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The use of cardio training facilities in training 7-9-year-old judo athletes

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A Study Design
B Data Collection
C Statistical Analysis
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Abstract

Background & Study Aim: The experts believe that the development of a complex of modern means and methods for improving the general fitness of athletes should take into account the peculiarities of their adaptation to physical activity. The aim of this study is knowledge about the effectiveness of cardio training facilities use to improve the physical and functional preparedness of judo athletes at the initial stage of training.

Material & Methods: The study involved the 36 boys (19 were divided into control /CG/ and 17 experimental /EG/ groups; age 7-9 years old who are engaged in judo at the initial stage of training. The study was conducted at the initial training stage (the general preparatory phase, convergent with the duration of the annual training cycle, i.e. 10 months): 260 hours of training sessions; 166 hours for general physical training; 41 hour for special physical training; 40 hours for technical and tactical training; 7 hours for the preparation and delivery of standards for general and special exercises. The control of pulse mode was carried out with the use of sensors «Polar».

Results: Judo athletes of the EG recorded a significant increase in the integral indicators of the level of physical preparedness (4 times more against the CG), the functional state of the cardiovascular (2 times respectively) and respiratory system of the body (2 times, respectively). It has been established that training sessions with the use of cardio training facilities should be allocated for 2 training sessions per week. Duration of the trainings must be 20 minutes in the first 2 months of the preparatory period and 25 minutes in the following months of this period. The main activity (essence) of cardio training should be the physical load of aerobic orientation in the amount of 3-4 series for 5 minutes each. The rest interval is 2 minutes.

Conclusions: The use of cardio training methods in judo training process helps to improve their physical and functional readiness and to increase the efficiency of the training process.

Keywords: initial stage • physical load • tactical training • technical training

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Fitness – *noun* the fact of being strong and healthy [50].

General fitness – noun a non-athlete's fitness for performing everyday tasks, achieved by eating a healthy diet and taking moderate exercise [50].

Performance – *noun* the level at which a player or athlete is carrying out their activity, either in relation to others or relation to personal goals or standards [50].

Technique– *noun* a way of performing an action [50].

Tactics – *plural noun* the art of finding and implementing means to achieve immediate or short-term aims [50].

Functional overload – *noun* training in a particular sport in which the athlete wears heavier clothes or shoes or carries weights to work the muscles harder [50].

Physical activity – *noun* exercise and general movement that a person carries out as part of their day [50].

Mesocycle – *noun* a training cycle that typically lasts for a few weeks [50].

Microcycle – *noun* a training cycle that typically lasts for one week [50].

Load – *noun* **1.** a weight or mass which is supported **2.** the force that a body part or structure is subjected to when it resists externally applied forces **3.** the amount of something, usually weight, that a body part can deal with at one time [50].

Cardiovascular training – *noun* exercise that raises the heart rate and increases circulation, strengthening the cardiovascular system and burning fat. Also called **cardio** [50].

INTRODUCTION

At present, one of the most urgent problems is the question of improving the quality of training the sports reserve in various kinds of sports, including judo. Most experts attribute the relevance of this problem to the lack of efficiency in the judo training process at various stages of multi-year sports training. It further influences the judo athletes performance at the most prestigious international competitions – World and European Cups, World and European Championships, and Olympic Games [1].

According to many authors, the practical solution to this problem involves the search for new means and methods to improve the main components of the general fitness of athletes (physical and functional preparedness – functional overload) in the process of their many years of sports training. It is of particular importance at the initial stages of this process [2, 3]. Particular attention is drawn to the widespread introduction into practice of psychophysiological analysis of the training and competitive activity of leading judo athletes using the latest advances in information technology [4, 5].

The actuality is obtained by studying the features of the dynamics of the main indicators of physical and functional fitness of athletes in individual mesocycles and microcycles. This allows us to develop more effective approaches for correction and improvement of these integral indicators. Such approaches completely coincide with the opinion of specialists [6-8]. The authors believe that the development of a complex of modern means and methods for improving the general fitness of athletes should take into account the peculiarities of their adaptation to physical activity.

It is equally important to take into account the intensity of loads at different stages of sports training. Such approaches require optimisation of various types of preparedness to achieve high sports results [5, 9]. The authors believe that this increases the level of motivation and positively affects the health of athletes. Other studies emphasize the necessity of proper pedagogical control and the selection of adequate tests [10, 11]; formation of the relationship between the trainer and athletes [12]; taking into account the role of parents in the achievement of success by young athletes [13]; reducing the level of aggression of young judo athletes [14].

In recent years, the attention of a number of researchers is drawn to the means of cardio training. This is due to the known high role of aerobic direction: in optimising the functional state of the leading physiological systems of the body (cardiovascular and respiratory); increase of adaptive possibilities of athletes; optimisation of energy supply of muscle activity; the implementation of the functional reserve [15-17]. The use of cardio training facilitates the development of strength and endurance [18]; greatly increases the level of aerobic energy [19, 20]; contributes to the development of special endurance [21, 22]; increases health [23].

In other studies using cardio training, it has been established that: for different microcycles of preparation, the intensity and duration of exercises are individually selected [24]; to forecast the efficiency it is necessary to use physiological indicators [25]; the value of the training effect depends on the duration and intensity of the exercise program [26]; imitation of discontinuous physical activity contributes to success in judo competitions [27]; cardio respiratory and functional indicators of the criteria for the preparedness of young judo athletes [28]. The importance of cardio training (cardiovascular training) in the training of athletes is emphasised in the studies Casals et al. [29] (judo athletes), Jung et al. [30] (taekwondo athletes), Vujkov et al. [31] (karate athletes).

At the same time, the available data indicate that the problem of the possibility of incorporating cardio training facilities into the judo training program at the initial stages of many years of sports training is not well developed.

The aim of this study is knowledge about the effectiveness of cardio training facilities use to improve the physical and functional preparedness of judo athletes at the initial stage of training.

Hypothesis: the development and application of the training process of judo of cardio training means will improve the physical and functional readiness and increase the effectiveness of the training process.

MATERIAL AND METHODS

Participants

The study involved the boys (n = 36, age 7-9 years old) who are engaged in judo at the initial

stage of training. The 19 boys were divided into control (CG) and 17 experimental (EG) groups.

Organization of research

In the control group, the classes were conducted according to the traditional judo JSS program [32, 33], which includes a weekly three-time training: Monday (1.5 hours) – development of speed and flexibility, improvement of technology in the stand-up struggle; Wednesday (1.5 hours) – general and special physical training; Friday (1.5 hours) – the development of power and coordination, the improvement of technology in the wrestle lying.

For judo athletes of the experimental group for general physical training, 31.8 hours have been allocated. This represents 19.2% of the total training hours for general physical training. Two training sessions per week were allocated for training sessions using cardio training facilities. Duration of the training sessions was 20 minutes in the first 2 months of the preparatory period (September-October) and 25 minutes in the following months of this period (November-June).

The main content of the cardio training was the physical activity of aerobic orientation in the amount of 3-4 series for 5 minutes each. The rest interval was 2 minutes. In the first series of each cardio treatment used physical activity, in which the pulse mode was consistent with the minimum values of heart rate (heart rate).

The minimum values of heart rate did not change during the entire preparatory period. The following series used physical activity with a gradual increase in heart rate to the upper limit of the pulse rate. The calculation of these values of heart rate was carried out using formulas [34-36]. Also, authors' recommendations regarding the use of submaximal physical activity (75% of the maximum oxygen consumption, MOC) at the level of 65-85% of the maximum heart rate were taken into account. According to the above, we have calculated the optimal pulse training regimen for young judo athletes 7-9 years: (1) In the first two months (September-October), each training session began with physical activity, at which the heart rate was 105 beats × min^{-1}, The training session was completed with loads of heart rate = 121 beats × min^{-1}; (2) In the following two months (November-December), the following pulse regimen was maintained: from heart rate = 105 beats × min^{-1} to heart rate = 130 beats × min^{-1}; (3) From January to February we used physical activity with pulse mode from heart rate = 105 beats × min^{-1} to heart rate = 139 beats × min^{-1}; (4) from March to June were used physical activity with a pulse rate of heart rate = 113 beats × min^{-1} to heart rate = 147 beats × min^{-1}.

The control of pulse mode was carried out with the use of sensors «Polar».

During the study, all the participants recorded the following tests [37, 38]: shuttle running 3 to 10 m (sec); running at 30 m (sec); running at 300 m (min); jumps in length from space (cm); throws of a stuffed ball (cm); tightening on high translation (number of times); tilt of the body from sitting position (cm).

Also determined were: (1) level of physical preparedness (LFP, points) – an indicator of the level of development of basic motor qualities and skills; (2) index of physical capacity (IC, c.u. *contractual units*) – is a loading complex designed to evaluate the cardiovascular capacity of a physical load; (3) the index of voltage of regulatory mechanisms of the circulatory system (INsss, c.u.) – characterizes the degree of functional voltage of the regulatory mechanisms of the blood circulation system; (4) Index of vegetative equilibrium (IVE, c.u.) – correlation between sympathetic and parasympathetic regulation of cardiac rhythm; (5) Heart rate index (HRI, standard units) – assesses the level of functioning of the cardiovascular system of the organism; (6) the adaptive potential of the cardiovascular system (APss, c.u.) is an indicator that has a direct relationship with the level of functioning of the circulatory system and inverse with the degree of stress of its regulatory mechanisms; (7) systolic blood volume (SBV, ml) – amount of blood emitted by the ventricle of the heart at each contraction; (8) minute volume of blood (MVB, l × min^{-1}) – quantity of blood ejecting ventricles in the heart for 1 minute; (9) cardiac index (CI, l × min^{-1} × m^{-2}) – an indicator of the function of the heart, which is the ratio of the minute volume of the heart to the area of the body surface; (10) total peripheral vascular resistance (PVR, dyn × s × $cm^{-0.5}$) – total resistance of the entire vascular system of blood flow emitted by the heart; (11) Lung Capacity (LC, ml) is the maximum amount of air that a person can exhale after one maximum inhalation; (12) the respiratory respiration time (Tr, sec) was determined using

Training load – "A simple mathematical model of training load can be defined as the product of qualitative and quantitative factor. This reasoning may become unclear whenever the quantitative factor is called 'workload volume' or 'training volume' interchangeably with 'volume of physical activity'. Various units have been adopted as measures, i.e. the number of repetitions, kilometres, tons, kilocalories, etc. as well as various units of time (seconds, minutes, hours) (...) As in the real world, nothing happens beyond the time, the basic procedure of improvement of workload measurement should logically start with separation of the time factor from the set of phenomena so far classified together as '***workload volume***'. (...) Due to the fact that the heart rate (HR) is commonly accepted as the universal measure of workload intensity, the product of effort duration and HR seems to be the general indicator of ***training load*** defined as the amount of workload. It is useful in analyses with a high level of generality. (...) In current research and training practice, the product of effort duration and HR was referred to as conventional units', or further calculations have been made to convert it into points." [51, p. 238].

the Stange functional test, for which the athlete, after a normal exhalation, took a deep breath and held his breath at the maximum possible time recorded by the stopwatch; (13) Expiratory breathing time (Teb, sec) – determined by Genci's test, for which the athlete, after a deep breath, made a deep breath and held his breath at the maximum possible time; (14) Hypoxia indices (IH, c.u.) – characterizes the degree of resistance of the body to oxygen deficiency; (15) Skibinsky's index [39, 40] (IS, c.u.) – characterizes the potential of the system of external respiration, its resistance to hypoxia, the level of coordination of functioning with the system of blood circulation; (16) the level of functional state of the cardiovascular (LFSCS, points) and respiratory (LFSRS, points) of the organism systems – integral indicators of the overall functional state of the organism.

The method of increasing the physical and functional preparedness of judo athletes with the use of cardio training agents [41, 42] was developed taking into account age characteristics of athletes. The method corresponded to traditional ideas about planning training sessions. The methodology included the preparatory, main and final parts. Physical loads at the main part of the cardio training program included exercises in the hall (indoor) or the open air (outdoor).

Statistical analysis

All experimental data obtained in this work were processed using the statistical package of Microsoft Excel with the calculation of the following indicators: arithmetic mean ($\overline{x}$); average arithmetic error (S); t – the criterion of reliability of normal distribution.

RESULTS

The obtained results testified to the relative homogeneity of the control and experimental group of judo athletes 7-9 years at the beginning of the forming experiment (there is no significant difference). The judo athletes of the control (CG) and experimental (EG) groups noted the average values: the index of performance, running time of 30 m, 300 m, shuttle run of 3 to 10 m, jumps in length from the place, throw of the stuffed ball, torso, tightening on the crossbar and overall level physical fitness (Table 1).

At the beginning of the study, the judo athletes of both groups had values of indices (VCL, respiratory detention time for inhalation and exhalation, hypoxia and Skibinsky indices), which corresponded to the physiological norm. These indices correspond to the average values of the level of functional state of the system of external respiration of an organism. The beginning of the general preparatory stage young judo athletes had an average level of their physical ability, physical and functional preparedness (Table 2).

At the end of the study, in the experimental group, there were significantly higher rates of growth of almost all indicators of physical fitness compared with the control group. The growth rates of high-speed and speed-strength abilities in the experimental group were 2-4 times higher than in the control group of judo athletes. The rates of growth in the level of development of agility and flexibility were higher in EG in about 3 times. The growth rates of power abilities in the EG were larger by 2 times. The growth rates of overall endurance in EG were 2.5 times larger.

Table 1. Absolute values ($\overline{x} \pm S$) of indicators of physical capacity and physical fitness at the beginning of the study.

Variable (indicator)	CG (n = 19)	EG (n = 17)
Disability index (c.u.)	9.13 ±0.37	9.83 ±0.42
Running at 30 m (sec)	7.25 ±0.08	7.21 ±0.05
Running at 300 m (min)	1.1 9 ±0.01	1.23 ±0.02
Shuttle running 3 x 10 m (sec)	10.58 ±0.14	10.80 ±0.22
Jump in lengh (cm)	142.40 ±2.92	146.46 ±2.58
Ball shot, the body forward from the sitting position (cm)	221.36 ±4.61	229.17 ±3.36
Tilt the body forward from the sitting position (cm)	6.20 ±0.32	6.77 ±0.21
Tightening on the crossbar (amount)	6.11 ±0.28	6.62 ±0.22
Level of physical fitness (points)	59.23 ±1.37	62.59 ±1.23

c.u. contractual units

Table 2. Absolute values ($\bar{x} \pm S$) of indicators of functional readiness at the beginning of the study.

Variable (indicator)	CG (n = 19)	EG (n = 17)
Voltage index of regulatory mechanisms of the circulatory system (VI, c.u.)	153.87 ±20.46	146.24 ±16.31
Index of vegetative equilibrium (IVE, c.u.)	179.23 ±16.19	167.33 ±15.22
Heart rate index (HRI, conditional units)	66.27 ±2.25	69.44 ±1.88
Adaptive Potential of the Cardiovascular System (APCS, c.u.)	0.55 ±0.08	0.78 ±0.08
Systolic blood volume (SBV, ml)	40.39 ±0.90	41.14 ±0.74
Minute volume of blood (MVB, $l \times min^{-1}$)	2.85 ±0.05	2.91 ±0.04
Cardiac index (CI, $l \times min^{-1}) \times m^{-2}$)	2.85 ±0.08	2.81 ±0.06
Total peripheral vascular resistance (TPVR, $dyn \times sec \times cm^{-0.5}$)	1273.84 ±98.14	1314.21 ±101.42
Level of functional state of the cardiovascular system (LFSCS, points)	65.94 ±2.27	68.42 ±2.38
Vital capacity of the lungs (VCL, ml)	1827.68 ±22.34	1871 ±20.20
Breathing inhalation breathing time (Tr, sec)	41.47 ±1.84	43.92 ±1.54
Respiratory depression time on exhalation (Teb, sec)	22.47 ±0.75	23.27 ±0.84
Hypoxia indices (IH, c.u.) Skibinsky index (IC, c.u.)	0.25 ±0.01	0.27 ±0.01
Skibinsky index (IS, c.u.)	886.67 ±33.83	940.12 ±29.76
Level of functional state of the respiratory system (LFSRS, points)	61.43 ±1.34	63.90 ±1.31

c.u. contractual units

The rates of increase in overall physical capacity in the EG were larger by almost 3 times (Figure 1). Relatively more favourable were judo athletes of the experimental group and the magnitude of relative changes in the indicators of their functional readiness (Figure 2).

DISCUSSION

At the beginning of the study, athletes of both groups were characterised by the same level of functional tension of the mechanisms of regulation of the cardiac rhythm that corresponds to the physiological norm. In favour of what was shown by the corresponding values of the voltage index of the cardiovascular system and the index of vegetative equilibrium. The physiological norm also met the values of such integral indicators of the circulatory system as SBB, MVB and total peripheral vascular resistance. Athletes of both groups had low values of the heart rate index.

At the beginning of the study, the average level of adaptive capacity of the circulatory system and the general functional state of the cardiovascular system of the body of athletes was noted. In our opinion, this was largely due to the lower level of functional stress of the regulatory mechanisms of the circulatory system. It is obvious that in young athletes, the required level of functioning of the cardiovascular system of the organism is ensured by economising the work of regulatory mechanisms.

The obtained results showed that the experimental group was characterised by higher rates of reduction of the functional voltage of the regulatory mechanisms of the circulatory system (2 times the magnitude of VIRMCS and almost 3 times the size of the IVE). There were also higher rates of cardiac efficiency (3 times), adaptive capacity of the cardiovascular system of the organism (4 times), lung capacity, respiratory detention times, inspiration and exhalation, hypoxia and Skibinsky indices (in all cases almost 3 times). The result is a higher rate of improvement in the overall functional state of circulatory and external respiration systems.

Based on the analysis of the problem of optimising the judo training process at the general preparation stage, the need for its further improvement was demonstrated. This is due to the lack of effectiveness of the traditional training

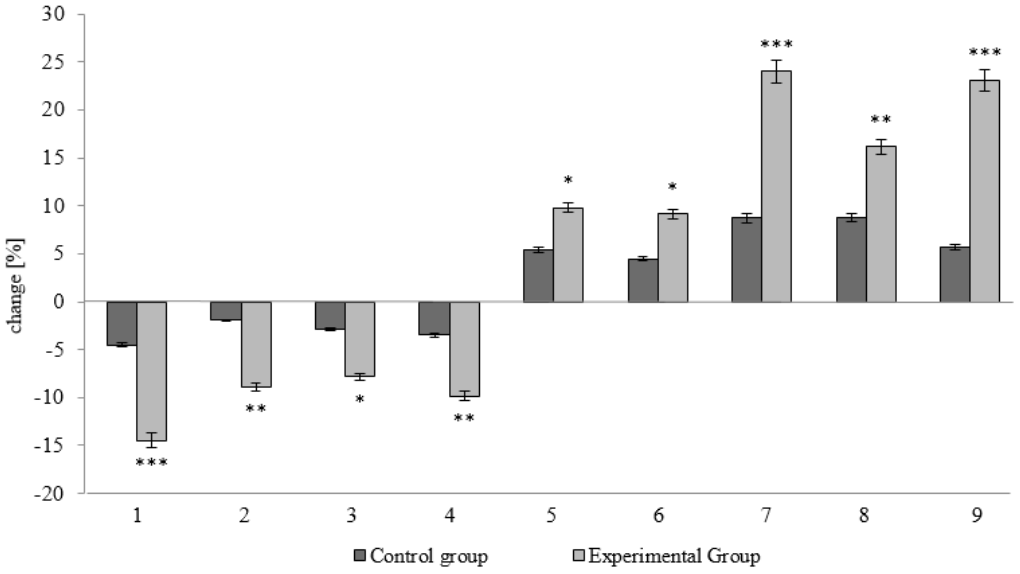

Figure 1. The values of the relative increase in the indicators of physical performance and physical fitness of athletes Control Group and Experimental Group at the end of the study (in% to the original values: 1 index of work capacity, 2 running at 30 m; 3 running at 300 m; 4 shuttle running 3 to 10 m; 5 jump in length from place; 6 a shot of a stuffed ball; 7 tilt of the trunk forward from sitting position; 8 tightening on the crossbar; 9 level of physical preparedness; *p<0,05; **p<0.01; ***p<0.001).

program, which coincides with the research data of other authors [1, 3, 28].

In the studies of a number of authors [18, 20, 22] it is determined that the use of aerobic exercises can be the basis for increasing the level of physical and functional fitness of athletes. This conceptual position was confirmed by our research. This made it possible to substantiate the need for the introduction of cardio training facilities taking into account the age of athletes and the stage of preparation. The developed program defines pulse modes, duration and intensity of the load, intervals of rest.

The results of the study allowed to distinguish: features of the dynamics of indicators in the process of adaptation to training loads within the preparatory period of the annual cycle of training; give an objective assessment of the effectiveness of the training program.

For the first time, we have developed a methodology for increasing the physical and functional preparedness of judo athletes 7-9 years with the use of cardio training in the preparatory period of the annual cycle. Appropriate algorithms for the exercise of aerobic stress (pulse regimens, duration, intervals of rest) were developed. The peculiarities of the influence of cardio training on the level of physical and functional preparedness of judo athletes were also studied. Athletes of the experimental group had the highest positive changes in their strength abilities, the level of development of flexibility and functional state of the cardiovascular system.

The experimental data obtained confirm scientific studies of other specialists [18, 43, 44]. The authors argue that the improvement of individual components of physical and functional preparedness is possible when using training complexes of modern means and methods for improving the general fitness of athletes.

It is important to note that the obtained results confirm the data of several authors about the positive influence of means of aerobic orientation on individual components of the general physical condition of athletes of all ages and specialisation. Confirmed is the information in Krstulović et al. [45], Boguszewska et al. [44], Parinova [1] about the lack of effectiveness of the training process of judo athletes at various stages of multi-year training. This is especially true for the initial stage of preparation. Completed research results: Little [6], Romanova [46], Slinkina et al. [47] on the possibility of improving the physical

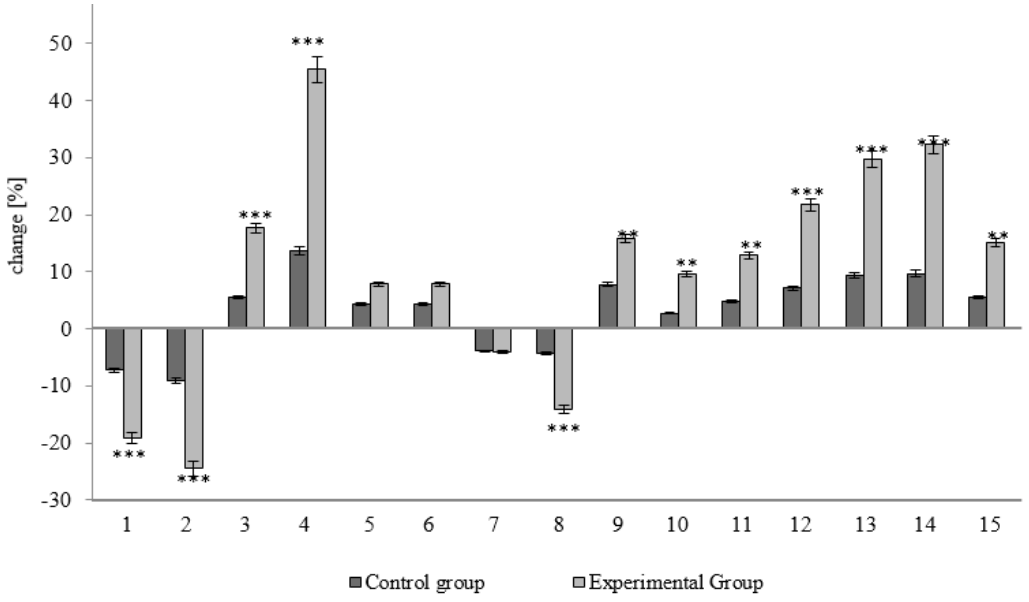

Figure 2. The values of the relative increase in the indicators of functional readiness of athletes of Control Group and Experimental Group at the end of the study (in% to the original values: 1 VIRMCS (VI); 2 IVE; 3 HRI; 4 APCS; 5 SVB; 6 MVB; 7 SI; 8 WFP; 9 LFSCS; 10 VCL; 11 IBT; 12 RDTE; 13 IH; 14 IS; 15 LFSRS).

and functional fitness of athletes by means of cardio training; Little [6], Almansba et al. [48] on the peculiarities of changes in the level of physical preparedness and functional state of circulatory and external respiration systems in the process of adaptation to systematic physical activity; Lauschke et al. [49], Almansba et al. [43], Shakhov et al. [3] on the effectiveness of using the most accessible and advanced training materials in optimizing the training process of athletes in various martial arts (in particular, in judo).

CONCLUSIONS

The use in the program of training sessions of judo athletes 7-9 years old of our developed method of using cardio training facilities contributed to the improvement of their physical and functional preparedness.

At the end of the general preparation stage, judo athletes of the control group noted only a tendency to improve the indicators that characterise their physical working capacity, physical and functional preparedness. Judo athletes of the experimental group recorded a significant increase in the integral indicators of the level of physical preparedness (4 times more against the CG), the functional state of the cardiovascular (2 times respectively) and respiratory system of the body (2 times, respectively).

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