in terms of static-strength endurance, which is required to maintain the Straddle support. From a sports-pedagogical point of view,

this means that during the future training sessions it is necessary for the athletes who have the lowest achievements in this area to increase the volume of training effects aimed at developing static-strength endurance.

In the dissertation we have also subjected to processing by variation analysis (Table 14) and the initial data of the athletes from the Control group, obtained from the conducted at the start of the experiment sports-pedagogical testing. We have graphically presented their homogeneity for each studied feature (Fig. 14).

**Table 14.**

Mean values and variability of the studied traits in 15-17-years-olds at the beginning of the sports-pedagogical experiment - Control group

№	tests	X	S	V	min	max	As	Ex
1.	pushups	31,78	7,14	22,46	21,00	42,00	-0,01	-1,25
2.	Abdominal presses	27,11	1,90	7,01	24,00	30,00	-0,20	-0,49
3.	Back presses	32,67	3,87	11,86	29,00	39,00	1,10	-0,33
4.	in height Lifting the knees to the chest	22,44	4,10	18,25	16,00	28,00	-0,26	-1,06
5.	Shuttle running	43,56	2,01	4,61	42,00	48,00	1,51	2,33
6.	in height holding the legs forward	20,89	11,79	56,46	7,00	50,00	2,12	5,91
7.	straddle support	24,89	8,89	35,74	12,00	41,00	0,39	0,01
8.	Long jump	201,78	13,27	6,58	174,00	218,00	-1,14	1,52
9.	Vertical jump	33,00	8,87	26,89	17,00	48,00	-0,09	0,69
10.	from lying down, standing up and straight jump	36,11	5,30	14,68	44,00	28,00	0,08	-1,21
11.	Running with high knees - on the spot	5,25	0,44	8,40	6,00	4,60	0,34	-0,14
12.	Lean forward	23,00	4,64	20,16	15,00	31,00	-0,12	0,63

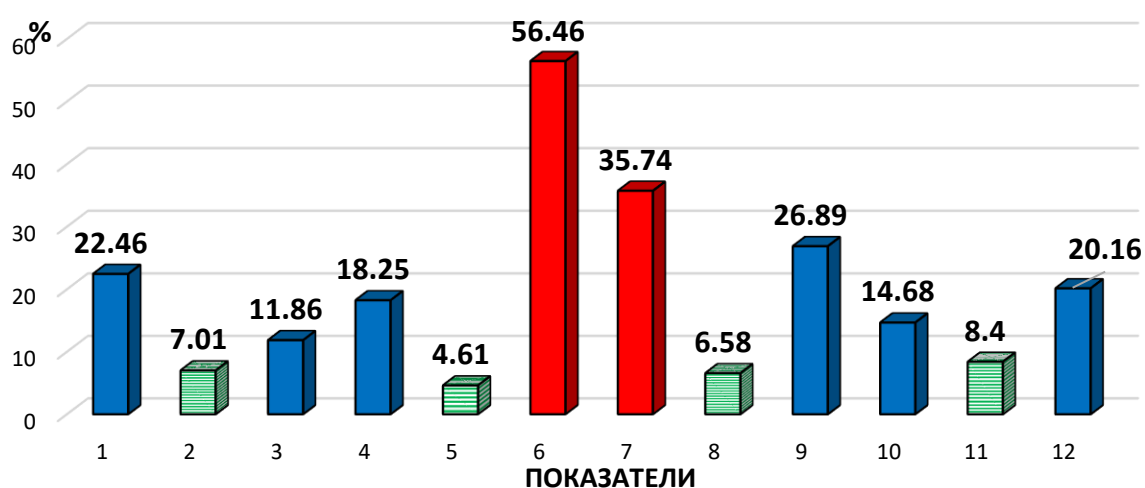


FIG. 14. Scattering (V%) of the studied traits AG 15-17 at the beginning of the sports-pedagogical experiment - Control group

From the values in Tables 13 and 14 it can be seen that in almost all studied traits the average achievements of the competitors from the Control group are higher than those of their colleagues from the Experimental one, but the analysis of Figure 15 shows that the

values of the  $t$ -test are in ranges between 0.10 and 1.71. Therefore, they are lower than the critical value of  $t$  ( $t_{\text{tabl}}$ ), which is 2.05. This gives grounds, with a high guarantee probability, to claim that at the beginning of the current sports-pedagogical experiment there are no significant differences between the average levels of the Experimental and Control groups on the studied signs of special physical fitness.

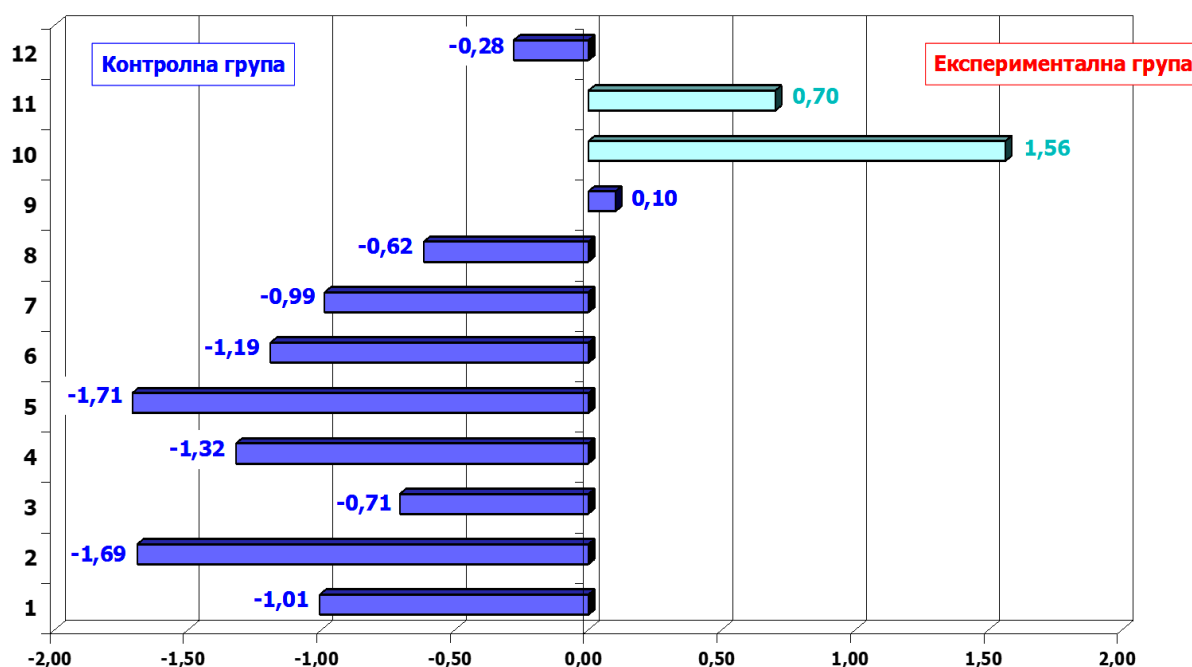


FIG. 15. Significance of the differences between the average levels of the studied traits in AG 15-17 at the beginning of the sports-pedagogical experiment

## II.6. Checking the effectiveness of the experimental methodology for 15-17-years-old athletes

In order to check the effectiveness of the applied experimental methodology, at the end of the observed period a second (final) sports-pedagogical testing was conducted with both groups in the 15–17-years-old participants in the experiment.

Information about the level and variability of the studied signs of special physical fitness in the athletes from the Experimental group at the end of the experiment gives table. 15.

**Table 15.**

Mean values and variability of the studied traits in AG 15-17 at the end of the sports-pedagogical experiment - Experimental group

№	tests	X	S	V	min	max	As	Ex
1.	pushups	37,78	4,58	12,11	31,00	44,00	-0,15	-1,67
2.	Abdominal presses	29,11	2,85	9,78	25,00	34,00	0,23	-0,33
3.	Back presses	33,67	2,55	7,57	30,00	38,00	-0,10	0,02
4.	in height Lifting the knees to the chest	26,56	1,67	6,28	23,00	28,00	-1,37	1,64
5.	Shuttle running	45,00	2,40	5,33	40,00	48,00	-1,12	1,44
6.	in height holding the legs forward	29,44	11,37	38,62	17,00	50,00	0,79	-0,14
7.	straddle support	41,22	13,17	31,95	25,00	64,00	0,46	-0,68
8.	Long jump	200,44	8,66	4,32	184,00	211,00	-0,71	0,19
9.	Vertical jump	38,44	3,50	9,12	34,00	44,00	0,42	-1,03
10.	from lying down, standing up and straight jump	30,33	5,34	17,60	43,00	26,00	2,01	4,20
11.	Running with high knees - on the spot	4,40	0,29	6,67	4,88	4,00	0,21	0,10
12.	Lean forward	26,11	3,66	14,00	21,00	30,00	0,43	-1,63

The analysis of the table shows that as a result of the applied training effects, after the end of the experiment there is an increase in the level of all studied traits. A good visual idea of this, as well as of the percentage change in the mean levels of these traits in the Experimental group is given by fig. 16.

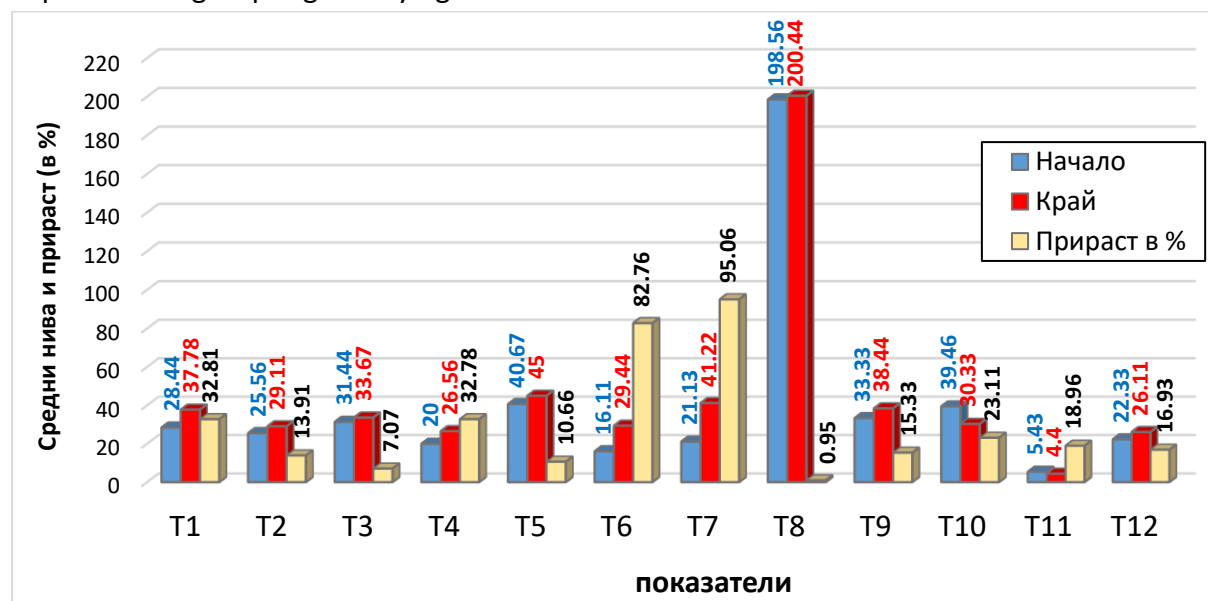


FIG. 16. Comparative analysis of the studied signs in AG 15-17 from the Experimental group at the end of the sports-pedagogical experiment

However, the positive changes found cannot be considered credible until their significance has been demonstrated.

Therefore, with the help of Student's comparative **t**-test, the null hypothesis was tested (Fig. 17).

The analysis of the figure shows that during the experiment, under the influence of the applied specialized training effects with the means of sports aerobics, there was a significant increase in the average levels of most of the studied signs of special physical fitness in the Experimental group.

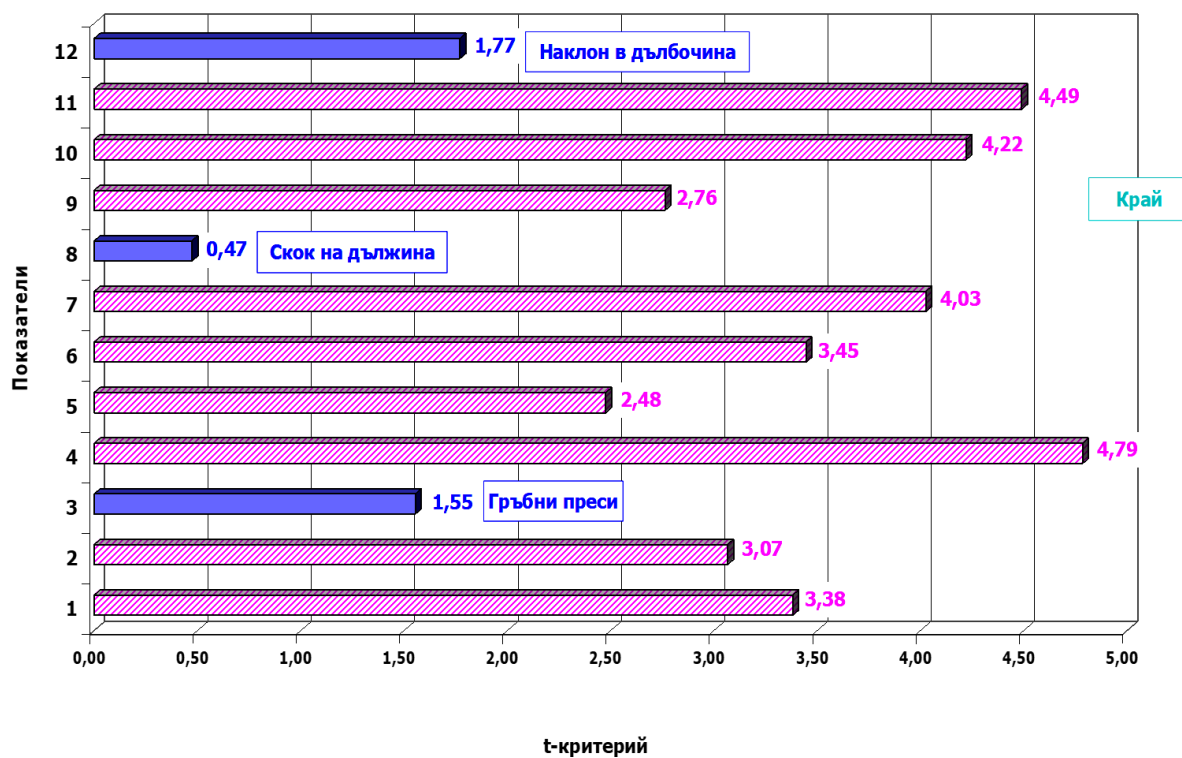


FIG. 17. Significance of the differences between the average levels of the studied traits in AG 15-17 from the Experimental group at the end of the sports-pedagogical experiment

Proof of this is the values of the calculated  $t$ -test. As shown in the figure, in 9 of the indicators (the shaded columns in Fig. 25)  $t$  moves within 2.48 and 4.79. According to the norms of sports statistics (at  $t > t_{\text{tabl}}$ ), with a high guarantee probability ( $P_t \geq 95\%$ ), with regard to the features for which these indicators carry information, the null hypothesis can be reasonably rejected and the alternative hypothesis can be accepted as true. According to it, these positive gains are significant.

What is the state of the Control group at the end of the experiment? The answer to this question is given in the dissertation, where in tabular and graphical form are presented the values for the development of the studied features after the time of the experiment.

It is clear from the analysis that the calculated comparative  $t$ -test in almost all indicators ranges between 0.18 and 1.23, which allows with a high guarantee probability to say that the null hypothesis is valid here. Therefore, in general, during the sports-pedagogical experiment the athletes from the control group did not experience significant changes in the levels of special physical qualities.

An exception is indicator 11 (Running in a place with high knees). The  $t$ -criterion is higher than the critical value ( $t_{11} = 3.71$ ), which allows us to claim with a high guarantee probability

( $P_t \geq 95\%$ ) that this increase is significant. However, according to the other signs, the changes in the competitors from the Control group are accidental.

## II.7. Evaluation and optimization of the special physical fitness of 12-14-years-old athletes

To solve the purpose and tasks of the study, an assessment was made of the condition of the studied traits of special physical fitness both at the start and at the end of the conducted sports-pedagogical experiments with AG 12-14 and AG 15-17 in sports aerobics.

The scores are obtained with the help of the normative tables attached to the dissertation.

The calculated average total score ( $\Sigma T$ ) of the special physical fitness of the AG 12-14 from the experimental group at the beginning of the observed period is 28.08 points. Relatively higher (30.00 points) is the generalized score of the athletes from the Control group. (Fig. 18).

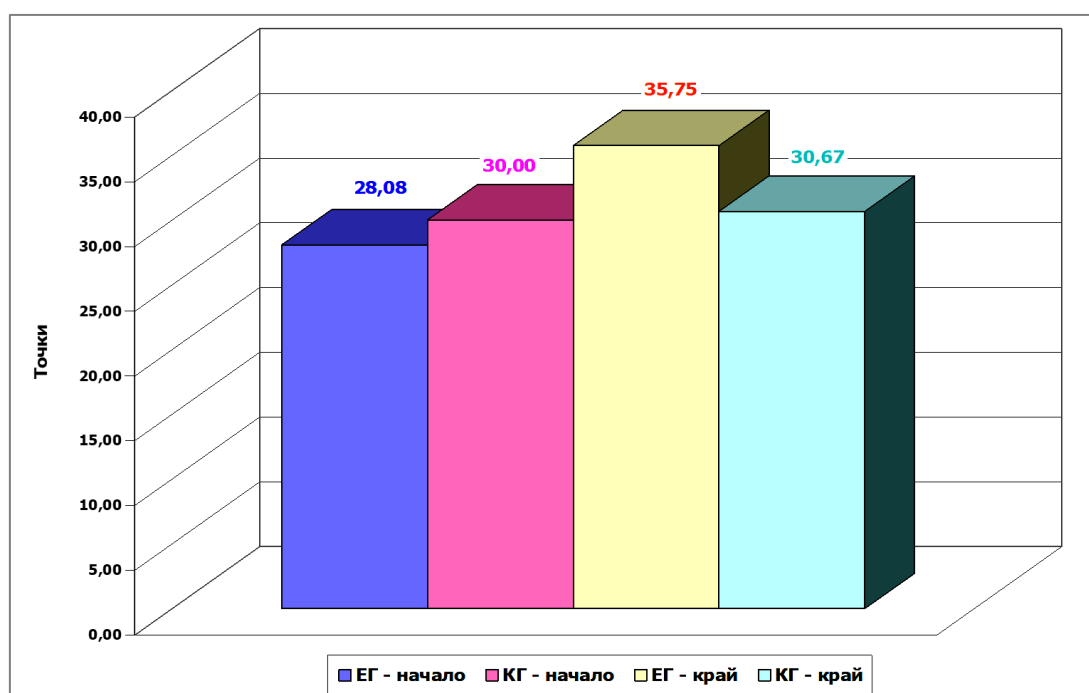


FIG. 18. Summarized assessments of the special physical fitness of AG 12-14

However, the difference between the average score for the studied sets is only 1.92 points and, as indicated in section III.4, the differences between the average levels of the studied traits at the start of the sports-pedagogical experiment with 12-14-years-old athletes, are generally insignificant.

By means of the group, individual and optimization profiles prepared by us, we can determine both the strengths and weaknesses of the special physical fitness of the athletes, exposed to the experimental methodology both at the beginning and at the end of the observed period (Fig. 19, 20 and 21).

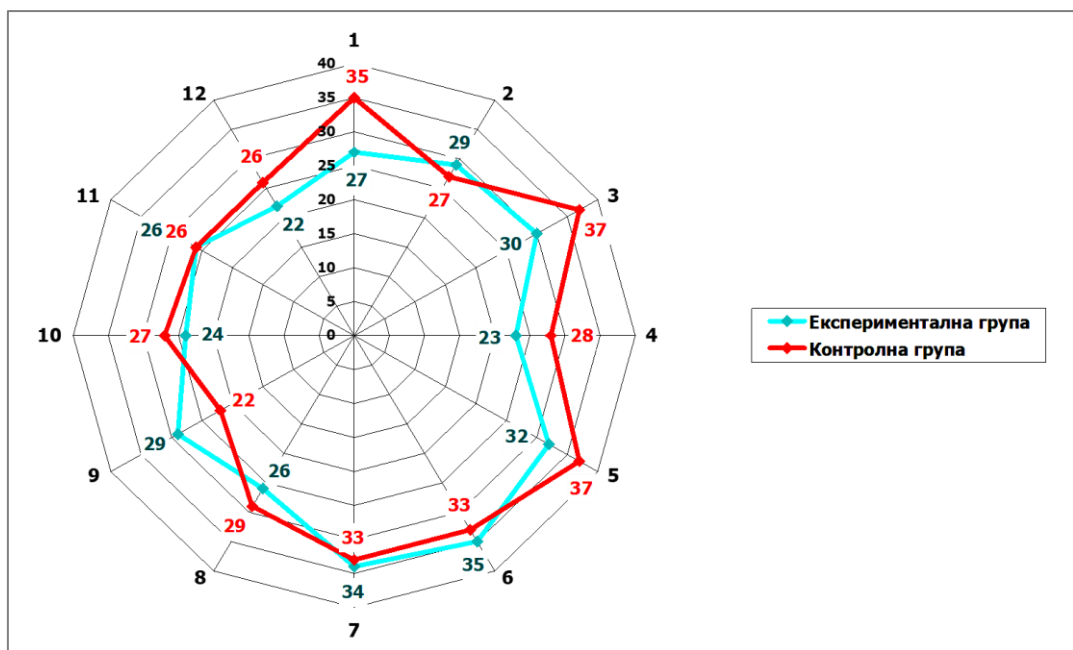


FIG. 19. Group profile of special physical fitness of AG 12-14 at the start of the sports-pedagogical experiment

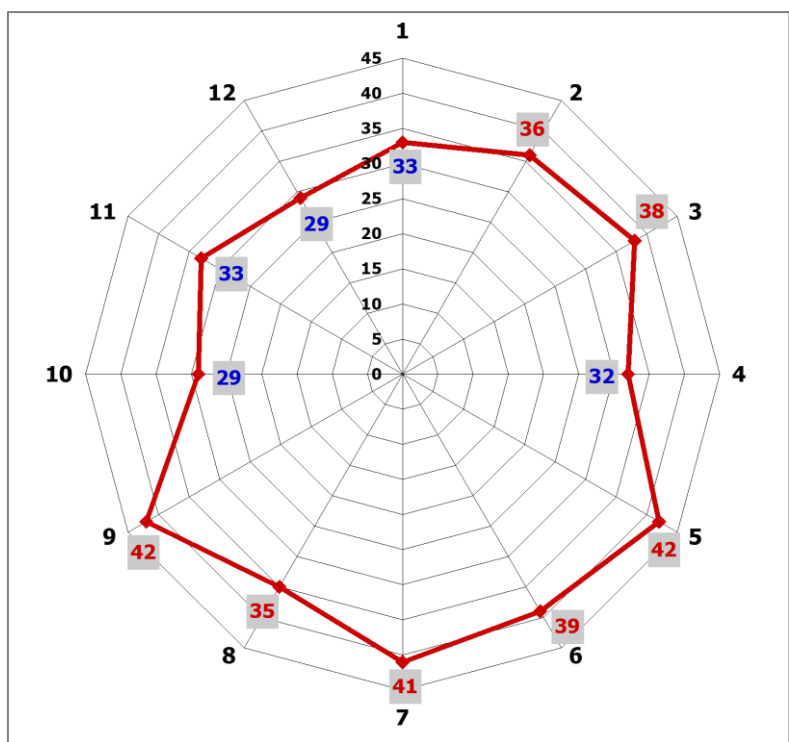


FIG. 20. Optimization profile of the special physical fitness of the 12-14-years-old athletes from the Experimental group



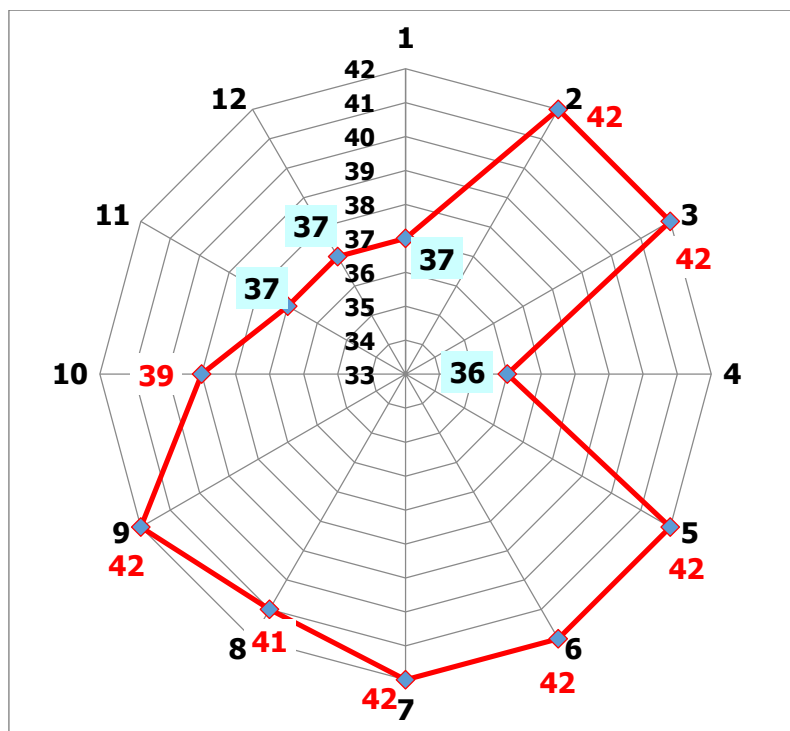


FIG. 21. Individual optimization profile of Janeta Petkova's special physical fitness ( $T_{\text{average}} = 39,92$  pt.)

## II.8. Evaluation and optimization of the special physical fitness of AG 15-17

The results obtained in the evaluation of athletes from the older AG 15-17 are presented in table. 16.

Table 16.

Assessment of the level of the studied traits in 15-17-years-old athletes

№	tests	Начало		Край		Прирасти	
		ЕГ	КГ	ЕГ	КГ	ЕГ	КГ
1.	pushups	25	28	33	30	8	2
2.	Abdominal presses	27	31	33	27	6	-4
3.	Back presses	25	27	30	26	5	-1
4.	in height Lifting the knees to the chest	9	13	23	18	14	5
5.	Shuttle running	18	25	30	25	12	0
6.	in height holding the legs forward	23	27	35	30	12	3
7.	straddle support	21	23	32	27	11	4
8.	Long jump	27	29	28	26	1	-3
9.	Vertical jump	18	18	24	19	6	1
10.	from lying down, standing up and straight jump	22	25	32	28	10	3
11.	Running with high knees - on the spot	23	25	31	31	8	6
12.	Lean forward	22	23	27	23	5	0
Т <sub>средно</sub>		21.67	24.5	29.83	25.83	8.16	1.33

The analysis of the table shows that at the start of the sports-pedagogical experiment the highest average level of 15-17-years-old athletes from the Experimental group demonstrated in terms of the following signs of special physical fitness:

- Speed and Strength endurance of the abdominal muscles (indicator 2 "Abdominal presses",  $T_2 = 27$  points);
- Dynamic force of the lower limbs during muscular efforts in the horizontal plane (indicator 8 "Long jump",  $T_8 = 27$  points);
- Speed-Strength endurance of the upper limbs (indicator 1 "Dynamic supports",  $T_1 = 25$  points);
- Speed-Strength endurance of the back muscles (indicator 3 "Back presses",  $T_3 = 25$  points).

At the same time, it is clear from the table that the scores on some of the indicators are much lower, which is evidence of a lower level of development of the features for which the respective indicators provide information. In the experimental group, this applies mainly to:

- Speed-Strength endurance of the abdominal and back muscles when performing Lifting of the knees from the occipital height (indicator 4,  $T_4 = 9$  points);
- Speed endurance (display 5 "Shuttle running",  $T_5 = 18$  points);
- the explosive power of the lower limbs during muscular efforts in the vertical plane (indicator 9 "Vertical rebound",  $T_9 = 18$  points).

The calculated average total score ( $\Sigma T$ ) of the special physical fitness of the 15–17-years-old athletes from the Experimental group at the beginning of the observed period is 21.67 points. Relatively higher (24.50 points) is the generalized score of the athletes from the Control group. This is clearly seen in fig. 22.

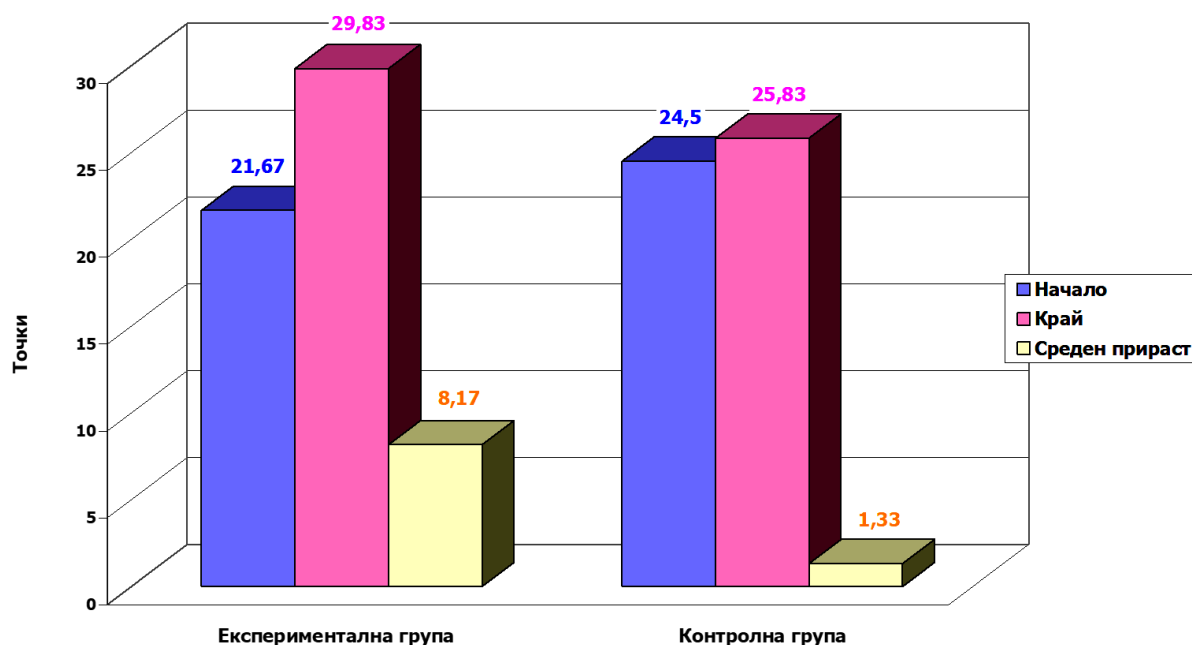


FIG. 22. Summarized assessments of the special physical fitness of 15-17-years-old athletes

The analysis of table 16 also shows that in this AG 15-17, as well as in AG 12-14, the higher average total score in the competitors from the Control group is a result of the higher level of development of the studied traits at the start of the experiment. This is illustrated in FIG. 23.

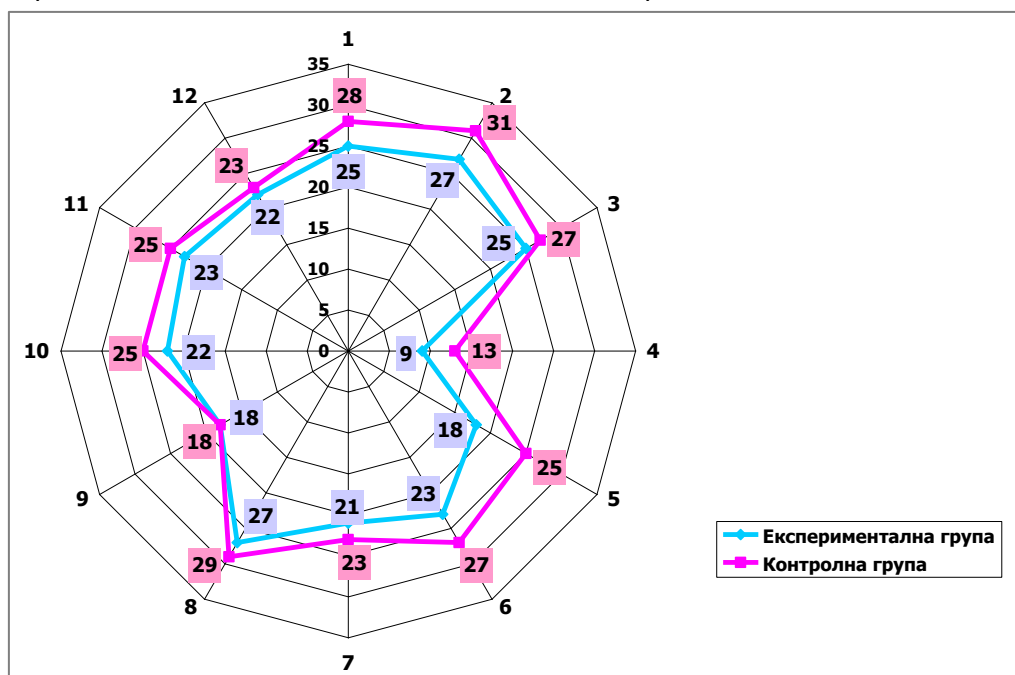


FIG. 23. Group profile of the special physical fitness of 15-17-years-old athletes at the start of the sports-pedagogical experiment

The figure shows that the special physical fitness of 15-17-years-old athletes from the Control group is characterized by the highest level of development of:

- Speed and Strength endurance of the abdominal muscles (indicator 2 "Abdominal presses",  $T_2 = 31$  points), of the upper limbs (indicator 1 "Dynamic supports",  $T_1 = 28$  points) and of the back muscles (indicator 3 "Back presses",  $T_3 = 27$  points);
- Dynamic power of the lower limbs during muscular efforts in the horizontal plane (indicator 8 "Long jump",  $T_8 = 29$  points) and
- Static-strength endurance (indicator 6 "Angular height",  $T_6 = 27$  points).

The weakest in this age group at the beginning of the experiment was developed speed-strength endurance when performing knee lifting from the occipital axis and the dynamic power of the lower limbs with muscular effort in the vertical plane, and more:

- Static-strength endurance when holding in an Straddle support (indicator 7,  $T_7 = 23$  points) and
- Mobility of the spine (indicator 12,  $T_{12} = 23$  points).

As can be seen from fig. 31, the group profile of the special physical fitness of the two sets participating in the experiment, at its start, are identical. This gives reason to believe that these profiles, quite logically, outline the structure of the studied phenomenon and determine both the strengths and weaknesses of the special physical fitness of 15-17-years-old athletes in sports aerobics.

Based on the obtained assessments we have prepared and analyzed in the dissertation optimization profiles for the two studied sets (control and experimental group), as well as individual ones of elite athletes from the National team for this AG (fig. 24, 25, 26 and 27).

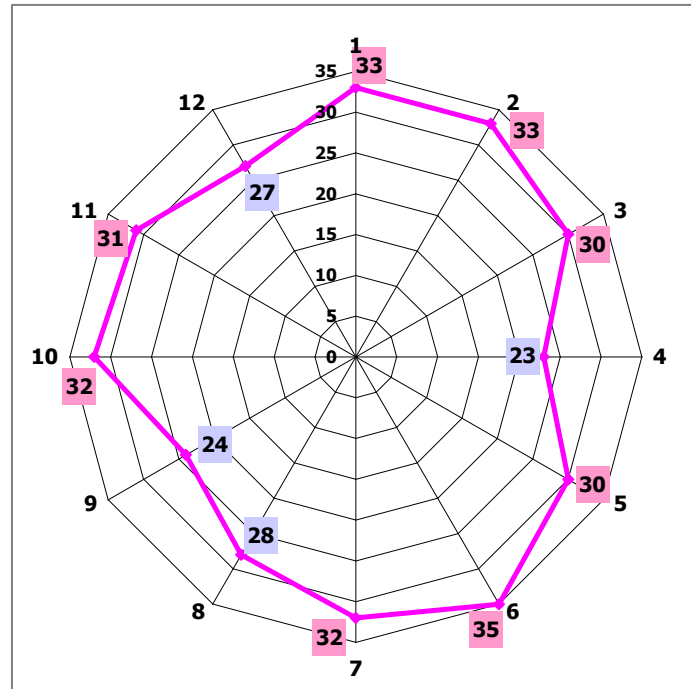


FIG. 24. Optimization profile of the special physical fitness of the 15-17-years-old athletes from the Experimental group

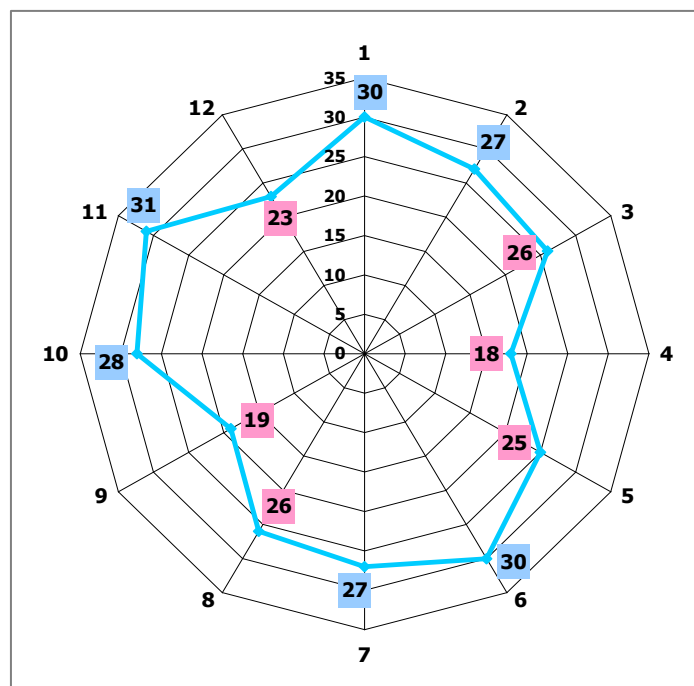


FIG. 25. Optimization profile of the special physical fitness of the 15-17-years-old athletes from the Control group

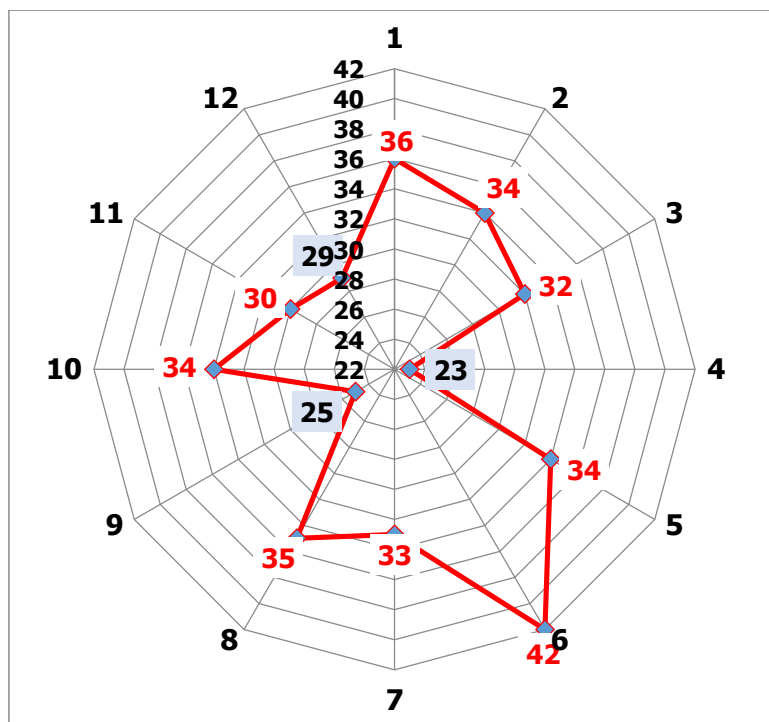


FIG. 26. Individual optimization profile of the special physical fitness of Ivelina Lukaki (Average = 32.25 points)

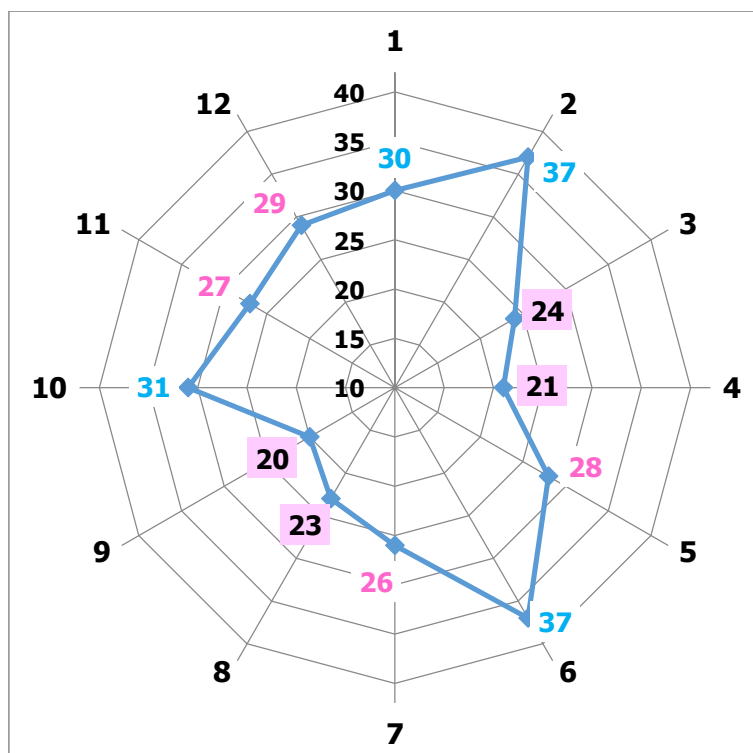


FIG. 27. Individual optimization profile of the special physical fitness of Lyuboslava Assenova ( $T_{Average} = 27.75$  points)

### **III. CONCLUSIONS, RECOMMENDATIONS AND CONTRIBUTIONS TO THE DISSERTATION**

#### **III. 1. CONCLUSIONS**

1. The analysis of the general indicators of the training load shows that the athletes in sports aerobics spend too little time for physical training during the separate stages and periods of their annual training. Also, at the time of the period studied by us, there is no data on the content of physical training, its nature and focus.

2. The monitoring of the dynamics of development of the main traits of the special physical fitness of the athletes in sports aerobics in the age aspect (from 7 to 17 years of age) shows that:

- The observed traits, as a whole, develop in a positive direction and at the end of the observed period (in AG 15-17) the increments in most of them are significant;
- There is an uneven dynamics of development of Speed-Strength endurance of the upper limbs and back muscles, as well as the speed when performing complex exercises.

3. The verification of the effectiveness of the applied specialized methodology for developing the special physical fitness of AG 12-14 in sports aerobics shows that the analyzes and summaries prove the effectiveness of the experimental methodology for complex development of special physical qualities of athletes in sports aerobics cannot be claimed for Control group competitors.

4. The verification of the effectiveness of the applied specialized methodology for developing the special physical fitness of AG 15-17 in sports aerobics shows that the performed experimental training work was sufficiently effective and had a significant positive impact on the level of special physical fitness of athletes. from the Experimental group in contrast to the Control group, in which only a significant increase in the speed of the lower extremities was observed.

5. The assessment of the state of the studied traits of special physical fitness both at the start and at the end of the conducted sports-pedagogical experiments with AG 12-14 and AG 15-17 in sports aerobics shows that the developed optimization models, completely logical , outline the structure of the studied phenomenon and determine both the strengths and weaknesses of the special physical fitness of the athletes.

#### **III. 2. RECOMMENDATIONS**

1. We recommend to specialists and trainers the use in practice of the experimental methodology prepared by us for AG 12-14, considering that it is necessary to adjust it for better efficiency, in the direction of increasing the volume of the training impact for the development of speed endurance and speed of competitors.

2. We also recommend the use of our experimental methodology for AG15-17, but again after making adjustments to increase the volume of training effects aimed at developing the dynamic

strength of the lower limbs, speed and strength endurance of the back muscles and mobility of the spine.

3. We recommend the use of the model approach for assessment of physical training in general in sports aerobics to improve the methodologies for the development of individual sports-specific motor skills.

### **III. 3. CONTRIBUTIONS**

1. A detailed content analysis of the competitive routines has been made and the necessary motor skills specific to each of their components have been differentiated. This clarifies the direction of development of physical training in sports aerobics.

2. The data from the longitudinal study of the duration of training sessions can serve as a starting point for optimizing planning in sports aerobics.

3. Two experimental methods have been developed to improve the special physical training of athletes in sports aerobics, which can be used in practice because they have proven their positive effectiveness.

### **PUBLICATIONS**

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2. Mineva, M., G. Sergiev, M. Tarnichkova (2005), Testing of the participants in the First World Championship in Sports Aerobics for boys and girls, Sofia'04, / year of study. conf. - Gymnastics / Sports and Science Magazine, special issue 2, p.76, ISSN 1310-3393.

3. Tarnichkova, M., I. Nikolova (2007) Dynamics of development of physical qualities in athletes in aerobic gymnastics /7-17 years old/, magazine "Sport and Science" issue. 4, p.15, ISSN 1310-3393.