



Study of the Factor Structure of Motor Fitness in 8-Year-Old Boys During the Process of Mastering the “Kin Geri” Kick Technique

Svitlana Marchenko^{1ABCD}

¹Kharkiv State Academy of Physical Culture

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Corresponding Author: Svitlana Marchenko, e-mail: sport-svet1968@ukr.net

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Abstract

Objectives. The research aims to identify the factor structure of motor fitness in 8-year-old boys during the process of mastering the “Kin geri” front kick technique.

Materials and methods. Thirty-two 8-year-old boys participated in the study. Both the children and their parents were informed about the nature of the research and provided written consent for participation. Participants were assured of their right to withdraw from the study at any time without explanation. All procedures were conducted following the Declaration of Helsinki. The following research methods were employed: analysis of scientific and methodological literature, pedagogical observation, timing of educational tasks, motor fitness testing, and statistical data analysis.

Results. Factor analysis identified six factors accounting for 73.98 % of the total variance. The largest contribution (24.87 %) to the total variance of the sample was made by the factor “special complex coordination preparedness”. The second most significant factor was the “level of special motor fitness” (15.71 %). Other identified factors included “physical development” (12.74 %), “coordination of movements” (9.04 %), “agility” (6.05 %), and “flexibility” (5.58 %). Since the “Kin geri” kick is executed below belt level (“Gedan” level), the contribution of flexibility is minimal and may be considered less relevant. During the training of the “Kin geri” front kick, the most influential elements include anthropometrical indicators, speed of integral movements, special coordination fitness, balance, static strength, general endurance, and the degree of technical mastery of the “Kin geri” front kick demonstrated through a series of training tasks.

Conclusions. The analysis of the factor structure of motor fitness provides essential data for optimizing the training process of the “Kin geri” front kick in 8-year-old karate athletes. The findings highlight the integrity of motor skill formation and the development of motor abilities. A significant outcome of the factor analysis is the establishment of a foundation for designing effective training programs tailored to the physical development and motor fitness level of children and adolescents.

Keywords: factor analysis, 8-year-old boys, fitness structure, Kyokushinkai karate, “Kin geri” kick.

Introduction

In recent years, numerous studies have highlighted the importance of creating a safe and motivating environment for children to acquire sport-specific knowledge and skills (Pavlova, Bodnar & Vitos, 2018; Rodrigues & Antunes, 2019; Pinto-Escalona, Gobbi, Valenzuela et al., 2024). These authors emphasise the importance of maximising the engagement of prepubertal and pubertal students in sports activities. According to Ma & Qu (2017), Antunes, Rodrigues & Kirk (2021), initiating martial arts training provides a positive sporting experience and contributes to children's physical,

intellectual, and spiritual development. Emphasis on karate training, as noted by Harwood-Gross, Lambez, Feldman et al. (2021), Pinto-Escalona, Valenzuela, Martin-Loeches et al. (2022), appears to be a promising alternative for enhancing learning and behavioural outcomes in children facing significant psychosocial challenges and low academic achievement.

Among the key factors contributing to high performance in martial arts, researchers identify morphological characteristics as particularly important (Rakita, Rakonjac, Vukadinović-Jurišić & Obradović, 2018). Long-term training is known to influence body composition and overall physical development (Carlisle, Weaver, Stodden et al., 2019; Drenowatz, Greier, Ruedl et al., 2019; Kolunsarka, Stodden, Gràstèn et al., 2024).

Experts have analysed how different levels and types of sports specialisation affect the morphological parameters of athletes across various environments. Chen, Chen, Liu et al. (2022) demonstrated a correlation between body mass index and physical fitness in children and adolescents. Similarly, den Uil, Janssen, Busch et al. (2023) examined how weight status, physical fitness, and motor competence vary with age. Their findings support the view that physically fit children from an early age tend to be more proficient in executing motor skills and are generally more active.

Barnett, Webster, Hulteen et al. (2022) reported insufficient evidence for a direct link between overall physical fitness and general motor competence. However, they found strong evidence supporting a reciprocal causal relationship between physical fitness and motor competence in specific domains such as locomotion, coordination, and balance.

Studies by Rakita, Rakonjac, Vukadinović-Jurišić et al. (2018), Kahrović, Jovanović, Murić et al. (2018), Marchenko, Ivashchenko, Jagiello et al. (2024), and others have demonstrated a strong correlation between physical fitness and motor awareness in children practicing Shotokan and Kyokushinkai karate.

Given that Kyokushinkai karate requires the development and expression of diverse motor abilities (speed, agility, power, aerobic capacity, etc.), researchers often recommend the use of comprehensive test batteries to assess athletes' motor fitness (Styriak, Billman & Augustovicova, 2020; Marchenko & Verdysh, 2021; Marchenko, Ivashchenko & Khudolii, 2023). These control tests should reflect the specific biomechanical patterns of movement relevant to the sport. The athlete's level of training is a critical consideration. Tests designed for highly skilled or well-conditioned athletes may not be appropriate for beginners, whose performance may be limited by technical deficiencies or insufficient conditioning. In addition, factors such as gender and age must also be considered (Ghadiri, O'Brien, Soltani et al., 2022; Marchenko, Ivashchenko, Jagiello et al., 2022; Marchenko, Ivashchenko, Khudolii & Verygin, 2024).

The analysis of primary test results in assessing motor fitness provides only indirect information about its actual state. Many of the measured parameters are correlated to varying degrees, which leads to redundancy and informational overlap. Therefore, it becomes necessary to transform large datasets into a more compact and interpretable form to better represent motor fitness development dynamics and general patterns in young karate athletes during the prepubertal period.

The research aims to identify the factor structure of motor fitness in 8-year-old boys during the process of mastering the "Kin geri" front kick technique.

Materials and methods

Study participants

Thirty-two 8-year-old boys participated in the study. Both the children and their parents were informed about the nature of the research and provided written consent for participation. Participants were assured of their right to withdraw from the study at any time without explanation.

All procedures were conducted following the Declaration of Helsinki.

Study Design

The following research methods were employed: analysis of scientific and methodological literature, pedagogical observation, timing of educational tasks, motor fitness testing, and statistical data analysis.

The testing programme included validated assessments that covered the following components:

- anthropometric indicators: body weight, body length, chest circumference, and lung capacity;
- general motor fitness indicators: 30 m run from a high start, 4x9 m shuttle run, coordination exercises involving combined movements of the arm, torso and legs; one-legged stance with eyes closed, walking in a straight line after 5 turns, standing long jump, dynamometry of the right and left arms, flexion and extension of the arms while hanging on a rope, 300 m run, and seated trunk forward flexion.
- exercises to assess special speed and coordination skills in karate athletes: "touch evasion test" exercise; execution of "Kin geri" front kicks on rackets with a partner, zigzag run around cones ("snake" drill); and "comprehensive test". These tests were adapted from classical boxing and martial arts (Slovensky zvez karate, 2017; Styriak, Billman & Augustovicova, 2020; Marchenko & Verdysh, 2021).

The "Touch evasion test" was performed in pairs. One participant attempted to touch specific permitted target areas on the opponent's body (head, shoulders, chest, abdomen) using open palms. The second participant executed only defensive action, maintaining stance, retreating, and covering the torso with the elbows, without delivering counterattacks. The exercise lasted for 15 s, and the number of touches received by the defending participant was recorded.

The "Speed front kicks "Kin geri" on rackets with a partner performing zigzag run around cones" test was conducted on a tatami measuring 8x3 m². Three cones were placed in a straight line: the first cone was positioned 2 m from the starting line, and the remaining two were spaced equidistantly at the same distance from each other. The subject started at the designated line alongside an assistant holding two striking targets (rackets). At the signal, the participant progressed through the cone arrangement using a snake-like pattern, performing "Kin geri" front kicks alternately while covering the 8-meter distance. Timing stopped once the participant fully crossed the finish line. The outcome of the test was calculated using the Efficiency Coefficient, defined as the ratio of the number of successful kicks to the total time taken to complete the distance (C_{eff}).

The "Comprehensive test" was modified to align with the technical focus of the study. It incorporated core karate techniques (4 "Tsuki chudan" hand strikes and 4 "Kin geri" front kicks). The test was conducted on a 7x7 m tatami. At a sound signal, the participant began in a sitting position on the floor, legs extended, with heels on the starting line. After the start, the participant runs around the cone, then continues to run backward, after he runs around four cones in a "snake" style, executing four hand strikes and four kicks; performing ten jumps over low barriers 10-12 cm (5

on one leg in one direction and 5 on the other leg in the reverse direction). In the final stage, the participant transfers tennis balls from one plastic plate to another. The stopwatch stopped when the participant placed the last tennis ball on the finish plate.

In the course of the research the results of the programmed training process for mastering the “Kin geri” front kick technique were recorded based on task decomposition: series 1 “Physical fitness”, series 2 “Execution of initial and final positions”, series 3 “Mastery of key movements essential for performing the exercise”, series 4 “Ability to control movements”, series 5 “Mastery of leading exercises”, series 6 “Mastery of leading exercises” (Marchenko, Khudolii, Ivashchenko & Musliumova, 2023; Marchenko, Ivashchenko, Jagielło et al., 2023). Testing was conducted using a competitive method.

Statistical Analysis

Data were collected and systematised using Microsoft Excel 2016 (Microsoft Corp., Redmond, WA, USA). Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA). Factor analysis was employed to summarise the variables and group them according to their characteristic relationships, helping to determine the role of the learning process within the overall training structure.

During the factor analysis, the following indicators were calculated and analysed: Bartlett’s test of sphericity and the Kaiser-Meyer-Olkin (KMO) test of sampling adequacy. Factors were extracted using the principal component analysis (PCA) method, and factor rotation was carried out using the Varimax method with Kaiser normalization.

Results

To determine the role of the learning process for the “Kin geri” front kick within the overall training structure of 8-year-old boys, a factor analysis was conducted (Tables 1-4). Table 1 presents the results of motor fitness testing in this age group. An analysis of the coefficients of variation (V, %) revealed that the motor fitness of young karate athletes was homogeneous in most tests: No. 1 “Body weight, kg” (21.4 %); No. 2 “Body length, cm” (4.1 %); No. 3 “Chest circumference, cm” (8.3 %); No. 4 “Lung capacity, m3” (13.2 %); No. 5 “30 m run, s” (10.5 %); No. 6 “touch evasion test, number of missed touches” (28.9 %); No. 7 “Speed front kicks Kin geri, C_{eff} ” (11.5 %); No. 8 “4x9 m shuttle run, s” (6.5 %); No. 9 “Coordination test (arm, torso, and leg movement combination), points” (4.0 %); No. 11 “Walking in a straight line after 5 turns, deviation in cm” (8.1 %); No. 12 “Comprehensive test, s” (8.8 %); No. 13 “Standing long jump, cm” (10.4 %); No. 14 “Dynamometry of the right hand, kg” (25.8 %); No. 15 “Dynamometry of the right hand, kg”

Table 1. Results of motor fitness testing of 8-year-old boys

Nº	Tests	X	S	m	V, %
1	Body weight, kg	27.506	1.038	5.875	21.4
2	Body length, cm	127.344	0.934	5.283	4.1
3	Chest circumference, cm	62.703	0.920	5.204	8.3
4	Lung capacity, m3	1506.875	35.062	198.339	13.2
5	30 m run, s	7.203	0.134	0.759	10.5
6	Touch evasion test, number of missed touches	7.156	0.365	2.065	28.9
7	Speed front kicks “Kin geri”, C_{eff}	1.496	0.030	0.172	11.5
8	4x9 m shuttle run, s	13.719	0.158	0.893	6.5
9	Exercises to combine movements of arms, body, legs, points	8.875	0.064	0.359	4.0
10	One-legged stand with eyes closed, s	4.031	0.303	1.713	42.5
11	Walking in a straight line after 5 turns, deviation in cm	127.063	1.808	10.229	8.1
12	Comprehensive test, s	25.232	0.393	2.223	8.8
13	Standing long jump, cm	117.250	2.153	12.181	10.4
14	Dynamometry of the right arm, kg	10.906	0.497	2.810	25.8
15	Dynamometry of the left arm, kg	9.938	0.419	2.368	23.8
16	Flexion and extension of the arms while hanging on a rope, repetitions	5.50	0.554	3.132	56.9
17	300 m run, s	110.25	2.919	16.512	15.0
18	Seated trunk forward flexion, cm	-1.406	0.933	5.278	375.4
19	1 series, assessment	8.928	0.132	0.749	8.4
20	2 series, assessment	7.981	0.107	0.605	7.6
21	3 series, assessment	8.950	0.124	0.70	7.8
22	4 series, assessment	8.050	0.143	0.810	10.1
23	5 series, assessment	8.641	0.155	0.878	10.2
24	6 series, assessment	9.384	0.109	0.614	6.5

(23.8 %); No. 17 “300 m run, s” (15.0 %); No. 19-24 Evaluation of results from programmed training in the “Kin geri” front kick, based on task decomposition (6.5 %-10.2 %).

The results of the tests revealed a heterogeneous level of motor fitness among the boys in the following assessments: No. 10 “One-legged stand with eyes closed, s” (42.5 %); No. 16 “Flexion and extension of the arms while hanging on a rope, repetitions” (56.9 %); No. 18 “Seated trunk forward flexion, cm” (375.4 %). The high coefficients of variation observed in tests “One-legged stand with eyes closed, s”, “Flexion and extension of the arms while hanging on a rope, repetitions” and “Seated trunk forward flexion, cm” indicate that these exercises are particularly difficult to perform.

Overall, the motor fitness level of 8-year-old boys was homogeneous in terms of anthropometric characteristics and physical qualities such as speed, coordination, speed-strength, static strength, endurance, flexibility, and the outcomes of the learning process. However, heterogeneity was observed in the development of arm strength and vestibular stability.

Bartlett's test of sphericity indicated that the data obtained are suitable for factor analysis during the training of the “Kin geri” front kick, with a significance level of $p < 0.05$. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy demonstrated a satisfactory level for applying factor analysis (KMO = 0.526; $p > 0.05$) to the sample of 8-year-old boys (Table 2).

Table 2. Checking the appropriateness of factor analysis

KMO and Bartlett's test of sphericity	
The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy	0.526
Approximate Chi-square	546.481
Bartlett's test of sphericity df	276
Significance	0.000

In the process of factor analysis of the testing data of 8-year-old boys, six factors were identified, explaining 73.98 % of the total variance of the indicators (Table 3). The factor matrix illustrating the structure of physical development, motor fitness, and technical preparedness of 8-year-old boys during the training of the “Kin geri” front kick is presented in Table 4.

The first factor makes the largest contribution to the total variance of the sample (24.87 %). It shows strong correlations

with the results of the following tests: “30 m run” (0.862), “Touch evasion test, number of missed touches” (0.794), “Speed front kicks “Kin geri” (-0.846), “Comprehensive test” (0.883). This factor reflects the manifestation of specific coordination in karate movements and overall movement speed. It is designated as “Special complex coordination preparedness”.

The second factor, which accounts for 15.71 % of the total variance, is identified as a unipolar factor representing the state of technical fitness. It correlates with the results of training in the following series: 1st – “Exercises for the development of motor abilities” (0.763); 2nd – “Starting and ending positions” (0.731); 3rd – “Actions essential for performing the exercise” (0.753); 4th “Training in movement control” (0.759); and 6th – “Overall exercise performance” (0.722). This factor is referred to as “The level of special motor fitness”.

The third factor (explaining 12.74 % of the variance) correlates with anthropometric indicators: “Body weight” (0.921), “Body length” (0.782), and “Chest circumference” (0.933). This factor is labelled “physical development”.

The fourth factor contributes 9.04 % to the total variance and is associated with the test results for “Exercises to combine movements of the arms, body, legs” (0.713) and “One-legged stand with eyes closed” (0.881). It characterises the ability to maintain postural stability and to control movement in static positions. This factor is termed “coordination of movements”.

Factor 5 accounts for 6.05 % of the total variance. It shows the highest correlation with the “4×9 m shuttle run test” (-0.737), which characterises the ability to differentiate spatial and temporal parameters of movement. This factor is referred to as “agility”.

Factor 6 contributes 5.58 % to the total variance. It is most strongly associated with the indicator “Seated trunk forward flexion” (0.757), highlighting the importance of flexibility in the process of mastering kicking technique. This factor is labelled “flexibility”.

The obtained communalities (h^2), presented in Table 4, indicate the proportion of variance in the variables explained by all six factors. The proposed test battery is informative. The most significant indicators for a comprehensive assessment of the learning process structure in 8-year-old boys mastering the “Kin geri” front kick include the results of the following tests: “Body weight” (0.859), “Chest circumference” (0.897), “30 m run” (0.926), “Touch evasion test, number of missed

Table 3. Explanation of aggregate variance

Component	The initial eigenvalues			Extracting the sum of squared loads			Rotation of the sum of squared loads		
	Total	% variance	Total %	Total	% variance	Total %	Total	% variance	Total %
1	5.968	24.87	24.87	5.968	24.87	24.87	4.514	18.8	18.8
2	3.771	15.71	40.58	3.771	15.71	40.58	3.534	14.7	33.5
3	3.056	12.74	53.32	3.056	12.74	53.32	3.322	13.8	47.4
4	2.169	9.04	62.35	2.169	9.04	62.35	2.592	10.8	58.2
5	1.452	6.05	68.40	1.452	6.05	68.40	1.952	8.1	66.3
6	1.338	5.58	73.98	1.338	5.58	73.98	1.839	7.7	74.0

Method of factor extraction: principal component analysis

Table 4. The returned matrix of components

№	Test title	Component						h ²
		1	2	3	4	5	6	
1	Body weight, kg			0.921				0.859
2	Body length, cm			0.782				0.706
3	Chest circumference, cm			0.933				0.897
4	Lung capacity, cm ³			0.357		0.360	0.487	0.607
5	30 m run, s	0.862				-0.337		0.926
6	Touch evasion test, number of missed touches	0.794				0.314		0.838
7	Speed front kicks “Kin geri”, C _{eff}	-0.846						0.826
8	4×9 m shuttle run, s	0.323				-0.737		0.720
9	Exercises to combine movements of arms, body, legs, points				0.713			0.531
10	One-legged stand with eyes closed, s				0.881			0.865
11	Walking in a straight line after 5 turns, deviation in cm	0.545			-0.683	-0.354		0.908
12	Comprehensive test, s	0.883						0.803
13	Standing long jump, cm	-0.671				0.484		0.719
14	Dynamometry of the right hand, kg			0.544			0.639	0.793
15	Dynamometry of the left hand, kg			0.550			0.484	0.619
16	Flexion and extension of the arms while hanging on a rope, repetitions				0.597	0.594		0.732
17	300 m run, s	0.711				-0.392		0.752
18	Seated trunk forward flexion, cm						0.757	0.624
19	1 series, score		0.763					0.667
20	2 series, score		0.731					0.672
21	3 series, score		0.753					0.697
22	4 series, score		0.759					0.622
23	5 series, score		0.654		0.341			0.736
24	6 series, score		0.722					0.635

Method of factor extraction: principal component method

Method of rotation: varimax with Kaiser normalisation

a. The rotation converged in 6 iterations

touches” (0.838), “Speed front kicks “Kin geri” (0.826), “One-legged stand with eyes closed” (0.865), “Walking in a straight line after 5 turns” (0.908), “Comprehensive test” (0.803), “Dynamometry of the right hand” (0.793), “300 m run” (0.752), and training results from the 5th series “Separate parts of the target exercise and leading exercises” (0.736).

Thus, in the factor model describing the physical development, motor, and technical fitness of 8-year-old boys during the process of learning the “Kin geri” front kick, leading roles are played by anthropometric indicators, speed in integrated movements, special coordination preparedness, balance, static strength, general endurance, and the degree of technical mastery achieved across the training task series.

The data presented in Tables 1-4 demonstrate that the factor structure analysis of motor fitness provided essential information for decision-making in the management of the teaching process of the “Kin geri” front kick technique to 8-year-old karate athletes. A key outcome of this analysis is the establishment of a foundation for designing effective training programmes tailored to the physical development and motor preparedness of children and adolescents.

The most important result of the factor analysis in the context of the programmed training of the “Kin geri” kick was the identification of an independent and dominant factor “special complex coordination preparedness”. This finding underlines the necessity for beginners to receive a high level of basic coordination training. Coordination abilities play a critical role in acquiring and refining specific elements of kicking technique and ensuring their consistency. These abilities enable athletes to perform motor actions efficiently under varying conditions and to execute movements under optimal conditions.

It is essential to teach and develop these coordination skills in alignment with the developmental stages of children. Coordination abilities are a decisive success factor in various competitive disciplines of Kyokushinkai Karate, such as Kumite and Kata.

To visually display the sufficiency of extracted factors, a scree plot of eigenvalues (Cattell’s Scree Test) was used (Fig. 1). This graphical representation highlights the point at which the decrease in eigenvalues becomes less pronounced, indicating the most informative factors. Based on this

graph, five key factors were determined to contribute most significantly to the total variance in the data. So, in the educational and training process when mastering the “Kin geri” kick technique, it is important to consider 5 factors: “special complex coordination preparedness”, “level of special motor fitness”, “physical development”, “coordination of movements” and “agility”.

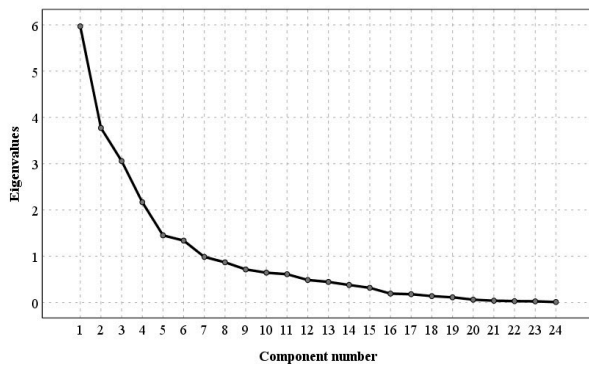


Fig. 1. Graph of eigenvalues

Discussion

The study examined a wide range of indicators aimed at identifying influential factors with prognostic value for planning the teaching process of the kicking technique “Kin geri”. It was assumed that motor skills play a significant role in the motor fitness structure of 8-year-old boys who regularly practice Kyokushinkai karate at the initial training stage. The degree of progressive mastery of exercises accounts for 15.71% of the variance in test results.

Based on the data analysis, it can be concluded that the development of movement coordination facilitates the formation of motor skills, while physical development serves as a reserve capacity in the process of teaching techniques to 8-year-old boys. This supports and expands upon the findings of Barnett, Webster, Hultheen et al. (2022), Marchenko, Khudolii, Ivashchenko & Musliumova (2023), Marchenko, Ivashchenko, Khudolii & Verygin (2024), who emphasize that the early stages of motor experience acquisition are critical periods during which coordination abilities should be a focal point of training.

Bojkowski, Kalinowski, Śliwowski et al. (2022), Oktarifaldi, Marta, Nugroho et al. (2024), Oktarifaldi, Nopembri, Yudanto et al. (2024), identified a positive and significant relationship between movement coordination and fundamental motor skills. These authors emphasize that enhancing general coordination skills is among the most important factors for achieving educational objectives and recommend incorporating a wide range of coordination-focused exercises into the learning process. In our case, the factors “coordination of movements” and “agility” were identified as components of the motor fitness structure.

The level of special complex coordination preparedness emerged as a general factor in our study, accounting for 24.87% of the variance in test results. Numerous researchers regard coordination as a cornerstone of motor and sport competence (Bernstein, 1996; Platonov & Nikitenko, 2019; Lyakh, Ambroży, Skripko et al., 2023). The results obtained

from the factor analysis highlight the importance of coordination in acquiring and refining specific karate techniques and ensuring their stability. Coordination enables the effective execution of motor actions under various conditions and contributes to the optimal performance of movements. These findings are consistent with previous research by Ma & Qu (2017), Marchenko, Ivashchenko, Jagiełło et al. (2023), Marchenko, Ivashchenko, Khudolii & Verygin (2024).

We agree with the opinion of Platonov & Nikitenko (2019), Styriak, Billman & Augustovicova (2020), Marchenko & Verdysh (2021) that diagnosing coordination abilities remains a controversial issue. This complexity is further heightened by the fact that athletes from different sports and martial arts styles exhibit distinct dominant coordination abilities, which significantly influence their training and competitive performance. As a result, their evaluation requires the use of specific, complex test tasks and diagnostic technologies that objectively assess the level of special coordination development (Styriak, Billman & Augustovicova, 2020; Marchenko & Verdysh, 2021; Ghadiri, O’Brien, Soltani et al., 2022).

Children’s physical development also contributed 12.74% to the variation in test scores, underscoring the importance of anthropometric parameters in teaching footwork to young karate athletes. Our findings are in agreement with those of den Uil, Janssen, Busch et al. (2023), who demonstrated a relationship between body mass index, physical activity, and physical fitness at the age of 8 years. However, they diverge from the same authors’ conclusion that anthropometric indicators are unrelated to motor competence at this age, with such associations only becoming evident at the age of 9 years.

The experimental results support the rationale for the organised participation of prepubertal children in sports as a long-term strategy to prevent overweight and obesity (Drenowatz, Greier, Ruedl et al., 2019; Chen, Chen, Liu et al., 2022), and to enhance body mass index, cardiorespiratory fitness, and muscular endurance (Kolunsarka, Stodden, Gråstén et al., 2024).

The influence of morphological features on specific karate skills, as analysed by Rakita, Rakonjac, Vukadinović-Jurišić et al. (2018), indicates that taller karate athletes with a higher percentage of muscle mass achieved better performance in executing the “Mae geri” kick and “Gyaku tsuki” punch techniques. The factor model of motor preparedness in 8-year-old karate athletes, developed in our study, expands on these findings and demonstrates the impact of physical development (chest circumference $h^2=0.933$; body weight $h^2=0.921$; body length $h^2=0.782$) on the effectiveness of learning the “Kin geri” kicking technique.

These results are consistent with the factor analysis findings reported by Rukavytsia, Ivashchenko, Khudolii et al. (2022), Ivashchenko, Berezhna & Cieślicka (2020), which confirm the holistic nature of motor skill formation and motor ability development in children and adolescents. They also provide a basis for identifying future research directions in the instruction of Kyokushinkai karate techniques and the development of appropriate curricula.

Conclusions

The analysis of scientific literature in the field of martial arts has made it possible to identify effective factors that

have been consistently validated over time. Researchers emphasise that the outcomes of sports training are closely interrelated with morphological, functional, and psychological characteristics, levels of physical fitness, as well as the development of both fundamental and specific motor skills, tactical preparedness, and other components. This multitude of factors necessitates a detailed investigation into the structure of motor fitness in 8-year-old boys.

Based on the analysis of empirical data obtained from testing 8-year-old boys, six factors were identified, collectively explaining 73.98 % of the total variance. The most significant contribution (24.87 %) was made by the factor of "special complex coordination preparedness". The next highest contribution (15.71 %) was attributed to "the level of special motor fitness". Additional factors included "physical development" (12.74 %), "coordination of movements" (9.04 %), and "agility" (6.05 %). The factor "flexibility" contributed the least (5.58 %) to the total variance. Since the "Kin geri" kick is executed below the belt level ("Gedan" level), this factor can be neglected.

The analysis of the factor structure of motor fitness yielded valuable insights for managing the training process of teaching the "Kin geri" front kick to 8-year-old karate athletes. One of the key outcomes of the factor analysis is the foundation it provides for developing effective training programs aligned with the physical development and motor fitness levels of children and adolescents.

The findings contribute to enhancing the methodology of teaching Kyokushinkai karate techniques in youth sports schools, clubs, federations, and general education institutions, supporting the effective organization of the educational and training process.

Conflict of Interest

The author declares that she has no conflict of interest.

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Дослідження факторної структури рухової підготовленості хлопців 8 років у процесі оволодіння технікою удару ногою «kin geri»

Світлана Марченко^{1ABCD}

¹Харківська державна академія фізичної культури

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

Реферат. Стаття: 9 с., 2 рис., 26 джерел.

Мета дослідження – визначити факторну модель структури рухової підготовленості хлопців 8 років у процесі оволодіння технікою удару ногою вперед «Kin geri».

Матеріали і методи. У дослідженні взяли участь 32 хлопці 8 років. Діти та їхні батьки були інформовані про всі особливості дослідження та дали згоду на участь в експерименті. Учасників повідомили, що вони можуть вийти з дослідження в будь-який момент без пояснення причини. Усі процедури були виконані відповідно до Гельсінської декларації. Були використані наступні методи дослідження: вивчення та аналіз науково-методичної літератури, педагогічне спостереження, хронометраж навчальних завдань, педагогічний експеримент, методи математичної статистики.

Результати. У процесі факторного аналізу виділилось шість факторів які пояснюють 73,98% сумарної дисперсії показників. Найбільшу величину вкладу (24,87%) в сумарну дисперсію вибірки вносить фактор «спеціальна комплексна координаційна підготовленість». Наступним за величиною вкладу (15,71%) став фактор «рівень спеціальної рухової підготовленості». Визначились також фактори «фізичний розвиток» (12,74%), «координація рухів» (9,04%), «спритність» (6,05%). Частка фактору «гнучкість» від загальної дисперсії найменша (5,58%). Удар «Kin geri» виконується нижче рівня поясу (рівень «Gedan») тому цим фактором можемо знехтувати. У процесі навчання удару ногою вперед «Kin geri» чільне місце займають спеціальна координаційна підготовленість, швидкість в цілісних рухах, загальна витривалість, ступінь оволодіння технікою відповідно серіям навчальних завдань, антропометричні показники, рівновага, статична сила.

Висновки. У результаті аналізу факторної моделі рухової підготовленості отримана необхідна інформація для прийняття рішень під час управління процесом навчання техніки удару ногою вперед «Kin geri» спортсменів-каратистів 8 років. Визначено цілісність процесу формування рухових навичок та розвитку рухових здібностей. Важливим результатом проведеного факторного аналізу слід вважати створення платформи для розробки ефективних навчальних програм відповідно до фізичного розвитку та рівня рухової підготовки дітей і підлітків.

Ключові слова: факторний аналіз, хлопці 8 років, структура рухової підготовленості, Кіокушинкай карате, удар ногою «Kin geri».

Information about the authors

Marchenko, Svitlana: sport-svet1968@ukr.net; <https://orcid.org/0000-0002-1013-9511>; Department of Olympic and Professional Sports, Kharkiv State Academy of Physical Culture, Klochkivska St, 99, Kharkiv, 61022, Ukraine

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