



Age Differences in the Manifestation of Endurance Ability of Boys Karate Athletes

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Abstract

Objectives. This research aims to determine the favourable age periods for endurance development among 7-11-year-old pupils who are engaged in initial karate training groups.

Materials and methods. The research involved 75 boys 7-11 years old, divided into five age groups: 7, 8, 9, 10, and 11 years old, with 15 participants per age group. The children's technical levels corresponded to the 10-9-8 Kyu (orange belt, orange with blue stripe, and blue). The children and their parents were informed about the features of the study and agreed to participate in the experiment. The study protocol was approved by the Ethics Committee of H.S. Skovoroda Kharkiv National Pedagogical University (Kharkiv, Ukraine). The following research methods were used: study and analysis of scientific and methodological literature, pedagogical observation, testing, pedagogical experiment, and methods of mathematical statistics.

Results. Statistically significant differences in the manifestation of local static power endurance of the hand muscles were observed in the groups of 7-8 and 8-9 years old ($p = 0.001$; $p = 0.007$). Differences in local dynamic power endurance of the hand muscles were found in the 8-9 years old group ($p = 0.001$), and in abdominal press endurance in the 8-9 and 9-10 years old groups ($p = 0.001$; $p = 0.01$). General cardiorespiratory endurance differences were observed in the 9-10-year-old group ($p = 0.001$). Differences in all tests between values of specified parameters in the 10-11-year-old samples were statistically insignificant ($p > 0.05$).

Conclusions. The favourable period for the development of general endurance in boys is between the ages of 8-9 and 9-10 years. At this age, it is important to start systematically and purposefully developing the aerobic abilities of pupils. Classes in the sports section of Kyokushinkai karate during extracurricular time will provide an opportunity to promote the development of general and special endurance and expand the range of motor skills.

Keywords: boys, age differences, endurance, cardiorespiratory endurance, Kyokushinkai karate.

Introduction

Endurance is considered one of the most important motor skills. It is usually associated with the ability to perform a certain activity effectively without becoming fatigued. This condition occurs when performance temporarily decreases during a given prolonged load. To continue working, individuals need to overcome fatigue. General endurance plays a significant role in optimizing vital activity, is an important component of physical health, and is, in turn, a prerequisite for the development of specific endurance (Zoladz et al., 2022; Manojlovic et al., 2023; Deng & Wang, 2024).

An analysis of studies over the past three decades has shown that low levels of cardiorespiratory endurance are associated with an increased risk of cardiovascular disease and mortality from various causes (Villa-González, Barranco-Ruiz, García-Hermoso, 2022; Manojlovic, Roklicer, Trivic et al.,

2023). Deng & Wang (2024) recommended cardiorespiratory fitness for endurance development and obesity control. Children and adolescents in the developmental stage who experience low cardiorespiratory fitness for a long time are at higher risk of cardiovascular and metabolic diseases in adulthood.

In modern studies, the authors emphasize the important role of endurance in martial arts (Kabadayı, Karadeniz, Yilmaz et al., 2022; Muñoz-Vásquez, Hernandez-Martinez, Ramos-Espinoza et al., 2023; Marchenko, Ivashchenko, Khudolii & Lubchenkov, 2023). Exercises in martial arts are intermittent by nature and include short periods of intense, maximal, and explosive movements followed by lower-intensity exercises or rest intervals for recovery (Vasconcelos et al., 2020; Ambrozy, Rydzik, Kwiatkowski et al., 2022; Marchenko, Ivashchenko, Khudolii & Lubchenkov, 2023).

It has been proven that there is a close correlation between motor competence and physical fitness in children (Luz, Rodrigues, Meester et al., 2017; Marchenko, Ivashchenko, Jagiello et

al., 2022; Marchenko, Ivashchenko & Khudolii, 2023). In contact karate, good general and special endurance is an important condition for mastering technical elements (Litvin & Marchenko, 2021; Marchenko, Ivashchenko, Jagielło & Bobrysheva, 2023; Vako, Kashuba, Khmel'nitska et al., 2024), and for successful performances at competitions (Plush, Guppy, Nosaka et al., 2022; Ambrozy, Rydzik, Kwiatkowski et al., 2022) during certification for apprentice and master degrees. The exam usually lasts several hours and ends with fights, the number of which depends on the level of the athlete and can reach several dozen.

The scheme of fights according to the rules of Kyokushinkai karate in the 'kumite' section among younger boys and girls lasts up to 3 min (if no winner is found after the first or second round), with the following intervals: 1,0 min, 1,0 min, weigh-in, 1 min (Goncharenko, 2021; EKO Kumite rules, 2023). The time between rounds for judges to make decisions can last approximately 10-15 s, and up to 1 min during the weigh-in. With such a short break, there is no full recovery. Children perform work in a dynamic mode at high, submaximal, and maximal intensity.

The study of sensitive periods in endurance development is of great importance for both the pedagogical and sports fields. Identifying the limits of morphological readiness of different systems in children's bodies for a certain type of activity within Kyokushinkai karate allows for timely and more accurate planning of loads to achieve optimal results in the formation of endurance ability (Zymohliad & Marchenko, 2021; Konopka, Zeegers, Solberg et al., 2022; Hontarenko, Marchenko & Korol, 2022).

Considering the gender and age characteristics of pupils, it is important to remember that when working on endurance, individual deviations in body development and genetic factors should be considered. Studies have shown that aerobic and anaerobic capacities are more influenced by heredity than by the environment (Pickering & Kiely, 2019; Sellami, Elrayess, Puce et al., 2022; Konopka et al., 2022).

Sellami, Elrayess, Puce et al. (2022) pointed out that, together with the environment and training experience, an athlete's biological and genetic characteristics play an important role in exercise physiology. Heredity can be associated with an athlete's performance by influencing exercise behavior, endurance, strength, power, speed, flexibility, energy expenditure, neuromuscular coordination, metabolic and cardiorespiratory fitness, and psychological traits. Short- and long-term endurance training can improve executive function in children (Drozdowska et al., 2022; Bahtra et al., 2023; Fahrudin et al., 2024).

Given the above, the study of the peculiarities of the manifestation of various components of endurance in boys aged 7-11 years is a relevant topic.

The aim of the research is to define favorable age periods for the development of endurance in pupils aged 7-11 years who are engaged in initial karate training groups.

Materials and Methods

Participants of the Research

The research involved 75 boys in primary and secondary grades (7-11 years old). They were divided into five age groups: 7, 8, 9, 10, and 11 years old, with 15 participants per age group. The children's technical levels corresponded to the

10-9-8 Kyu (orange belt, orange with a blue stripe, and blue). The inclusion criterion was the absence of injuries within the last 3 months. The children and their parents were informed about the features of the study and agreed to participate in the experiment. The study protocol was approved by the Ethics Committee of H.S. Skovoroda Kharkiv National Pedagogical University (Kharkiv, Ukraine). This study was conducted in accordance with the Declaration of Helsinki-Ethical Principles for Medical Research Involving Human Subjects (World Medical Association Declaration of Helsinki, 2013).

Design of the Research

To solve the tasks, the following research methods were used: study and analysis of scientific and methodological literature, pedagogical observation, testing of endurance ability, pedagogical experiments, and methods of mathematical statistics.

The study was conducted during the pedagogical practice from March 4 to 29, 2024, with boys who attended the karate sports section. Training were held 3 times a week in the afternoon and lasted approximately 90 min. To determine the endurance level and identify favorable age periods for its development, testing was performed. Simple tests were chosen that did not require sophisticated equipment and were not financially expensive. A prerequisite was that the selected control exercises comprehensively covered various types of endurance: cardiorespiratory, static, and dynamic local endurance of different muscle groups.

Physical performance was assessed using the modified Harvard step test index. This test quantified the recovery processes after dosed muscle work (Hughes & Chaturvedi, 2017; White, Lu, Ibrahim et al., 2020).

Methods of the Modified Harvard Step Test: The subject walked on an 8-inch (20 cm) step for 3 min, regardless of weight and height, at a speed of 30 steps per min (one step every two s). A metronome was used to maintain the required step rate. Each movement corresponded to a single metronome beat. The Modified Harvard Step Test Index (MHSTI) was calculated using the following formula:

$$\text{MHSTI} = t \times 100 / (f_1 + f_2 + f_3) \times 2,$$

where t is the time of ascent in s; f_1 , f_2 , and f_3 are the heart rates measured at the 2nd, 3rd, and 4th min of recovery, respectively, for 30 s.

The examinations were conducted in a gym and on a sports field. The warm-up (10-15 min) consisted of simple general developmental exercises.

Statistical Analysis

The study used IBM SPSS 26 software. The following parameters were calculated: the arithmetic mean value, the standard deviation characterizing the variability of the trait (S), Student's t -test for independent samples, and Mann-Whitney U test. The hypothesis of equality of variances among the compared groups was determined using Levene's test. The threshold for statistical significance was set at $p < 0.05$.

Results

The results of statistical analysis demonstrate the peculiarities of endurance development in pupils aged 7-11 years

(Tables 1-14). At the beginning of the research, the null hypothesis regarding the equality of average values of endurance indicators among boys of all age groups was accepted. To compare the results between the study groups, the individual mean value of each parameter was calculated (Tables 1-5). Subsequently, these data were used to calculate the para-

metric Student's t-test for independent samples (Tables 6, 9, 10, 13) and the nonparametric Mann-Whitney U-test (Tables 7, 8, 11, 12, 14). Levene's test was used to compare variances between groups and to select a statistical test method.

Levene's criterion in age groups of 7-8 years old in tests "Push-ups in a lying position" ($p = ,008$) and "Sit-ups in 30 s

Table 1. Statistical description of endurance indicators in 7-year-old boys

Tests			Average	Standard error of mean value	Standard deviation	Skewness	Standard deviation of skewness	Kurtosis	Standard error of the kurtosis
	Minimum	Maximum							
Push-ups in a lying position, times	6.0	13.0	9.6	0.542	2.098	-0.349	0.58	-0.421	1.121
Sit-ups in 30 s from the supine position, times	6.0	18.0	12.6	0.940	3.641	-0.315	0.58	-1.119	1.121
Bent arm hang, s	2.0	10.0	6.7	0.622	2.410	-0.783	0.58	-0.386	1.121
300 m run, s	92.0	128.0	108.6	2.798	10.835	0.381	0.58	-0.71	1.121
MHSTI	39.2	64.3	52.1	2.031	7.865	-0.153	0.58	-1.039	1.121

Table 2. Statistical description of endurance indicators in 8-year-old boys

Tests			Average	Standard error of mean value	Standard deviation	Skewness	Standard deviation of skewness	Kurtosis	Standard error of the kurtosis
	Minimum	Maximum							
Push-ups in a lying position, times	6.0	23.0	11.33	1.256	4.865	1.102	0.58	0.787	1.121
Sit-ups in 30 s from the supine position, times	10.0	20.0	14.60	0.638	2.473	0.336	0.58	0.487	1.121
Bent arm hang, s	4.50	14.60	10.53	0.725	2.809	-0.736	0.58	-0.094	1.121
300 m run, s	82.0	121.0	103.73	3.391	13.134	-0.387	0.58	-1.31	1.121
MHSTI	39.80	72.20	55.73	2.780	10.767	0.383	0.58	-1.312	1.121

Table 3. Statistical description of endurance indicators in 9-year-old boys

Tests			Average	Standard error of mean value	Standard deviation	Skewness	Standard deviation of skewness	Kurtosis	Standard error of the kurtosis
	Minimum	Maximum							
Push-ups in a lying position, times	11.0	27.0	18.33	1.267	4.909	0.282	0.58	-0.809	1.121
Sit-ups in 30 s from the supine position, times	12.0	25.0	19.80	0.932	3.610	-0.97	0.58	0.354	1.121
Bent arm hang, s	9.70	21.20	13.83	0.859	3.326	1.002	0.58	0.87	1.121
300 m run, s	80.0	122.0	97.40	3.722	14.416	0.558	0.58	-1.046	1.121
MHSTI	50.0	75.0	60.02	2.192	8.488	0.355	0.58	-1.067	1.121

Table 4. Statistical description of endurance indicators in 10-year-old boys

Tests	Minimum	Maximum	Average	Standard error of mean value	Standard deviation	Skewness	Standard deviation of skewness	Kurtosis	Standard error of the kurtosis
	Push-ups in a lying position, times	16.0	27.0	20.9	0.894	3.461	0.344	0.58	-1.011
Sit-ups in 30 s from the supine position, times	17.0	31.0	24.0	1.187	4.598	0.102	0.58	-1.266	1.121
Bent arm hang, s	5.2	32.5	16.4	2.376	9.203	0.558	0.58	-1.082	1.121
300 m run, s	73.0	95.0	80.3	1.722	6.670	0.996	0.58	0.438	1.121
MHSTI	50.0	72.0	60.6	1.709	6.620	-0.276	0.58	-0.139	1.121

Table 5. Statistical description of endurance indicators in 11-year-old boys

Tests	Minimum	Maximum	Average	Standard error of mean value	Standard deviation	Skewness	Standard deviation of skewness	Kurtosis	Standard error of the kurtosis
	Push-ups in a lying position, times	17.0	27.0	22.1	0.736	2.850	-0.411	0.58	-0.18
Sit-ups in 30 s from the supine position, times	20.0	32.0	26.1	1.093	4.234	0.018	0.58	-1.499	1.121
Bent arm hang, s	9.70	32.45	19.17	1.870	7.243	0.578	0.58	-0.745	1.121
300 m run, s	73.0	82.0	77.1	0.784	3.035	0.316	0.58	-1.125	1.121
MHSTI	50.0	72.0	58.8	1.542	5.973	0.152	0.58	0.542	1.121

Table 6. Analysis of features of manifestation of abilities to endurance of boys karate athletes of 7-8 years old

Indicators studied	Criterion for independent samples							
	Levene's criterion for equality of variance		t-test for equality of means					
	F	p	t	p	Δx	Δs	95% confidence interval for the difference	
							Lower	Upper
Push-ups in a lying position, times	8.170	0.008	-1.267	0.216	-1.733	1.368	-4.535	1.069
Sit-ups in 30 s from the supine position, times	4.499	0.043	-1.76	0.089	-2.0	1.136	-4.328	0.328
Bent arm hang, s	0.368	0.549	-4.046	0.001	-3.867	0.956	-5.824	-1.909
300 m run, s	1.180	0.287	1.107	0.278	4.867	4.396	-4.138	13.872
MHSTI	2.736	0.109	-1.061	0.298	-3.654	3.443	-10.706	3.398

Assume equal variance levels

from the supine position” ($p = 0.043$) indicates heterogeneity of dispersions ($p < 0,05$). In this case, the use of the Student's t-test for independent samples is inappropriate. Therefore, we decided to use the non-parametric Mann-Whitney U test (Tables 7, 8).

The analysis of the Mann-Whitney U-test for independent samples indicates that the distribution of the results of the tests “Push-ups in a lying position” ($p = 0.545$) and “Sit-ups in 30 s from the supine position” ($p = 0.203$) of boys aged 7-8 years is the same for these age categories. The null

hypothesis regarding the equality of groups is accepted. The differences between the values of these parameters in these samples are unreliable. Statistically significant differences between the groups according to Student's t-test were found only in the test “Bent arm hang” ($p = 0.001$).

The obtained levels of significance of empirical Student's t-criteria revealed that in groups of boys aged 8-9 years, there are statistically significant differences in most tests ($p < 0.05$). Age characteristics of children influence the level of dynamic local endurance of arm muscles and press in control exercises

Table 7. Analysis of features of manifestation of abilities to local endurance of muscles of hands of boys karate athletes of 7-8 years old

Summary of the Mann–Whitney U test for independent samples “Push-ups in a lying position”	
Total	30
Mann–Whitney U	127.0
Wilcoxon’s W	247.0
Criterion statistics	127.0
Standard error	23.964
Standardised criteria statistics	0.605
Asymptotic significance (2-sided test)	0.545
Exact significance (2-sided test)	0.567

Table 8. Analysis of the peculiarities of the manifestation of abdominal muscle local endurance abilities of boys karate athletes of 7-8 years old

Summary of the Mann–Whitney U test for independent samples “Sit-ups in 30 s from the supine position”	
Total	30
Mann–Whitney U	143.0
Wilcoxon’s W	263.0
Criterion statistics	143.0
Standard error	23.950
Standardised criteria statistics	1.273
Asymptotic significance (2-sided test)	0.203
Exact significance (2-sided test)	0.217

Table 9. Analysis of features of manifestation of abilities to endurance of boys karate athletes of 8-9 years old

Indicators studied	Criterion for independent samples							
	Levene’s criterion for equality of variance		t-test for equality of means				95% confidence interval for the difference	
	F	p	t	p	Δx	Δs	Lower	Upper
Push-ups in a lying position, times	0.018	0.893	-3.923	0.001	-7.0	1.784	-10.655	-3.345
Sit-ups in 30 s from the supine position, times	1.080	0.308	-4.603	0.001	-5.2	1.130	-7.514	-2.886
Bent arm hang, s	0.036	0.850	-2.93	0.007	-3.293	1.124	-5.596	-0.991
300 m run, s	0.067	0.798	1.258	0.219	6.333	5.035	-3.981	16.648
MHSTI	1.787	0.192	-1.212	0.236	-4.291	3.540	-11.542	2.961

Assume equal variance levels

Table 10. Analysis of features of manifestation of abilities to endurance of boys karate athletes of 9-10 years old

Indicators studied	Criterion for independent samples							
	Levene’s criterion for equality of variance		t-test for equality of means				95% confidence interval for the difference	
	F	p	t	p	Δx	Δs	Lower	Upper
Push-ups in a lying position, times	1.776	0.193	-1.634	0.114	-2.533	1.550	-5.710	0.643
Sit-ups in 30 s from the supine position, times	1.989	0.169	-2.783	0.010	-4.20	1.509	-7.292	-1.108
Bent arm hang, s	18.429	0.000	-1.007	0.323	-2.543	2.527	-7.719	2.632
300 m run, s	9.175	0.005	4.177	0.000	17.133	4.101	8.732	25.535
MHSTI	2.152	0.154	-0.203	0.841	-0.564	2.779	-6.257	5.129

Assume equal variance levels

Table 11. Analysis of the features of static local endurance abilities in the hand muscles of 9-10-year-old boys karate athletes

Summary of the Mann–Whitney U test for independent samples “Bent arm hang”	
Total	30
Mann–Whitney U	115.000
Wilcoxon’s W	235.000
Criterion statistics	115.000
Standard error	24.106
Standardised criteria statistics	0.104
Asymptotic significance (2-sided test)	0.917
Exact significance (2-sided test)	0.935

“Push-ups in a lying position” (p = 0.001) and “Sit-ups in 30 s from the supine position” (p = 0.001). In the case of indicators of static arm muscle endurance, the average results of the

test “Bent arm hang” also differed statistically significantly (p = 0.007) in favor of 8-years old boys. The mean values characterizing the manifestation of cardiorespiratory endurance in the “300 m run” (p = 0.219) and “MHSTI” (p = 0.236) groups did not differ significantly (p > 0,05).

Statistically significant differences were revealed between samples of boys aged 9-10 years by results of tests “Sit-ups in 30 s from the supine position” (p = 0.01) and “300 m run” (p < 0.001). At the age of 10, boys demonstrate a higher level of dynamic local endurance of abdominal muscles (21.2%) and cardiorespiratory endurance (17.6%). The differences between all other values of the studied parameters in these samples were not statistically significant (p < 0.05).

The Mann–Whitney and Student’s criteria for independent samples of boys aged 10-11 years indicate that the distribution of the results of all tests was the same for these age groups. The null hypothesis of equality of groups was confirmed. In all tests, the differences between the values of

Table 12. Analysis of the manifestation of cardiorespiratory endurance abilities in 9-10-year-old boys karate athletes

Summary of the Mann–Whitney U test for independent samples “300 m run”	
Total	30
Mann–Whitney U	26.500
Wilcoxon’s W	146.500
Criterion statistics	26.500
Standard error	24.061
Standardised criteria statistics	-3.574
Asymptotic significance (2-sided test)	0.000
Exact significance (2-sided test)	0.000

these parameters in these samples were statistically insignificant ($p > 0.05$).

Summarizing the results of the research, it is possible to state that changes in endurance development occur already in the primary school age. In this connection, it is expedient to perform the purposeful development of separate components of endurance in children aged 8, 9, and 10 years when their most intensive growth is observed.

Discussion

Physical activity (PA) aimed at developing endurance in the younger generation plays a key role in health, given the threats of the present caused by a sedentary lifestyle. It helps prevent obesity and strengthens bones, heart, and joints, thereby reducing the risk of cardiovascular disease. PA can be performed during health or sports activities.

This study demonstrated the peculiarities of the manifestation of various components of endurance abilities of boys aged 7-11 years at the stage of initial training. The study of the favorable development of these components according to age will allow preparing the functional and muscular systems of children for mastering the technical elements of karate, create favorable conditions for the manifestation of special endurance during fights at competitions and certifications, and identifying potentially gifted students inclined to this sport.

The results of this study extend and supplement the data from previous studies, which showed that introducing karate into the physical activity of schoolchildren improves the components of physical fitness (Hontarenko, Marchenko & Korol, 2022; Kabadayı, Karadeniz, Yılmaz et al., 2022; March-

Table 14. Analysis of the manifestation of cardiorespiratory endurance abilities in 10-11-year-old boys karate athletes

Summary of the Mann–Whitney U test for independent samples “300 m run”	
Total	30
Mann–Whitney U	84.0
Wilcoxon’s W	204.0
Criterion statistics	84.0
Standard error	23.972
Standardised criteria statistics	-1.189
Asymptotic significance (2-sided test)	0.234
Exact significance (2-sided test)	0.250

enko, Ivashchenko, Khudolii & Lubchenkov, 2023). Martial arts training involves work of moderate to submaximal intensity. This requires adaptive changes in the cardiovascular system, skeletal muscles, and lung ventilation (Villa-González et al., 2022; Deng & Wang, 2024).

We agree with Vasconcelos, Protzen, Galliano et al. (2020) that a more developed cardiorespiratory capacity contributes to maintaining effort during bouts through faster recovery between efforts. Various methods can contribute to the improvement of aerobic endurance (Manojlovic, Roklicer, Trivic et al., 2023).

The most common forms of martial arts are general and special exercises. General exercises: running on a treadmill or track, running with obstacles, cross-country running on rough (hilly) terrain in the forest, park, on the shore of a reservoir, skiing, and skating (Prommer, Wachsmuth, Thieme et al., 2018; Polevoy, 2023), swimming, rope jumping, cycling (Prommer, Wachsmuth, Thieme et al., 2018), sports and outdoor games (Unierzyski & Bogusławski, 2016; Marchenko, Ivashchenko, Khudolii & Lubchenkov, 2023), high-intensity interval training (HIIT) (Duncombe, Barker, Bond et al., 2022; Bauer, Sperlich, Holmberg et al., 2022; Wu, Yang, Yu et al., 2023).

Special exercises: performing striking techniques with hands and feet, various fast movements on the tatami, and around the partner, various combinations in defense with counterattacks with hands, feet, and their combinations, improving combinations under conditions of increasing mutual resistance of opponents, work with several opponents, various wrestling exercises from different positions (standing, on the ground, with a change of partners of different weight categories and heights), training on sandy soil, training in water,

Table 13. Analysis of features of manifestation of abilities to endurance of boys karate athletes of 10-11 years old

Indicators studied	Criterion for independent samples							
	Levene’s criterion for equality of variance		t-test for equality of means					
	F	p	t	p	Δx	Δs	95% confidence interval for the difference	
							Lower	Upper
Push-ups in a lying position, times	1.217	0.279	-1.094	0.283	-1.267	1.158	-3.638	1.105
Sit-ups in 30 s from the supine position, times	0.067	0.798	-1.281	0.211	-2.067	1.614	-5.372	1.239
Bent arm hang, s	1.650	0.210	-.925	0.363	-2.796	3.024	-8.991	3.397
300 m run, s	5.933	0.021	1.691	0.102	3.20	1.892	-0.676	7.076
MHSTI	0.000	0.986	0.783	0.440	1.802	2.302	-2.914	6.518
Assume equal variance levels								

special outdoor games with wrestling elements, and others (Marchenko & Satdyiev, 2021; Ambrozy, Rydzik, Kwiatkowski et al., 2022; Stamenković, Manić, Roklicer et al.).

Promoting endurance development in children and adolescents is not an easy task. They cannot overcome the fatigue caused by the central nervous system. The brain protects the body by regulating power output during any form of exercise, with the ultimate goal of maintaining homeostasis and protecting life to ensure that exercise is completed before harm occurs (Noakes, 2012). Therefore, the child's CNS is unable to activate the muscles for further action or performance at the desired level. Music, games, and competitive methods can be recommended to increase motivation. Konopka, Zeegers, Solberg et al. (2022) pointed out that it is difficult to individualize the stimulus to perform high-intensity exercises.

Although Balyi, Way, & Higgs (2013) rationale for generalized sensory periods and the scientific evidence for their existence have been criticized by Van Hooren & De Ste Croix (2020), Van Hooren & De Ste Croix (2020) stated that coaches should not rely on general sensitivity periods but rather should train all physical characteristics at all stages of development.

In our opinion, it is necessary to develop mechanisms for load correction during the development of various endurance components based on the sensitive periods and biological maturity. It is essential to pay attention to processes in physical development such as maturation with acceleration (accelerants) or lag (retardants).

Conclusions

Based on the analysis of modern scientific research, a tendency to reduce the level of physical activity in children and adolescents has been identified. A sedentary lifestyle contributes to the deterioration of motor competence and physical fitness.

Endurance is an important element in the training process, along with technical, psychological, and tactical training. The higher the level of endurance, the greater the activity potential of the body's major functions, especially respiration and circulation. The body learns several basic and applied physical skills more easily and effectively.

The results of the research indicate certain differences between boys of different age groups (7, 8, 9, 10, and 11 years). Statistically significant differences were observed in boys aged 7-8 years in the manifestation of local static power endurance, 8-9 years in local static and dynamic power endurance of the hand and abdominal muscles, and 9-10 years in dynamic power endurance of the abdominal muscles and general cardiorespiratory endurance ($p < 0.05$). Differences in all tests between the values of the specified parameters in samples of 10-11 years old are statistically unreliable ($p > 0.05$).

The favorable period for the development of general endurance in boys is between the ages of 8-9 and 9-10 years. At this age, it is important to start the systematic and purposeful development of pupils' aerobic abilities.

In our opinion, extracurricular classes in the Kyokushinkai karate sports section during extracurricular time will provide an opportunity to promote the development of general and special endurance and expand the range of motor skills. This approach will increase interest in physical activity and prevent overweight in children.

Conflict of Interest

All authors have read and approved the final version of the manuscript, and they declare no conflicts of interest.

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Вікові відмінності прояву здібності до витривалості хлопців-каратистів

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів
Реферат. Стаття: 9 с., 14 табл., 40 джерел.

Мета дослідження – визначити сприятливі вікові періоди розвитку витривалості школярів 7-11 років, які займаються у групах початкової підготовки секції карате.

Матеріали і методи. У дослідженні взяли участь 75 хлопців 7-11 років. Вони були розподілені на п'ять вікових груп: 7, 8, 9, 10 і 11 років. В кожній віковій групі було по 15 учасників. Технічний рівень дітей відповідав учнівським ступеням 10-9-8 Кю (помаранчевий колір поясу, помаранчевий із синьою смужкою та синій). Діти та їхні батьки були ознайомлені про всі особливості дослідження і дали згоду на участь в експерименті. Протокол дослідження схвалено Етичним комітетом Харківський національного педагогічного університету імені Г.С. Сковороди (Харків, Україна). Для вирішення поставлених завдань були використані методи дослідження: вивчення та аналіз науково-методичної літератури, педагогічне спостереження, тестування, педагогічний констатуючий експеримент, методи математичної статистики.

Результати. Спостерігалися статистично достовірні відмінності у прояві локальної статичної силової витривалості м'язів рук у групах 7-8, 8-9 років ($p = 0,001$; $p = 0,007$), локальної динамічної силової витривалості м'язів рук 8-9 ($p = 0,001$) і червоного пресу 8-9, 9-10 ($p = 0,001$; $p = 0,01$), загальної кардіореспіраторної витривалості 9-10 ($p = 0,001$). Відмінності за всіма тестами між значеннями вказаних параметрів у вибірках 10-11 років статистично недостовірні ($p > 0,05$).

Висновки. Сприятливим періодом для розвитку загальної витривалості хлопців є вік 8-9 і 9-10 років. У цьому віці важливо почати систематично і цілеспрямовано розвивати аеробні здібності школярів. Заняття у спортивній секції кіокушинкай карате в позаурочний час дасть можливість сприяти розвитку загальної та спеціальної витривалості, розширенню спектру рухових навичок.

Ключові слова: хлопці, вікові відмінності, витривалість, кардіореспіраторна витривалість, кіокушинкай карате.

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