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# THE ANNUAL DYNAMICS OF INDICES OF FUNCTIONAL CONDITION OF THE CARDIOVASCULAR SYSTEM AT FREESTYLE WRESTLERS OF 10-12 YEARS UNDER THE INFLUENCE OF THE CIRCUIT TRAINING

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***Abstract.*** *The circuit training exercises has a beneficial effect on the cardiovascular system of pupils- wrestlers of 10-12 years, expressed by increasing of his functional reserve and of his resistance to the physical effort, improvement of the economy functions and increasing of adaptive potential, and these changes are favorable for adaptation of the body to physical effort and improve the level of motor training of sportsmen.*
***Keywords:*** *wrestling pupils of 10-12 years old, circuit training, cardiovascular system, indices of functional condition, adaptation to physical effort*

**The actuality**. Wrestling is a task of sport, included in the Olympic Games program from 1904 year, and the interest of our country for qualifying of its wrestlers and their participation in these competitions is extremely high. At the same time the UWW (United World Wrestling) – the World Union of Wrestling tries to make them more dynamic and more spectacular [7], and the numerical increase of the pretenders to the highest places within national and international competitions, but also of global sports skills, requires an appropriate approach of the aspects related to continuous improvement of wrestlers training [6, 7]. In this context, Milan Ercegan, the President of FILA (1986) believes that to improve the mastery of the wrestlers and conducting of competitions in a high tempo should be revised the training way of wrestlers who are at an earlier stage, because the poor motoric training of wrestler in the early stages of training has strong repercussions on his sport's career, which sometimes cannot be remedied. The wrestlers must have an extensive motoric experience and continuously improve the functionality of the body in order to can activate in the difficult conditions within the competitions.

Currently, on the initial training stage in wrestling are selected children of 10-12 years, basically healthy, admitted by doctors. By child participation at trainings it occurs the body adaption to higher progressive efforts, which ensures the obtaining of sports form, sport training, actually, being executed throughout the year [5].

Keeping of the health condition of sportsmen is a core objective of the trainer [2]. To ensure the growth and development of the body in accordance with regularities of conducting of the genetic program is necessary that the training effort to be effective from the motoric point of view, but does not exceed the physiological possibilities of adapting of the child to physical effort.

The functional condition of organ systems constitutes a criterion for the health of body, of ability it adaption to physical effort [4], being the factor which limits often the achievement of sports performance.

From the arsenal of methods used for motor training and ensuring the multilateral physical development of the body (competitive method, play method, the method of uniform long-term exercise), I have selected the method of circuit training, which, in according with its organization and conducting, is accessible one and can ensure the increasing of the capacity of physical effort [3]. This method is used successfully in the training of soldiers, swimmers, gymnasts, volleyball players, in sports aerobic, but also in training of students, pupils and of the elderly.

*The hypothesis.* We have expected that the circuit training method, implemented in the motor training of freestyle wrestlers of 10-12 years, according to the methodology developed by us, will help at the improvement of the functional condition of the cardiovascular system, and from this perspective, will increase the efficiency

of sports training.

*Goal of the paper*. The analysis of annual dynamics of functional condition indices in 10-12 years pupils – wrestlers' cardiovascular system under the influence of circuit training.

The experimental researches were conducted in the Republican Boarding High School of Sports Profile from Chisinau municipality, on a sample of 24 freestyle wrestlers – pupils of 10-12 years. The chosen pupils attend the lessons, and two trainings per day, each of it having 90 minutes duration.

The wrestlers from the control group (n = 12) have participated in trainings organized according to the Educational Program in the training of freestyle wrestlers (2013/2014) and those from the experimental group (n = 12) – to the training in circuit, generally respecting the ratio and the structure between forms of training of sportsmen, set for the first year of initial training in free wrestling. The months of September-October have served as the adaption period of pupils to physical efforts, and the teaching experiment itself was conducted in the period of November - May, during 26 weeks. At first training the sportsmen were familiar with the specific of exercises to be performed at stations, which are already well known, and at the second training – has been determined the maximum number of repetitions (TM) for each type of exercise. The circuit training was used only in the basic part of training, and in the other were respected basic principles of their organization. Thus, in the month of November in the circuit were included 4 stations, and in the month of May this number was up to 10, monthly adding in the circuit one station. The duration of activity in the station constituted 1 min, of which the duration of the execution of the exercise constituted on average 30 sec., and 30 sec – of rest, the number of repetitions being ¼ of TM. The exercises complexes were daily modified in a station, and at the beginning of each week were completely altered, being selected exercises from acrobatic, which trains the vestibular system, develops the explosive power and prowess; exercises from athletics, a particular attention being offered to the run courses; exercises from gymnastics, involving the shoulder girdle muscles, sports games, and elements of free wrestlers, in particular, those relating to the exercise with legs, given the fact that the legs are commonly used in the shooting down of the opponent. The continues diversification of exercises in stations was necessary to achieve due to the adaption of the body to effort and decrease of their effectiveness, but also to keep alive their interest for the most difficult elements from the technically point of view. In the months of April and May within several stations, which constituted about ½ of the total number, were imitating the technical and tactical actions, specific to free wrestling.

**Methods of research of functional condition of the cardiovascular system.** To assess the influence of circuit training on functional condition of the cardiovascular system in the dynamics of annual training cycle we determined following indices: frequency of heart rate (FHR), systolic blood pressure (SBP) and diastolic blood pressure (DBP). This parameters were fixed at the beginning of pedagogical experiment (month of October) and at the end of (month of May.) In certain cases was appealed to the full appreciation indices, these being the most informative as particulars one.

The determining of FHR and of blood pressure (BP) was performed according to traditional methods, the FHR being determined before BP measurement. The information concerning FHR was obtained by palpation of the radial artery for 15 sec, restating one minute, and the blood pressure, according to the Korotkov (mmHg) method. The blood pressure is determined in seated position, after 3 – 5 min of rest.

The FHR depends on many factors: physical effort, energy expenditure, condition of vegetative nervous system etc. This index is used to assess the effort's intensity. Under certain conditions it is directly related to oxygen consumption. Therefore, in the accordance with the dynamics

of this index, can be appreciated by a greater degree of accuracy or less the physical effort and condition of tiredness. A broader view about the processes above mentioned can be achieved considering the dynamics of FHR during the study and in the complex with dynamics of other physiological indices.

*Blood pressure* (BP) is a primary index in assessing of the way of adaption of circulatory system to body requirements. The BP value depends on systolic volume, vascular tone and emotional condition of the sportsmen in the professional activity etc.

The maximum SBP (systolic) expresses the energy expenditure of the heart and is in a direct relationship with systolic volume. The increasing of the maximal BP value during work shows about heart function activation. The DBP expresses the degree of vascular resistance and general condition of the vascular system.

To assess the adaptation of the cardiovascular system of pupils are defined *the levels of adaptation*, assessed as "satisfactory adaptation", "tense adaptation", "insufficient adaptation" and "breaking of adaptation". The level of adaptation is assessed depending on the value of adaptability index (AI) according to the formula:

**AI (points) = 0,011 x (FHR) + 0,014 x (SBP) + 0,008 x (DBP) + 0,014 x (age in years) + 0,009 x (body weight, kg) – 0,009 x (waist, cm) – 0,27** (1.1)

where: FHR – frequency of heart rate / min; SBP – systolic blood pressure (mmHg); DBP – diastolic blood pressure (mmHg).

*Evaluation of the results* "satisfactory level of adaptation" - will not exceed 2.59 u.c.; "Strain of adaptation mechanisms" – 2.6 – 3.1 u.c .; "Unsatisfactory adaptation" – 3,1 - 3.49 u.c.; "breaking of adaptation" – over 3,5 u.c.

The activity of the cardiovascular system considerably limits the possibilities for executing of the physical exercises with maximal intensity, and the ignoring of the real possibilities of adaptation to physical effort can lead to abandoning of efforts by sportsmen or to competitions loss [3].

The adaptation is one of the main qualities of the human body, based on the available functional reserves, which, being aroused, ensure the interaction between body and the external environment [6]. In the specialty bibliography I have encountered stories concerning the adaptive potential of the cardiovascular system at adults, preschoolers and pupils of 11-17 years, but I have not found scientific information on adaptive capacity of freestyle wrestlers of 10-12 years.

It is important that for the assessment of the functional condition of the body to be used informative indices [7], which would objectively reflect the condition of the systems responsible primary for execution of physical effort and which would confirm and fulfill the results obtained by other methods. Therefore, together with appreciation of AI, I have determined the functional reserves of cardiovascular system of the pupils, involved in teaching experiment, calculating the index of Robinson (IR), according to the formula:

**IR= FHR (rest) x SBP / 100 units,** (1.2)

where: FHR- frequency of heart rate, beats per minute; SBP – systolic blood pressure, mmHg

*Evaluation of the results*: 70-110 units – medium level; over 110 units – reduced level; under 70 units – high level.

**The resistance coefficient Kvass (KR)** is determined in accordance with formula:

**KR = FHR x 10 : (SBP –DBP);** (1.3)

where: FHR- frequency of heart rate, beats per minute; SBP – systolic blood pressure, mmHg; DBP – diastolic blood pressure, mmHg.

*Evaluation of the results*: KR is in norm 16. The values over this number indicate a poor function of the cardiovascular system, and the lowest as the norm – to the overwork condition.

**The coefficient of economy (KE)** of the blood circulation system is determined by formula:

**KE = (SBP – DBP) x FHR,** (1.4)

where: (SBP –DBP) – pulsatile blood pressure; FHR- frequency of heart rate, beats per minute.

*Evaluation of the results*: KE is the norm - 2600. The values over this norm indicate a poor activity of the cardiovascular system, and the lowest as the norm indicates to the overwork condition of respective system.

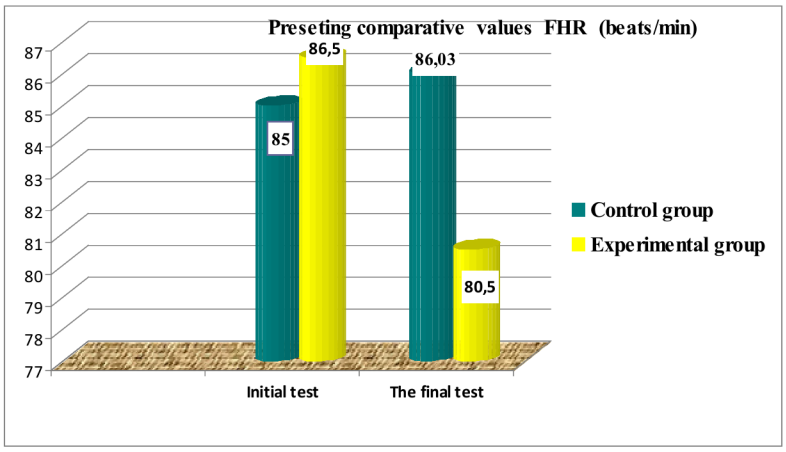


***Fig. 1. Annual dynamics of FHR (beats/min) of wrestlers from control and experimental groups***

**Results of the research.** To the initial testing of the boys from the control group (Fig.1), the frequency of heart rate (FHR) constituted about 85.00 ± 2.15 beats per minute and truthfully there are no different (t = 0,43; P> 0.05) by the value recorded by those from the experimental group, which was about 86.03 ± 2.11 beats per minute. At the final testing, the medium data of the respective index has the value of 86.50 ± 1.23 beats per minute in the control group, slightly increasing from the initial figures (t = 0,90; P> 0.05).

In the experimental group, the annual dynamics of the medium values of group is different from the previous one, being expressed by reducing of FHR from 86.00 ± 2.11 beats per minute at initial testing till to 80.50 ± 2.12 beats per minute at final testing, the threshold of veracity of changes being to the significance t = 3.04; P <0.05. The FHR decrease denotes an economy activity of the heart, which occurs as a result of its training [8, 69, 94]. There is a veridic difference between the results of the final testing from the control group (86.50 ± 1.23 beats/min) and those from the experimental group (80.50 ± 2,12 beats/min) (t = 2.66; P < 0.05), which, in our view, expressed the positive influence of circuit training on the heart, based on training of cardiovascular system of the wrestlers to physical efforts.

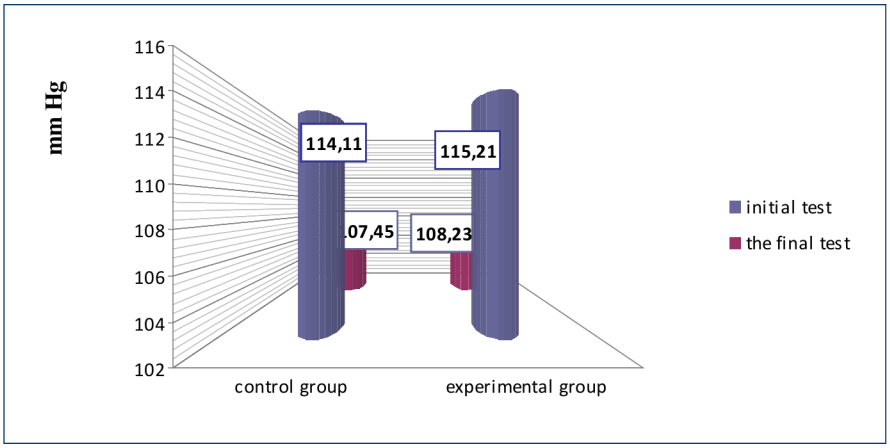


***Fig. 2. Annual dynamics of FHR indices (mmHg) in the control and experimental groups***

*Systolic blood pressure (SBP).* The absolute values of SBP for pupils from the experimental and control groups presented in the annual dynamics can be seen in Figure 2, these being enrolling in the limits of values of age for 10-12 years old pupils. From Figure 2, we see that SBP of wrestlers from both groups is truthful changed in the annual dynamics, but with different mathematical and statistical significance degree. Thus, to the final test the medium value of SBP to sportsmen from control group is smaller than the initial at statistical significance limit t = 2,74; P<0.05, while to those from the experimental group - to the significance limit of 5%, (P<0,05).

It is considered that the decrease of systolic blood pressure is a normal physiological reaction of the human body to physical training and express the arteriolar dilation in skeletal muscle, reducing the peripheral resistance of blood vessels, helping to provide the oxygen supply of tissues and organs.

*Diastolic blood pressure (DBP).* The medium values of group of wrestlers from both groups - control and experimental, have not significantly changed in the dynamics of the school year (P> 0.05), which corresponds to the data of other authors [95].

*The Robinson index.* In the initial testing the functional reserves of the cardiovascular system of wrestlers from both groups can be assessed as "medium". At the end of the experiment, in the control group they did not differ from their initial testing data (Figure 3), and in the experimental group is approached more to the "high" level, the differences between baseline and final being truthful, to materiality of 5%, (P<0,05). Also, at the end of the experiment appears a clear difference between the indices of both groups, to the mathematical-statistical significance threshold t = 2.37, P <0.05. The facts exposed are an eloquent proof of the fact that the circuit training in functional stimulate the creation of functional reserves of cardiovascular system, which facilitates the adaptation of the wrestlers of experimental group to physical effort.

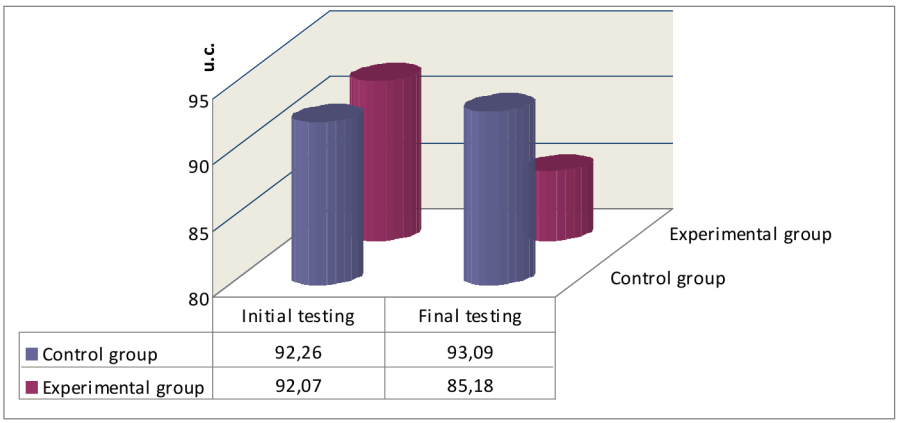


***Fig. 3. Annual dynamics of IR (c.u.) of wrestlers from control and experimental groups***

*Resistance index Kvaas.* Analyzing the results of the control group in the annual dynamics we mention the veridic growth of respective index in this period to mathematical – statistic significance limit of 5%, (P <0.05), reflecting, in fact, decrease of resistance of cardiovascular system to physical effort. In the experimental group but, on the contrary, is manifested the increase tendency of the resistance of cardiovascular system of sportsmen to physical effort. The difference between indices of final testing of both groups has a truthful character, to the statistical - mathematical significance degree t = 2.61; P <0.05, the best results being specific to the experimental group. These results indicate that the use of circuit training method during the annual cycle of training

helps to increase the resistance of cardiovascular systems of wrestlers at physical effort.

*The coefficient of economy* (KE) constitutes in norm - 2600. The values exceeding the norm denotes a poor activity of the cardiovascular system, and the lowest as norm indicates the overwork condition. Analyzing the results from Figure 4, we observe that at initial testing both groups have poor activity of the cardiovascular system, and at the final testing the experimental group has registered more good results, both, compared to initial values (t = 2.19, P <0, 05) and toward the average values of the control group, at the significance degree t = 2.20; P <0.05. I.A. Arshavskii considers that the economy function of the cardiovascular system depends on the motility degree of the sportsmen, that it is more evident, as is more intense the motor activity of sportsmen.

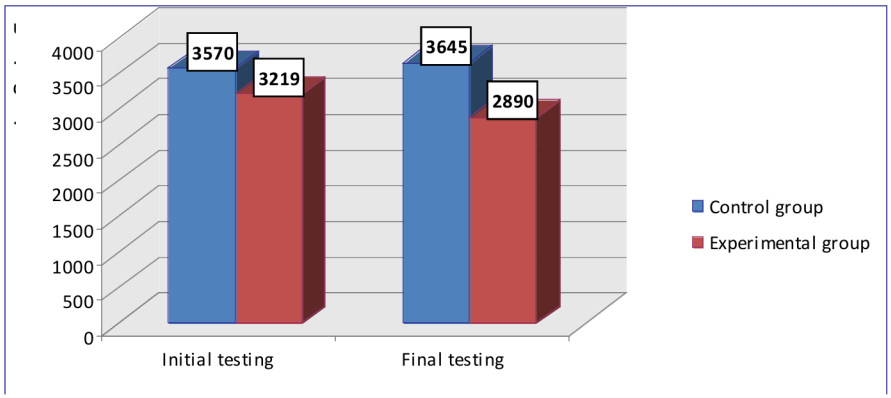


***Fig. 4. Annual dynamics of KE (u. c.) of wrestlers from control and experimental groups***

At the same time, was established that the training which requires considerable energy expenditure from sportsmen creates favorable conditions for conducting of restorative processes of the body in rest or in low-intensity muscle activity. Given the fact that wrestlers from the experimental group performs during a training a larger number of locomotion, compared to those from the control group, we say that the function of economy of the cardiovascular system can be explained namely by increased motility of wrestlers practicing to circuit training.

*Adaptability index (AI).* At the beginning of the experiment, the adaptive potential of boys from experimental and control groups was 2.06 ± 0.07 u.c., and in that experimental - 1.96 ± 0.04 u.c. the difference between these values is insignificant in the mathematical-statistical terms (t = 1.25, P>0.05). These express that the boys from both groups almost are identical adapted to physical effort. At the end of the experiment the situation is reversed: the value of AI to the boys from the control group in medium 1.98 ± 0.09 u.c., and of those from the experimental group reached the value of 1.82 ± 0.05 u.c., being with 7.14% higher as at the beginning of the experiment and with 8.1% more advanced than in the control group (Figure 5). It is considered that, as the AI values are lower, so they express a better potentially of adaption of the cardiovascular system to the physical effort, and increase of AI over index 2.2 u.c. reflects the strain of adaptation mechanisms of the body to physical effort. In our case, the AI values of wrestlers from both groups express satisfactory possibilities of adaptation to physical effort, the best results being specific to sportsmen from the experimental group.

Thus, we can state that the circuit training improves the cardiovascular condition of wrestlers, which is expressed through increased adaptive potential of children at the end of the experiment. *Vegetative index Kerdo (IVK).* At the initial testing there is not a true difference between IVK values of the control group and the experimental group (t = 0.18, P> 0.05). At the end of the experiment the results are improved in both groups,

but in the experimental one in a greater extent, as compared with the initial data (t = 3.86; P<0.01) and compared to the control group (t = 2 11; P <0.05). In both groups IVK <0, which indicates a predominance of parasympathetic vegetative system activity on the sympathetic one, expressed by reducing of excitability of nervous system and predominance of the inhibition processes on those of excitation, which, in our opinion, has a protective role.

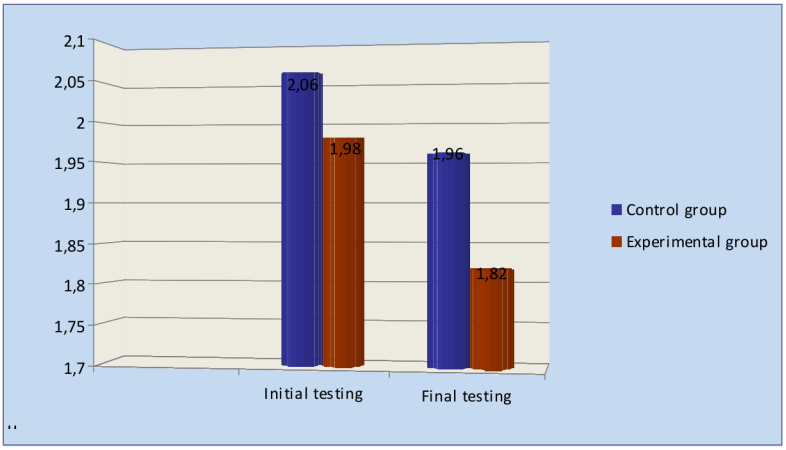


***Fig. 5. Annual dynamics of AI (u.c.) determined by the wrestlers from control and experimental groups***

This way, at the end of the annual cycle of training, the changes that occur in the cardiovascular system of the pupils - wrestlers from the experimental group is expressed by: reducing of the FHR and SBP values, improvement of Robinson index values, of coefficients of resistance and of economy, the increase of adaptive potential of pupils – wrestlers, predominance of influence of the parasympathetic nervous system, which expresses the increase of functional reserves of the heart and a most economical activity of the heart and circulatory system, both, in comparison with initial values and with the control group. These results express the importance of circuit training in cardiovascular system's training of wrestlers of 10-12 years at physical effort, which creates favorable conditions for the continue improvement of the level of general and special physical training of them.

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