

## Original Article

### Posture correction methods and physical qualities development in 10–12-year-old karate athletes

NATALYA MISCHENKO<sup>1</sup>, MIKHAIL KOLOKOLTSEV<sup>2</sup>, ELENA ROMANOVA<sup>3</sup>, GALINA ILYINA<sup>4</sup>,  
NATALIA KOTLYAR<sup>5</sup>, EVGENII TSAPOV<sup>6</sup>, NATALYA USTSELEMOVA<sup>7</sup>

<sup>1</sup> Department of Theory and Methods of Physical Education, Ural State University of Physical Culture, Chelyabinsk, RUSSIA

<sup>2</sup> Department of Physical Culture, Irkutsk National Research Technical University, Irkutsk, RUSSIA

<sup>3</sup> Department of Physical Education, Altai State University, Barnaul, RUSSIA

<sup>4</sup> Institute of Humanities education, Magnitogorsk, Nosov Magnitogorsk State Technical University, Magnitogorsk, RUSSIA

<sup>5,6,7</sup> Department of Physical Culture, Nosov Magnitogorsk State Technical University, Magnitogorsk, RUSSIA

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#### Abstract:

Research aim is to work out and test the method of using a static-dynamic exercises' set for correct posture formation and physical qualities development in karate athletes aged 10-12.

*Research materials and methods.* 20 athletes with impaired posture took part in the experiment. The complex consists of static-dynamic exercises with a local focus on trunk, upper and lower extremities muscles. Exercises for each muscle group were performed with different movement amplitudes. The muscles static-dynamic work took place in a sequential amplitudes alternation without intervals for rest between them and was performed from different starting positions at the end of the main part of the training session. This technique is included in karate athletes' standard training program. Three times a week, three versions of the complex were used: muscle groups' static strength endurance development, dynamic endurance development, speed and strength abilities' active development. Before and after the experiment, the spine active flexibility, the spinal muscular corset state, and general and special physical fitness were tested. *Research results.* At the end of the pedagogical experiment, a significant ( $p < 0.05$ ) increase in the test indicators' values, characterizing the vertebral column active mobility and the spine muscular corset, all general physical and special fitness indicators' values was established. The number of athletes with «high» and «medium» spinal mobility, muscular corset functional state, general and special physical fitness levels has increased, and the number of athletes with «low» levels has decreased.

*Conclusions.* The proposed and tested experimental pedagogical method of a static-dynamic exercises set using in the athletes' training process had a positive effect on the postural posture deviations correction, young karate athletes' aged 10-12 physical qualities and special motor abilities development.

**Key Words:** martial arts, posture, static and dynamic exercises, motor qualities

#### Introduction

Much attention is paid to the younger generation health protection and promotion in many countries of the world (Görner, Reineke, 2020; Nesterchuk et. al., 2020; Ilyina, 2014; Romanova, & Dolzhikov, 2015). Over the past decade, there has been a decline in children's, adolescents' and young people's health status (Yang, Dong, 2017; Yatsun et. al., 2017).

One of a person's physical health indicators is their posture state (Kashuba et. al., 2017; Ivanchykova et. al., 2018; Sauko, & Zernova, 2019), its formation depends on the muscular corset development degree and its ability to work in the mode of long-term static tension (Kotliar et. al., 2019). Contractions consistency and steady muscle traction in various muscle groups of the neck, back, pelvis, and lower extremities contributes to maintaining correct posture. Functional posture disorders are the most common disease and are observed in schoolchildren in Russia (Kochomanov, V. N., Kalashnikova, 2016; Makarova, 2016), the Czech Republic (Balkó et. al., 2017), and girls in Ukraine (Vitalii Kashuba et. al., 2019). According to different research works, posture disorders occur more often during the child's intensive growth periods: 5-8 years and 11-12 years. These age periods are critical for correct posture formation, when children's bones and muscles increase in length, and the neuromuscular mechanisms for maintaining posture have not yet adapted to the morphological changes that have occurred in the body (Metalnikov, Romanova et. al., 2020). Posture violations negatively affect the activity of the cardiovascular, respiratory, digestive and other body systems, reduce the physical and mental performance level and quality of life (Boak et. al., 2014; Kozina et. al., 2017; Timnea et. al., 2019). Experts note that one of the reasons for the mass postural disorders spread is associated with students' negative attitude to motor activity (Drachuk et. al., 2018; Furman et. al., 2018) or pedagogical defects in the system of young people's physical

education (Olena Andrieieva et. al., 2020). Various postural disorders that do not require surgery can be corrected by methods and means of physical education in combination with orthopedic care (Yarmak et. al., 2017; Kashuba et. al., 2019; Metalnikov et. al., 2020). The literature describes methods for correcting posture defects using isotonic exercises (Kukoba, 2011), fitball (Bibik, 2013), fitness technologies (Ivanchykova, et.al., 2018), and gymnastic exercises (Cruz-Ferreira, et.al., 2013 ). In Russia, there is a wide popularization of martial arts among the population (Vorozheykin et al., 2020). In The Unified All-Russian Sports Classification, karate is represented by several styles, one of which is the style of traditional karate (WKF) (Korobeinikov, 2011). A mandatory requirement for an athlete in karate is compliance with «Shisey» complex of factors («bearing»). This concept implies the unity of physical training and psychological attitude (posture, visual direction, hands and feet position when moving, maintaining stability, etc.). Without proper posture, an athlete will not be able to achieve a high professional level in the chosen sport. We believe that statodynamic exercises, which are understood as dynamic exercises without complete muscle relaxation or alternation of static and dynamic modes in one exercise, can become an expedient means in solving the issue of the formation of a rational posture of karate athletes.

Researchers have found that static-dynamic exercises allow selectively and effectively train various muscle groups, affecting all types of muscle fibers (Myakichenko & Seluyanov, 2001). Meanwhile, the analysis of the scientific literature showed the lack of research related to the methods and training programs development for young karate students based on the static-dynamic exercises influence on the athletes' posture formation.

**Research aim** is to work out and test the method of using a static-dynamic exercises' set for correct posture formation and physical qualities development in karate athletes aged 10-12.

### **Material & methods**

The research was conducted during an academic year (September 2019 - March 2020) at the specialized children's and youth sports school of the Olympic reserve «Konas» in Chelyabinsk (Russia). The experiment involved 20 karate athletes aged 10-12 with posture disorders (stoop, round, flat back, round and flat back, scoliosis of the 1<sup>st</sup> degree). Before and after the pedagogical experiment, the athletes' posture state was evaluated by somatoscopy (in points from 0 to 5). Attention was paid to the head, shoulders, shoulder blades, limbs position, the severity of spinal bends, the position of the spinous processes' line, and the chest shape (Chernozemov et. al., 2017). Studies of the vertebral column active flexibility were performed using tests: «leaning forward from a standing position» (cm), and «leaning to the side» (cm). The muscular corset functional state was evaluated by tests: «holding the body in a horizontal position lying on the hips» (min); «muscles' static strength endurance of the right and left sides of the trunk» (min); «keeping straight legs balanced in the supine position (arms along the trunk)» (min); «flexion-extension of the torso from a horizontal position lying on the back to a sitting position (hands behind the head) for 1 minute» (number of times). Some motor tests were used to assess the motor qualities of speed, endurance, movements coordination, strength, speed and strength ability and flexibility: «running at 60 m» (sec); «running at 1000 m» (min, s); « rope jumping (30 sec)»; «shuttle run 3x10 m» (sec); «pull-up from the hang on a high crossbar» (number of times); «bending and extending the arms at the stop lying on the floor» (number of times); «standing long jump» (cm); «rope jumping (30 sec)»; «rope jumping for 60 sec» (number of times); «leaning forward from a standing position with your fingers touching the floor» (number of times). We have developed a set of static-dynamic exercises with a local focus on the trunk, upper and lower extremities muscles. Exercises for each muscle group were performed with three amplitudes of movement (15°, 30°, 45°). The muscles' static-dynamic work took place in a sequential transition from one amplitude to another without intervals for rest between them from the initial positions lying on the stomach, back, right and left sides, knee-elbow position. When learning exercises, the coach used video material with a demonstration broadcast of the proposed complexes on a computer monitor. The complexes of static-dynamic exercises developed by us are included in the karate athletes' standard training program. 90 minutes' classes were held three times a week as a circular training session. At the end of the main part of the training session, three versions of the complex were used for 20 minutes. The first option provided for the muscle groups' static strength endurance development (transition from one level of movement amplitude to another with holding for 10 seconds at each level). When performing the second option, the emphasis was placed on dynamic endurance development (the transition from one movement amplitude to another is performed quite quickly). In the third option, the students actively developed their speed and strength abilities (spring movements are performed at maximum speed the movement amplitude is maintained within 5° for 10 seconds). The number of static-dynamic (isotonic) exercises in one training session ranged from 6 to 18 exercises (1-4 series each). The rest between laps was no more than 30 seconds. Pedagogical control for posture began with correcting the right position of the lower limbs, then the upper parts of the body. In the future, this postural position of the body was fixed when performing various exercises. The work was carried out in accordance with the ethical standards of the Human Rights Committee of the Helsinki Declaration of 2008. (World Medical Association Declaration of Helsinki, 2013), does not infringe on the rights or endanger the well-being of young athletes. The parents' consent to the survey was obtained. Statistical analysis involved calculating the mean (M), minimum, maximum, standard deviation ( $\sigma$ ), standard error (m), and Student's confidence score.

**Results**

At the end of the experiment, young athletes significantly ( $p < 0.05$ ) showed an 84.2% decrease in the score of body parts' postural position violations (Table 1).

**Table 1. Assessment of body parts' postural position violations in karate athletes, aged 10-12, before and after the experiment (in points)**

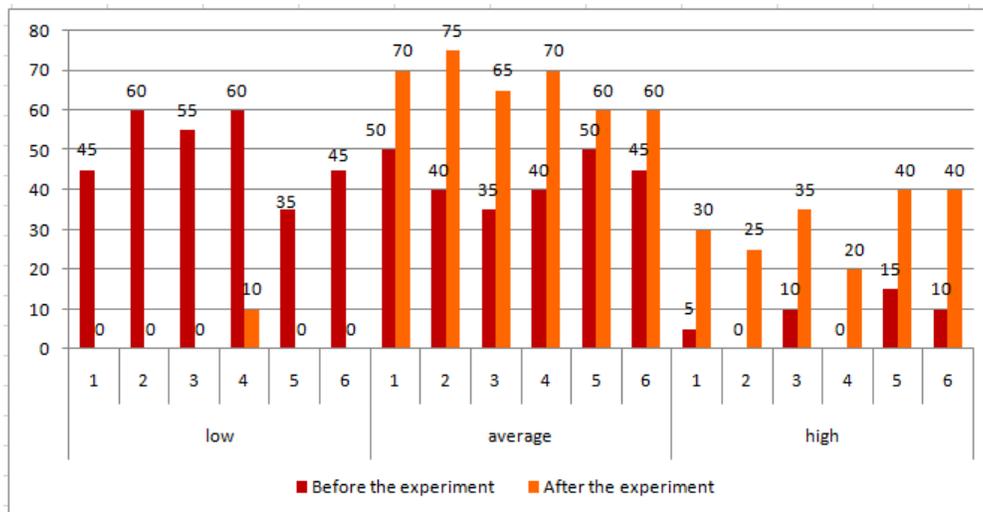
Body parts	Before the experiment (M±m)	After the experiment (M±m)	P
Head	0,7±0,21	0,1±0,02	<0,05
Upper back	1,1±0,35	0,2±0,03	<0,05
Waist	0,6±0,19	0,1±0,02	<0,05
Stomach	0,5±0,15	0,1±0,02	<0,05
Shoulders	0,9±0,27	0,1±0,02	<0,05
Total:	0,76±0,23	0,12±0,11	<0,05

After the experiment, out of 20 examined athletes, 8 (40.0%) boys had minor deviations of body parts from the symmetrical position relative to the spine. The other children did not have any posture defects. A comparative assessment of young athletes' musculoskeletal system functional state before and after the experiment is presented in Table 2.

**Table 2. Young karate athletes' musculoskeletal system functional state indicators values before and after the experiment (M±m)**

Test	Before the experiment	After the experiment	P
1. Leaning forward from a standing position, cm	6,8±1,53	11,0±1,41	<0,05
2. Leaning to the side, cm	14,2±1,68	18,5±1,59	<0,05
3. Holding the body in a horizontal position lying on the hips, min	1,6±0,24	2,4±0,34	<0,05
4. Muscles' static strength endurance of the right and left sides of the trunk, min	1,0±0,18	1,6±0,25	<0,05
5. Keeping straight legs balanced in the supine position (arms along the trunk), min	1,2±0,16	1,9±0,46	<0,05
6. Flexion-extension of the torso from a horizontal position lying on the back to a sitting position (hands behind the head) for 1 minute, number of times	31,8±1,12	42,6±2,38	<0,05

At the end of the pedagogical experiment, a significant ( $p < 0.05$ ) increase in the test indicators values characterizing active mobility of the vertebral column was established: «leaning forward from a standing position» by 4.2 cm (61.7%) and «leaning to the side» by 4.3 cm (30.3%). There was a significant ( $p < 0.05$ ) increase in the test indicators values, characterizing the spinal muscular corset functional state: «holding the body in a horizontal position lying on the hips» by 50.0%; «static strength endurance of the muscles of the right and left sides of the trunk» by 60.0%; «keeping straight legs on weight in the supine position (hands along the trunk)» by 58.3%; «flexion-extension of the trunk from the horizontal position lying on the back to the sitting position (hands behind the head) for 1 minute» by 33.9%. After the experiment, the number of young athletes with «high» and «medium» levels of spinal mobility and the muscular corset functional state increased, and the number of boys with the «low» level decreased (Fig.1). Note: 1, 2, 3, 4, 5, 6 – tests numbers, their names are given in Table 2



**Figure1. The number of young men with different levels of spinal mobility development and the muscular corset functional state before and after the experiment (%)**

Analysis of the karate athletes, aged 10-12, motor qualities testing results after the experiment showed statistically significant ( $p < 0.05$ ) positive changes in all indicators values of general physical activity (Table. 3) and special training (Table 4).

**Table 3. Young karate athletes' general physical fitness indicators values before and after the experiment (X±m)**

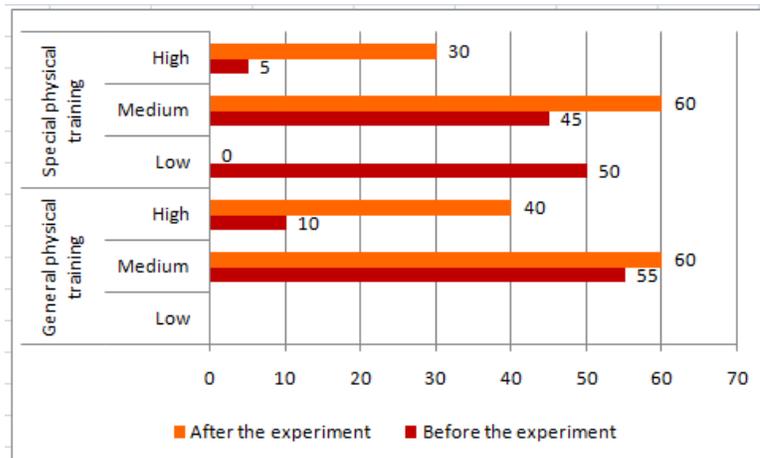
Test	Before the experiment	After the experiment	P	Growth rate, %
Running at 60 m, sec	11,9±0,85	10,1±0,57	<0,05	15,1
Running at 1000 m, min, sec	8,95±0,49	6,12±0,86	<0,05	31,6
Shuttle run 3x10 m, sec	11,24±0,67	9,46±0,38	<0,05	15,8
Pull-up from the hang on a high crossbar, number of times	4,0±0,43	7,0±0,31	<0,05	75,0
Bending and extending the arms at the stop lying on the floor, number of times	8,0±0,42	15,0±0,98	<0,05	87,5
Standing long jump, cm	128,9±4,45	138,8±3,95	<0,05	7,7
Rope jumping for 60 sec, number of times	59,0±2,67	72,4±3,23	<0,05	22,7
Leaning forward from a standing position with your fingers touching the floor, number of times	2,0±0,54	3,0±0,21	<0,05	50,0

The greatest increase in the indicators values was noted in the strength tests «Bending and extending the arms at the stop lying on the floor» (87.5%), «Pull-up from the hang on a high crossbar» (75%) and in the test for spinal flexibility «Leaning forward from a standing position with fingers touching the floor» (50.0%). The smallest increase (7.7%) in the value of the speed and power qualities indicator was noted in the «Standing long jump» test.

**Table 4. Young karate athletes' special physical fitness indicators values before and after the experiment (X±m)**

Test	Before the experiment	After the experiment	P	Growth rate, %
Static balance on right leg sec	22,6±0,24	42,5±1,89	<0,05	88,1
Static balance on left leg sec	21,9±1,05	40,6±1,52	<0,05	85,3
Five sidekicks by raising the right foot to the upper level, sec	7,6±0,11	6,1±0,12	<0,05	19,7
Five sidekicks by raising the left foot to the upper level, sec	8,5±0,11	6,9±0,16	<0,05	18,8
Sidekicks by the right leg to the middle level for 10 sec, number of times	11,5±0,2	17,3±0,2	<0,05	50,4
Sidekicks by the left leg to the middle level for 10 sec, number of times	11,8±0,2	16,2±0,2	<0,05	37,2
Punches for 10 seconds: the front hand - a blow to the chest, the back hand - in the stomach, number of times	7,6±0,2	9,8±0,1	<0,05	28,9
Two punches and one kick in the middle level, 5 combinations, sec	17,4±0,09	12,7±0,07	<0,05	27,0
Attack-counterattack, sec	6,9±0,07	5,2±0,08	<0,05	24,6

The largest increase in the indicators values was noted in the tests «Static balance on the right leg» - 88.1%, «Static balance on the left leg» - 85.3% and in the test «Sidekicks by the right leg to the middle level for 10 sec» - 50.4%. The smallest increase in the indicator value was established in the test «Five sidekicks by raising the left foot to the upper level» - 18.8%. After the experiment, the number of athletes with «high» and «medium» levels of general and special physical fitness increased. Athletes with a «low» level of training were not identified (Fig. 2).



**Figure 2. The number of karate athletes with different levels of general and special physical fitness before and after the experiment (%)**

The proposed and tested experimental pedagogical method of a static-dynamic exercises set using in the young athletes' educational and training process had a positive effect on the postural deviations correction, and karate athletes' aged 10-12 physical qualities and special motor abilities development.

### **Dicussion**

In Russia, there is a wide popularization of martial arts among the population. A mandatory requirement for an athlete in karate is compliance with «Shisey» complex of factors («bearing»). The wide spread of postural disorders among young people actualizes research in the field of means and methods of musculoskeletal system diseases correction and prevention (Balkó et. al., 2017; Vitalii Kashuba et. al., 2019). According to the authors' research (Nosova, et. al., 2015; Yarmak, et. al., 2017; Vitalii Kashuba et. al., 2020), it is noted that the leading means of correcting posture defects is physical exercise, which confirms the importance and relevance of our chosen study.

There are several methods of improving a person's health from postural disorders using physical education and sports (Usina, 2020). The effect of aerobic exercise on spine morphological and functional disorders correction was studied and tested (DrzałGrabiec, 2014). Techniques for correcting posture defects using isotonic exercises for various types of body constitution (Kukoba, 2011), fitball (Bibik, 2013), fitness technologies (Ivanchykova, et. al., 2018), and gymnastic exercises (Cruz-Ferreira, et. al., 2013) are described in scientific literature.

Our research results have shown the positive effectiveness of the proposed method for correcting posture disorders in karate athletes aged 10-12, using a set of static-dynamic exercises: dynamic exercises without complete muscle relaxation or alternating static and dynamic modes in one exercise.

The inclusion of the static-dynamic exercises complex developed by us in the generally accepted training program for karate athletes positively affected the children's posture state. The results of our research showed a significant increase in the young athletes' general and special physical fitness indicators values and increased the training process effectiveness in karate. This is consistent with the results obtained by other researchers (Vitalii Kashuba et. al., 2019). The authors show that the use of means to increase physical activity in the program of a one-year pedagogical experiment of posture correction allowed not only to correct posture disorders in the frontal plane, but also to improve young women's physical development and physical fitness parameters. We believe that further study of the set of static-dynamic exercises use to correct posture disorders in children, adolescents and young people is a promising direction of the program to improve younger generation health.

### **Conclusions**

The developed experimental method of forming correct posture in karate athletes aged 10-12 using a set of static-dynamic exercises has shown its high effectiveness. After the experiment, 60.0% of athletes had no posture defects, 40.0% had minor deviations of body parts from a symmetrical position relative to the spine.

In athletes, the indicators of tests that characterize the condition of the muscular corset and active mobility of the spinal column significantly increased. The use of statodynamic exercises in the training process allowed by the end of the experiment to significantly increase the values of the indicators of motor qualities of speed, endurance, strength, strength endurance and flexibility. An increase in the results of tests of special physical fitness was established. After the experiment, the number of athletes with "high" and "medium" levels of development of general and special physical fitness increased, athletes with a "low" level of training were not identified.

Athletes significantly improved the morpho-functional characteristics of the spine and significantly increased the indicators of general and special physical fitness.

The proposed and tested method expands the list of pedagogical methods and means of posture defects correction in karate athletes, existing in physical culture and can be recommended for postural disorders prevention in people who are not related to sports activities.

**Conflicts of interest:** No potential conflict of interest relevant to this article was reported.

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