



Assessment of Speed Indicators of School Students Practicing Kyokushinkai Karate

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Abstract

The purpose of this study was to determine the age-specific features of the manifestation of differences in the speed fitness of younger grade boys who attend a karate class at the sports and health stage.

Materials and methods. The study participants were 60 younger grade boys (aged 7 to 10). They were divided into four groups: those aged 7, 8, 9, and 10, each of the age group comprising 15 participants. The children's technical level corresponded to the student grades of 10th or 9th Kyu (Orange Belt). The children and their parents were informed about all the features of the study and gave their consent to participate in the experiment. The solution of the set tasks involved the use of the following research methods: review and analysis of scientific and methodical literature, pedagogical observation, timing of educational tasks, testing, pedagogical ascertaining experiment, methods of mathematical statistics.

Results. Statistically significant ($p < .05$) age-specific differences were observed in the speed in integral movements ($p = .037$; $p = .004$; $p = .041$), in the latent time of a simple motor response ($p = .003$; $p = .001$; $p = .026$), and in the frequency of unloaded movement ($p = .002$; $p = .039$; $p = .001$) between all the study groups aged 7-8, 8-9, and 9-10, respectively; in speed-strength abilities ($p = .009$; $p = .024$) between the groups aged 7-8 and 9-10; in the general motor function of the body ($p = .007$; $p = .006$) between the groups aged 7-8 and 8-9; and in the frequency of a single movement ($p = .044$) between the groups aged 8-9.

Conclusions. Based on the results of the SI and SSI indices, most younger grade karate boys develop harmoniously and have a sufficient level of development of speed abilities, their results clearly showing improvement. It was established that there are differences between children in various structural units of speed, which correspond to the age indicators and technical levels of the karate boys.

Keywords: boys, speed abilities, kyokushinkai karate, younger grade students.

Introduction

The State actively responds to the negative challenges of nowadays and promotes the development of new innovative approaches to implement the idea of 'Formation of a healthy nation'. State and regional programs are actively being created, international charitable foundations offer programs for the development of physical education and mass physical culture using modern technologies for teaching motor actions and developing physical abilities in various forms of work in physical education at school.

The President's nationwide Healthy Ukraine program has been developed. The healthy school model is one of the components of this program. It is designed to improve the citizens' health and quality of life, to make sports accessible to everyone. Its main task is to make a healthy lifestyle

part of the Ukrainian mentality. The program was created by the Office of the President of Ukraine together with relevant ministries: Ministry of Education and Science, Ministry of Youth and Sports, and Ministry of Health. Many experts and specialists from various fields took part in the development and discussion of the program (The healthy school model is a component of the President's Healthy Ukraine program, 2021).

A comprehensive New physical education program was created on the platform of the international charitable fund Parimatch Foundation to develop and popularize physical education in schools with the aim of increasing the physical activity of children aged 6 to 16, motivating physical education teachers to introduce new modern approaches to conducting their classes, providing tools to make physical education classes up-to-date and interesting for the digital generation (The comprehensive New physical education pro-

gram, 2021). New sports modules such as game, traditional, and new ones are being introduced to physical education classes. To date, the Ministry of Education and Science of Ukraine has approved more than 40 modules in sports. These modules also include various types of martial arts: hand-to-hand combat, wushu, military sports games, horting, fencing, and unarmed combat (Krutsevych, Tymchyk, Der-evianko, and others, 2017; Pedan, Kolomoiets, Boliak, and others, 2022). A lot of research has been recently conducted on the implementation of kyokushinkai karate within the school process (Marchenko & Kovalenko, 2020; Marchenko & Satdyiev, 2021; Marchenko, Ivashchenko, Jagiello et al., 2022). Hence there are prerequisites for offering supplements to already existing modules, creating a separate new section of martial arts in the school curriculum or using the data obtained from completed studies in out-of-class and out-of-school work in the form of sports work in sports classes.

The use of well-organized children's martial arts programs can lead to increased motor activity, improved physical condition, motor skills, and physical fitness of schoolchildren, influence the mental health and character formation of young people, increase social skills and self-confidence. As for motor skills, Khudolii & Marchenko (2007), Boguszewski & Socha, (2011), Stamenković, Manić et al. (2022) noted the need to develop explosive power, speed of movements, agility, strength, balance and accuracy during training.

The dominant physical components that martial arts athletes must constantly train are reaction, coordination, and speed. These three things are closely related to some techniques necessary in martial arts, specifically kicking and punching, and defense techniques (Siregar, Soegiyanto & Rustiadi, 2021; Marchenko, Jagiello, Iermakov et al., 2021; Zymogliad & Marchenko, 2021).

In view of the above, the study of the specific features of the manifestation of various speed components in school students is a topic of relevance.

The purpose of this study was to determine the age-specific features of the manifestation of differences in the speed fitness of younger grade boys who attend a karate class at the sports and health stage.

Materials and methods

Study participants

The study participants were 60 children who were tested to determine their level of speed abilities. The study sample was divided into four age groups: 7-year-old boys (n=15), 8-year-old boys (n=15), 9-year-old boys (n=15), and 10-year-old boys (n=15). The children and their parents were informed about all the features of the study and gave their consent to participate in the experiment. The children's technical level corresponded to the student grades of 10th or 9th Kyu (Orange Belt). All the participants did regular practical training, which comprised 3 classes per week, each about 90 minutes long. The inclusion criteria were the absence of injuries in the last 2 months and the absence of intake of medication that could affect the correct performance of tests.

Ethical considerations. Ethical approval of the entire study was obtained from the Ethics Committee of H.S. Skovoroda Kharkiv National Pedagogical University. All the par-

ticipants were given an information sheet detailing the study conditions. The study procedure and possible risks were explained to all the participants and their parents by members of the research team. The participants were informed that they could withdraw from the study at any time and for whatever reason without explanation. Informed consent was obtained from all the participants and their parents. All procedures were performed in accordance with the Declaration of Helsinki.

Study organization

The solution of the set tasks involved the use of the following research methods: review and analysis of scientific and methodical literature, pedagogical observation, timing of educational tasks, testing of speed abilities, pedagogical ascertaining experiment, and methods of mathematical statistics.

To determine the level of the indicators under study according to age, various manifestations of speed were tested using a battery of fitness tests that comprehensively characterize various manifestations of speed abilities. The tests were selected depending on the subject matter and were included in the analysis according to the purpose of the study. The tasks performed during the examination of the children were assessed using quantitative indicators (Eurofit, 1993; Krutsevych, Vorobiov & Bezverkhnia, 2011; Zymohliad & Marchenko, 2021).

Control exercises were carried out in the gym and on the sports field of the school. Before the examination, a set of exercises (10–15 minutes) was performed, which included running, jumping, general physical development exercises, and movement games. It was aimed at preparing the children to perform the test tasks.

The method of determining the speed and speed-strength indices proposed by Krutsevych, Vorobiov & Bezverkhnia (2011) was used as criteria for performing a differentiated assessment of the motor fitness of younger grade students. Both speed and speed-strength indices take into account the appropriate values of the ratio of the morphological and functional indicators of school students, because of this, a downward deviation of these values can be evidence of a low level of functional capabilities as an indicator of physical condition (Tables 1, 2).

Table 1. Speed Index (SI) assessment for children and adolescents, c. u. (according to Krutsevych et al., 2011)

Functional level				
High	Above average	Average	Below average	Low
4.3	4.2–3.9	3.8–3.5	3.4–3.1	3

Table 2. Speed-Strength Index (SSI) assessment for boys, c. u. (according to Krutsevych et al., 2011)

Age, years	Functional level				
	High	Above average	Average	Below average	Low
7 to 10	1.11	1.1–1.01	1.0–0.91	0.9–0.81	0.8
11 to 15	1.26	1.25–1.16	1.15–1.07	1.06–0.96	0.95
16 to 17	1.31	1.3–1.21	1.2–1.11	1.1–1.01	1.0
18 to 20	1.41	1.4–1.31	1.3–1.21	1.2–1.11	1.1

Statistical analysis

The study used IBM SPSS 26 software application. The following parameters were calculated: arithmetic mean value (X), standard deviation, which characterizes the variability of the characteristic (S), independent samples t-test, and Mann-Whitney U-test. The hypothesis of equality of variances for the compared groups was determined using Levene's test.

Results

Tables 3–10 provide the data of the statistical analysis of the features of the manifestation of speed abilities in the younger grade boys who attend a sports class of kyokushinkai karate.

Table 3 shows a differentiated assessment of the development of speed and speed strength in younger boys depending on their anthropometric measures (body length). Comparison of the obtained values with the tabular data of

Table 3. Distribution of boys according to the level of development of speed abilities

Indices	Age	Functional level, %				
		High	Above average	Average	Below average	Low
Speed (SI)	7	–	20.0	33.3	20.0	26.7
	8	–	33.3	26.7	40.0	–
	9	13.3	33.3	33.3	20.0	–
	10	20.0	20.0	33.3	26.7	–
Speed-strength (SSI)	7	26.7	46.7	20.0	6.7	–
	8	6.7	46.7	40.0	6.7	–
	9	20.0	26.7	33.3	20.0	–
	10	26.7	26.7	40.0	6.7	–

Table 4. Analysis of the specific features of the manifestation of speed in boys aged 7 to 8

Test number	Investigated indicators	Test for independent samples							
		Levene's test		t-test for equality of means				95% confidence interval for the difference	
		F	p	t	p	Δx	Δs	Lower	Upper
1	30 m running from a standing start, s	5.172	0.031	2.596	0.015	0.680	0.262	0.143	1.217
2	Standing long jump, cm	0.032	0.86	-2.787	0.009	-8.933	3.205	-15.499	-2.368
3	Shuttle run 4×9 m, s	5.363	0.028	3.795	0.001	0.893	0.235	0.411	1.375
4	Falling Dietrich's stick grasp, cm	2.198	0.149	3.209	0.003	4.267	1.33	1.543	6.991
5	Rope jumping, times	0.525	0.475	-3.351	0.002	-3.933	1.174	-6.338	-1.529
6	Speed side kicks, (Cres)	1.903	0.179	-1.053	0.301	-0.027	0.025	-0.079	0.025
7	Speed Index, (SI)	2.185	0.150	-1.411	0.169	-0.200	0.142	-0.490	0.090
8	Speed Strength Index, (SSI)	0.014	0.908	-1.163	0.255	-0.036	0.031	-0.099	0.027

Equal variances are assumed

Krutsevych, Vorobiov & Bezverkhnia (2011) makes it possible to conclude that the boys of all age categories have above average, average, below average, and low levels. It should be noted that a high level of normative differentiated assessment of the development of speed relative to body length is not observed in boys aged 7 and 8. Moreover, all group samples did not fall into the low level category, except for boys aged 7 with a percentage of 26.7%. The great bulk of the children (85%) was distributed in the SI according to levels as follows: above average (26.7%), average (31.7%), and below average (26.7%). The distribution is somewhat different in the SSI: 70% of the children fell into the categories of above average (36.7%) and average (33.3%) levels. The analyzed indices show that the children develop harmoniously and have a sufficient level of development of speed abilities.

The improvement of motor abilities with age and the effect of the body length of the children on their results are clearly visible. Guided by the obtained index data, it is possible to implement the person-centered approach, which contributes to the prerequisites for the development of the best motor mode in the process of developing motor abilities. This motivates younger children to develop motor skills during training sessions.

To choose a statistical method for the review of average values, variances in the groups were first compared using Levene's test of equality of variances. Depending on the level of significance, the parametric independent samples t-test (Tables 4, 7, 9) or the non-parametric Mann-Whitney U-test (Tables 5, 6, 8, 10) were chosen as the basis for calculations.

The calculated significance levels of empirical t-tests demonstrate that there are statistically significant differences ($p < 0.05$) in almost all data between the groups of boys aged 7 and 8.

The age-specific characteristics of these children affect their level of speed in integral movements "30 m running

Table 5. Analysis of the specific features of the manifestation of speed in integral movements (30 m running) in boys aged 7 to 8

Summary of the Mann-Whitney U-test for independent samples	
Total	30
Mann-Whitney U value	62.000
Wilcoxon W value	182.000
Test statistics	62.000
Standard error	24.055
Standardized test statistics	-2.099
Asymptotic significance (2-tailed test)	.036
Exact significance (2-tailed test)	.037

Table 6. Analysis of the specific features of the manifestation of the general motor function of the body and resistance to tempo changes (shuttle run 4x9 m) in boys aged 7 to 8

Summary of the Mann-Whitney U-test for independent samples	
Total	30
Mann-Whitney U value	48.000
Wilcoxon W value	168.000
Test statistics	48.000
Standard error	24.058
Standardized test statistics	-2.681
Asymptotic significance (2-tailed test)	.007
Exact significance (2-tailed test)	.007

Table 7. Analysis of the specific features of the manifestation of speed in boys aged 8 to 9

Test number	Investigated indicators	Test for independent samples							
		Levene's test		t-test for equality of means				95% confidence interval for the difference	
		F	p	t	p	Δx	Δs	Lower	Upper
1	30 m running from a standing start, s	0.013	0.91	4.87	0.004	1.013	0.208	0.587	1.44
2	Standing long jump, cm	4.987	0.034	-2.305	0.029	-9.6	4.165	-18.131	-1.069
3	Shuttle run 4x9 m, s	0.201	0.657	3.002	0.006	0.647	0.215	0.205	1.088
4	Falling Dietrich's stick grasp, cm	2.766	0.107	4.313	0.001	4.867	1.128	2.555	7.178
5	Rope jumping, times	1.238	0.275	-2.167	0.039	-3.2	1.477	-6.225	-0.175
6	Speed side kicks, (Cres)	3.247	0.082	-2.110	0.044	-0.085	0.041	-0.168	-0.002
7	Speed Index, (SI)	0.01	0.922	-3.746	0.001	-0.473	0.126	-0.732	-0.214
8	Speed Strength Index, (SSI)	0.585	0.451	-0.898	0.377	-0.029	0.033	-0.096	0.038

Equal variances are assumed

from a standing start" (p=.037), in speed-strength abilities "Standing long jump" (p=.009), in the general motor function of the body and resistance to tempo changes "Shuttle run 4x9 m" (p=.007), in the latent time of a simple motor response "Falling Dietrich's stick grasp" (p=.003), and in the frequency of unloaded movement "Rope jumping" (p=.002).

In the test "Speed side kicks on rackets with a partner in running around the cones following an S-shaped path" (side kicks – SK), which characterizes the manifestation of the frequency of a single movement in the boys of this category, the obtained data do not differ statistically significantly (p=.301). No significant differences were observed between the speed and speed-strength indices in these age groups (p=.169; p=.255, respectively).

The ascertaining experiment revealed great statistically significant age-specific differences in children aged 8 and 9 based on the results of the tests "30 m running from a standing start" (p=.004), "Shuttle run 4x9 m" (p=.006), "Falling Dietrich's stick grasp" (p=.001), "Rope jumping" (p=.039), and "SK" (p=.044).

Table 8. Analysis of the specific features of the manifestation of speed-strength abilities (standing long jump) in boys aged 8 to 9

Summary of the Mann-Whitney U-test for independent samples	
Total	30
Mann-Whitney U value	158.500
Wilcoxon W value	278.500
Test statistics	158.500
Standard error	24.085
Standardized test statistics	1.910
Asymptotic significance (2-tailed test)	.056
Exact significance (2-tailed test)	.056

Table 9. Analysis of the specific features of the manifestation of speed in boys aged 9 to 10

Test number	Investigated indicators	Test for independent samples							
		Levene's test		t-test for equality of means				95% confidence interval for the difference	
		F	p	t	p	Δx	Δs	Lower	Upper
1	30 m running from a standing start, s	5.044	0.033	2.404	0.023	0.44	0.183	0.065	0.815
2	Standing long jump, cm	3.258	0.082	-2.38	0.024	-10.2	4.286	-18.98	-1.42
3	Shuttle run 4x9 m, s	0.92	0.346	1.811	0.081	0.373	0.206	-0.049	0.796
4	Falling Dietrich's stick grasp, cm	0.466	0.501	2.352	0.026	2.867	1.219	0.37	5.363
5	Rope jumping, times	1.159	0.291	-5.309	0.001	-10.4	1.959	-14.413	-6.387
6	Speed side kicks, (Cres)	0.058	0.811	-0.997	0.327	-0.047	0.047	-0.143	0.049
7	Speed Index, (SI)	0.137	0.714	-0.937	0.357	-0.120	0.128	-0.382	0.142
8	Speed Strength Index, (SSI)	0.760	0.391	-0.586	0.563	-0.019	0.032	-0.084	0.047

Equal variances are assumed

In the "Standing long jump" test, which characterizes speed-strength abilities, the boys aged 8 do not statistically differ from those aged 9 ($p=.056$). We believe that boys do not have enough strength to perform a powerful muscular effort of a reactive-explosive nature. Moreover, jumping requires a higher level of neuromuscular coordination.

The karatekas aged 10 demonstrate a higher level of speed fitness than those aged 9. Statistical data processing revealed significant differences in test results. The largest differences are observed in the values of the following tests: "30 m running from a standing start" ($p=.041$), "Standing long jump" ($p=.024$), "Falling Dietrich's stick grasp" ($p=.026$), and "Rope jumping" ($p=.001$).

Table 10. Analysis of the specific features of the manifestation of speed in integral movements (30 m running) in boys aged 9 to 10

Summary of the Mann-Whitney U-test for independent samples	
Total	30
Mann-Whitney U value	63.000
Wilcoxon W value	183.000
Test statistics	63.000
Standard error	23.991
Standardized test statistics	-2.063
Asymptotic significance (2-tailed test)	.039
Exact significance (2-tailed test)	.041

No statistically significant differences were found between the samples of boys aged 9 and 10 based on the results of testing of all other types of manifestation of speed abilities ($p>0.05$). The age-specific characteristics of the boys of these groups do not affect the level of the general motor function of the body, resistance to tempo changes ($p=.081$), and the frequency of a single movement ($p=.227$).

In the "Shuttle run 4x9 m" test, the braking speed is important, which is characterized by a quick stop and an instant change in the direction of movement. Physical development of the boys is gradually accelerating, growth processes are becoming more active, but weight gain is still lagging behind. This may result in clumsiness of the stature, disproportionality, and coordination of movements decreases in children.

Summarizing the results of the study, it can be stated that an increase in the speed of movements for younger grade students practicing karate is natural in ontogenesis.

Discussion

It was assumed that the study of the specific features of the manifestation of various speed components in younger grade karate boys can facilitate the development of correct training programs and talent identification by coaches, physiologists, sports scientists, sports doctors and sports performance researchers who work with young athletes of various categories.

The implementation of new sports modules will make it possible to increase children's interest in physical education classes and develop their interest in sports, teach physical education teachers modern approaches and improve their pedagogical skills (Marchenko & Taranenko, 2020; The comprehensive New physical education program, 2021; Pedan, Kolomoiets, Boliak, and others, 2022). Our studies comple-

ment the findings of Marchenko & Kozar (2015), Marchenko & Handymov (2021), Pinto-Escalona, Gobbi, Valenzuela et al. (2021) about the need to involve children as much as possible in mass and sports activities in out-of-class and out-of-school work.

The analysis of the obtained average values of the karate athletes confirms a higher level of speed abilities compared to children of these age categories who do not practice any sports activities (Marchenko, 2008; Marchenko & Holubov, 2015; Herrmann, Heim & Seelig, 2019).

The conducted study also shows that the level of speed fitness of karatekas can be assessed using a set of simple tests (Martinez-de-Quel, Alegre, Castillo-García & Ayán, 2021). They are easy to perform and their informativeness and reliability have been confirmed by many studies (Chaabène, Hachana et al., 2012; Marchenko & Verdysch, 2021). Taking the test results as a basis, coaches and teachers obtain the necessary useful information for further planning of the academic process with children in accordance with the individual characteristics of the organism.

The obtained results expand and complement the data of Ivashchenko, Berezna & Cieśllicka (2020), Litvin & Marchenko (2021), Minenko & Marchenko (2021) on the need to improve the motor fitness of school students as a condition for improving the learning process (Marchenko, 2007; Khudolii, Kapkan, Harkusha et al., 2020). Speed fitness plays a central role in the education of boys aged 7 to 10, and it makes it possible to increase the effectiveness of the education process. Quick application of force and a high level of mechanical power are important for young karatekas, as they allow to perform quick and explosive movements, kicks and punches, i.e., the basic skills necessary for success in karate (Martinez-de-Quel, Alegre, Castillo-García & Ayán, 2021).

Conclusions

The analysis of State programs makes it possible to conclude that the entire system of physical education and mass sports needs an urgent reboot. There is a need to introduce up-to-date technologies in the teaching of motor actions and the development of physical abilities in various forms of work in physical education at school.

The review of scientific and pedagogical literature made it possible to identify the need to develop speed as a key factor in the effectiveness of young karatekas at the initial stage of training as well as to determine the main structural components of speed.

The obtained SI and SSI indices show that the majority of young grade karate boys develop harmoniously and have a sufficient level of development of speed abilities, and the improvement of speed abilities with age is clearly visible.

Statistically significant ($p < .05$) age-specific differences are observed in the speed in integral movements, in the latent time of a simple motor response, and in the frequency of unloaded movement between all the study groups; in speed-strength abilities between the groups aged 7-8 and 9-10; in the general motor function of the body between the groups aged 7-8 and 8-9; and in the frequency of a single movement between the groups aged 8-9.

No statistically significant differences ($p > .05$) were found when comparing the results in terms of speed-strength abili-

ties between the samples aged 8-9; in the general motor function of the body between the samples aged 9-10; and in the frequency of a single movement in the groups aged 7-8 and 9-10.

Conflict of interest

All authors have read and approved the final version of the manuscript and declare no conflict of interest.

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Оцінка показників швидкості школярів, що займаються кіокушинкай карате

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 8 с., 10 табл., 30 джерел.

Мета дослідження – визначити вікові особливості прояву відмінностей у швидкісній підготовленості хлопців молодших класів, які займаються в секції карате на спортивно-оздоровчому етапі.

Матеріали і методи. У дослідженні взяли участь 60 хлопців молодших класів (7-10 років). Їх розподілили на чотири групи: 7, 8, 9 і 10 років. В кожній віковій групі було по 15 учасників. Технічний рівень дітей відповідав учнівським ступеням 10-9 Кю (помаранчевий колір поясу). Діти та їхні батьки були інформовані про всі особливості дослідження і дали згоду на участь в експерименті. Для вирішення поставлених завдань були використані методи дослідження: вивчення та аналіз науково-методичної літератури, педагогічне спостереження, хронометраж навчальних завдань, тестування, педагогічний констатуючий експеримент, методи математичної статистики.

Результати. Спостерігаються статистично достовірні ($p < ,05$) вікові розбіжності між усіма досліджуваними групами у швидкості в цілісних рухах 7-8 ($p = ,037$), 8-9 ($p = ,004$), 9-10 ($p = ,041$), латентному часі простої рухової реакції ($p = ,003$; $p = ,001$; $p = ,026$ відповідно) та частоти ненавантаженого руху ($p = ,002$; $p = ,039$; $p = ,001$); між групами 7-8, 9-10 років у швидкісно-силових здібностях ($p = ,009$; $p = ,024$); 7-8, 8-9 років у загальній моториці тіла ($p = ,007$; $p = ,006$); 8-9 років у частоті одиночного руху ($p = ,044$).

Висновки. За результатами індексів ІІІ і ІІІС більшість хлопців-каратистів молодшого шкільного віку розвиваються гармонійно і мають достатній рівень розвитку швидкісних здібностей, чітко простежується покращення результатів. Встановлено, що між дітьми існують відмінності за різними структурними одиницями швидкості, які відповідають віковим показникам і технічному рівню каратистів.

Ключові слова: хлопці, швидкісні здібності, кіокушинкай карате, школярі молодших класів.

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