Original Article

Development of speed-strength qualities of boys doing karate

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ABSTRACT

Aim

is to increase the level of development of speed-strength abilities of 13-14-year-old boys who do karate.

Material and methods

The pedagogical experiment was conducted in 2024 at the Moscow Olympic Reserve Sports School, the Karate department. The study involved 68 boys aged 13-14. Classes in the karate section were held 3 times a week for 90 minutes. The speed-strength qualities of the core muscles were determined by lifting the body in the sitting position for 1 minute, the speed-strength qualities of the leg muscles were determined using the shuttle run 3*10 m, and the speed-strength qualities of the arm muscles were determined using the test of flexion and extension of the arms in the prone position for 1 minute.

Results

After the pedagogical experiment, the speed-strength qualities of the 13-14-year-old children participating in the study increased in both groups. Children from the control group, who trained according to the standard program, increased their core muscle indicators from 43.4±5.1 to 46.7±4.1, the increase is 7.1% ($p>0.05$), in the shuttle run test the indicators improved by 8.3% from 9.1±0.8 to 8.4±0.6 ($p>0.05$), and the speed-strength qualities of the arms became higher by 8.8%, the average results increased from 19.8±4.2 to 21.7±3.9 ($p>0.05$). Children from the experimental group, who also trained according to the standard karate program, but at the same time performed special sets of physical exercises for 20 minutes after the warm-up, were able to significantly improve their speed-strength qualities. The core muscle indices increased from 42.2±3.9 to 48.9±4.6, the increase is 13.7% ($p<0.05$), in the shuttle run test the indicators improved by 16.5% from 9.2±0.5 to 7.9±0.7 ($p<0.05$), and the speed-strength qualities of the arms became higher by 22.9%, the increase in average results from 19.5±2.2 to 25.3±4.3 ($p<0.05$).***Conclusion:***The proposed sets of physical exercises are recommended for the development of speed-strength qualities in the training process of boys aged 13-14 who do karate. It is recommended to perform sets of exercises 3 times a week for 20 minutes.

Keywords:

Sensitive periods; Physical qualities; Physical training; Training process; Martial arts.

INTRODUCTION

Recently, contact combat sports, including karate, have been developing rapidly worldwide, but there is very little scientific literature on training karateka's for competitions. In this regard, many coaches study literature on other sports disciplines (boxing, kickboxing) to improve the effectiveness of the training process.[1,2]

Each sport has its own specific motor actions, determined by its objectives, external conditions, and competition rules. Conducting competitive fights according to the rules, to identify the strongest, became the basis for the development of karate as a sport.

The style of karate is athletic, powerful, dynamic, active and offensive. A fight between martial artist's places increased demands on their physical qualities. Some of the main physical qualities in contact types of combat sports are: strength, speed, endurance, coordination, agility, flexibility. A high level of development is a prerequisite for achieving victory in combat. In turn, a significant degree of development of these qualities has a positive effect on the technical preparedness of the athlete.[3,4]

During a fight, the competitor is constantly, every second, bombarded with a large amount of the most diverse information from the opponent's actions or the combat situation. The competitor must instantly process this information - determine the time and distance, the direction of blows and the nature of the opponent's actions, the general situation and the course of the fight, evaluate and remember their own successes and

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the opponent's mistakes, react to the opponent's actions and switch to a new movement, instantly choosing it from a mass of techniques and effectively performing it.[5-7]

During individual development, physical qualities increase unevenly. In addition, it has been established that at certain age stages, some physical qualities do not undergo qualitative changes (development) in the training process and even their level can decrease. Motor abilities, especially speed and speed-strength, develop at varying rates. Periods in which the development of these abilities is especially rapid are called sensitive:[8,9]

The main physical qualities are subject to targeted training influence in the following age periods:[10-12]

– coordination abilities – the greatest increase between 0 and 5 years of age;

– speed – development occurs between 7 and 17 years of age, with the greatest growth rate at 16–17;

– strength abilities – development occurs between 12 and 18 years of age, the greatest growth rate is at the age of 16-17;

– speed-strength qualities – development occurs between 10 and 18 years of age, the greatest growth rate is at the age of 13-14;

– endurance – development occurs from preschool age to 30 years of age, with the most intensive growth in endurance observed between 14 and 20 years of age.

A person's successful labor activity and achievement of high sports results largely depend on a high level of development of speed-strength abilities. Speed-strength abilities are the human ability to exert maximum power in the shortest period of time, while maintaining an optimal range of motion. The degree of manifestation of speed-strength abilities depends not only on muscle strength but also on the athlete's ability to concentrate neuromuscular efforts and mobilize the body's functional capabilities.[13-15]

A high level of development of speed-strength abilities is innate; however, targeted physical exercises can significantly improve speed-strength preparedness. This is possible with the correct selection of means and methods of training.[16-18]

The main methods of developing speed-strength abilities include short-term efforts and repetitions used in various combinations: conjugate, repeated, variable; dynamic effort method, shock method, static-dynamic method, circuit training, and game method.[19-21]

Speed-strength abilities, strength and speed are often considered as independent abilities; however, they are closely related to each other. The predominance of any one quality (speed or strength) does not give such an advantage as their optimal combination. Insufficient development of strength or speed limits the manifestation of speed-strength abilities. Speed-strength abilities are characterized by submaximal muscle tension, expressed with the required, often maximum, power in exercises performed at high speed but not at maximal load.[22-24]

When choosing the speed-strength direction in training, the task is to increase the strength of muscle contraction and the speed of movement. The main competitive exercises or their elements are used, alone or in combination, without weights or with light weights such as belts or vests, including running, jumping, moving against the wind or uphill, increasing step length, barrier distance, and obstacle height. The weight or resistance ranges from 80% to maximum, while the nature and pace of exercises vary from moderate (60%) to maximum intensityю[25-27]

To develop speed-strength abilities, all exercises can be divided into 3 groups:[28-30]

1. Exercises using one's own body weight: fast straight runs, quick sideways and backward movements, direction changes, jumps on two legs, alternating legs, one leg, depth, height, and distance jumps, as well as bends and torso turns performed at maximum speed.

2. Exercises performed with additional weights (belt, vest, cuff, weighted equipment). Running, jumping exercises, throwing and special exercises similar in form to competitive movements.

3. Exercises associated with overcoming environmental resistance (water, snow, wind, soft ground, running uphill).

Thus, despite some research, there is still no clear, scientifically based system of speed-strength training for children practicing karate. The search for more specific or new means and methods of speed-strength training can contribute to solving the problem of improving speed-strength training, especially during the sensitive period of training.

The purpose of the study is to increase the level of development of speed-strength abilities of boys aged 13-14 who do karate.

MATERIALS AND METHODS

The pedagogical experiment was conducted at the Karate Department of the Moscow Olympic Reserve Sports School. The study involved 68 boys aged 13-14. Classes in the karate section were held 3 times a week for 90 minutes.

On January 15, 2024, the initial testing of all study participants was conducted. The level of development of speed-strength abilities of athletes was determined by 3 tests:

1) Speed-strength qualities of the core muscles were assessed using sit-ups performed for 1 minute (torso exercise). The exercise is performed from the starting position lying on the back on a gymnastic mat, hands behind the head, fingers clasped, shoulder blades touching the mat, legs bent at the knees at the right angle, feet pressed to the floor by the partner. The participant performs the maximum number of torso lifts in 1 min, touching the elbows to the hips (knees), followed by returning to the starting position (Figure 1). The result is the number of times in 1 min.

Figure 1. Test for determining the speed-strength qualities of the core muscles

2) The speed-strength qualities of the leg muscles were assessed using a 3 × 10-meter shuttle run test. Two lines are drawn on the floor in the hall at the distance of 10 m from each other (start and finish lines). The coach was positioned at the finish line. At the command of the coach, the stopwatch is turned on, the participants take one ball (cube) each, which lies behind the start line, run to the finish line, put the balls on it, run to the start line, take the second ball each, run to the finish line. The stopwatch stops when the second ball touches the floor behind the finish line (Figure 2). The result was the number of seconds spent on completing the test.

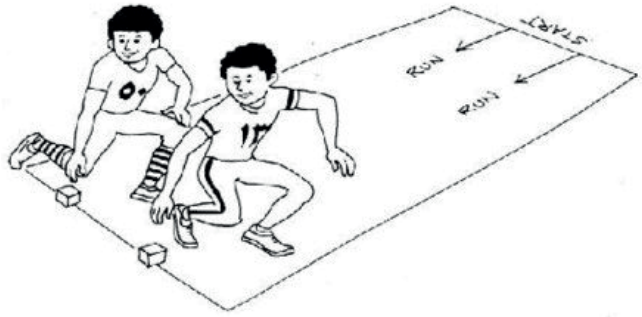

Figure 2. Test for determining the speed-strength qualities of the leg muscles

3) The speed-strength qualities of the arm muscles were assessed using a 1-minute push-up test (push-ups). Starting position: prone position; head, torso, legs form a straight line. Arm flexion is performed to the right angle at the elbow joint; extension - until the arms are fully straightened, while maintaining a straight line - head, torso, legs (Figure 3). The result was the number of repetitions completed in 1 minute.

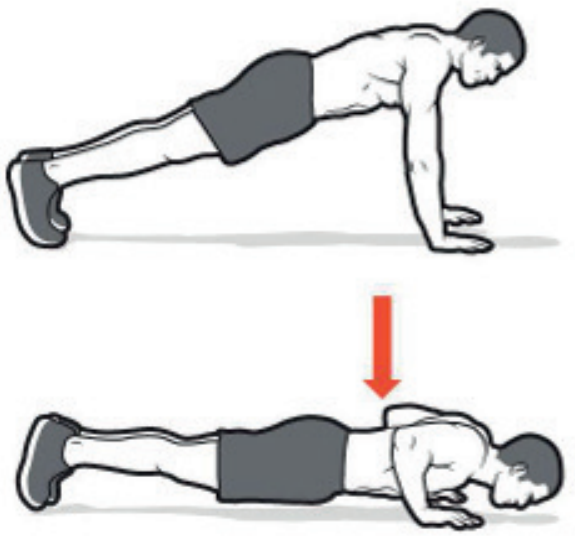

Figure 3. Test for determining the speed-strength qualities of arm muscles

Based on the test results, 2 groups (control and experimental) were formed, 34 people in each. The groups were formed so that the difference between the average indicators was not statistically significant. Both groups were engaged in a regular training program for children who do karate.

The difference between the groups in the training process was that after the warm-up, for 20 minutes, children in the control group performed general physical training exercises stated in the regular program. Exercises included striking with hands and feet, gymnastic stick routines, flexibility drills, repetitions of defensive and offensive techniques, games (such as rugby and handball), and sports relays. At this time, children from the experimental group used a specially developed set of physical exercises for 20 minutes after the warm-up, which was formed on the basis of the analysis of scientific and methodological literature. It should be noted that for the development of speed-strength training, the time at the beginning of the main part of the training session will be more effective, since applying such loads at the end of a session, when fatigue has set in, would be ineffective.

A set of physical exercises in experimental group №1:

1) punches on makiwara, 20-30 punches, 3-4 series, add 5-8 punches at each session, 1-minute rest between sets;

2) punches on a hanging boxing bag, straight punches, 4 series of 20 seconds, 40 seconds rest between sets;

3) exercise with a rubber expander, spreading straight arms to the sides, affecting the pectoral and deltoid muscles. Starting position: feet together, arms shoulder-width apart, raised to chin height. 1 – spread straight arms to the sides; 2 – return to the starting position, 4 sets of 5 reps, 1-minute rest between sets;

4) jumping out of a squat with a 2 kg barbell on the shoulders, 4 sets of 20 reps (1-minute rest between sets);

5) lifting the body to the legs from the supine position, legs bent at the right angle, 6 sets of 20 seconds, rest 20 seconds;

6) straight kick (mae-geri chudan) to the paw, moving forward 4 sets of 30 kicks, rest between sets 1 minute.

A set of physical exercises in the experimental group №2:

1) hip lifts with a weight of 0.5 kg, 4 sets of 15 seconds, 45 seconds rest between sets;

2) push-ups from the plank position on fists, a 2 kg weight on the back, 4 sets of 15 times, 45 seconds rest between sets;

3) work on a hanging bag 5 times for 1 minute, 30-45 seconds rest between rounds;

4) jumping from a squat 3 sets of 35 times, 1-minute rest between sets;

5) lifting the body to the legs from the supine position, legs bent, throwing a medicine ball with both hands from the chest (0.5 kg) to a partner 3 sets of 30 times, 50 seconds rest between sets;

6) kick (mawashe-geri chudan) on an air shield with forward movement: 4 sets of 30 kicks, 1-minute rest between sets.

These sets of physical exercises are examples, and their content may vary slightly depending on the athletes' training level.

On May 15, 2024, the repeated test was conducted, which determined the difference between the groups after the end of the pedagogical experiment.

Mathematical and statistical analysis of the research results was performed using Student's t-test.

RESULTS

Before the start of the pedagogical experiment, all children took baseline control tests. The groups were randomly assigned and were homogeneous in terms of training level. After processing the initial results, the control and experimental groups were formed so that there were no statistically significant differences in the test indicators (Table 1).

Table 1. Speed-strength qualities of children aged 13-14 before the start of the pedagogical experiment

Tests	Experimental group (n=34)	Control group (n=34)	p
Torso exercise	42,2±3,9	43,4±5,1	>0,05
Shuttle run	9,2±0,5	9,1±0,8	>0,05
Press-ups	19,5±2,2	19,8±4,2	>0,05

After the end of the pedagogical experiment, all children re-took the control tests (Table 2).

Table 2. Speed-strength qualities of children aged 13-14 After the pedagogical experiment, all children took the control tests again

Tests	Experimental group (n=34)	Control group (n=34)	p
Torso exercise	48,9±4,6	46,7±4,1	<0,05
Shuttle run	7,9±0,7	8,4±0,6	<0,05
Press-ups	25,3±4,3	21,7±3,9	<0,05

Table 2 shows that from the beginning to the end of the pedagogical experiment, the differences in speed-

strength indicators between the control and experimental groups became statistically significant in favor of the experimental group.

The increase in speed-strength indicators in each group from the beginning to the end of the pedagogical experiment in percentage is shown in Figure 4.

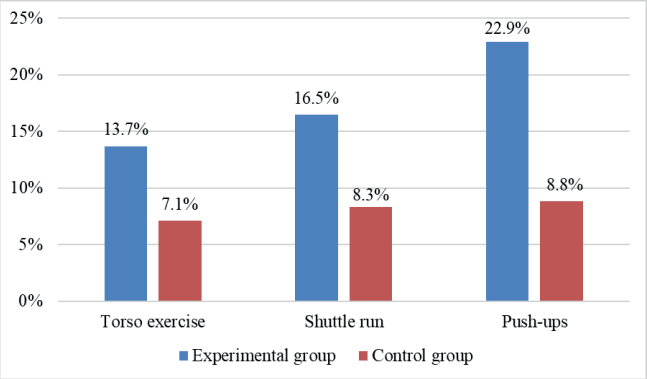

Figure 4. Increase in the indicators of speed-strength abilities of children in each group from the beginning to the end of the pedagogical experiment

Figure 4 shows that children from the control group were able to improve their speed-strength qualities from 7.1% to 8.8%, while children from the experimental group improved their indicators from 13.7% to 22.9%. These results indicate the effectiveness of using speed-strength exercise complexes in training 13–14-year-old children practicing karate.

DISCUSSION

The analysis of literary sources has shown that an effective sports training program at the initial stage largely determines the success of long-term athletic development. In karate, much attention should be paid to the development of speed-strength qualities, which are the most important component of the structure of the karateka's physical fitness due to the very high significance of their manifestation during competitive fights,[13,17,21] especially at the age of 13-14, since this age is favorable for the development of speed-strength qualities.[8-11] However, the targeted use of speed-strength exercises during the initial sports specialization stage in karateka's has not been sufficiently studied.

Several studies exist in this area, but most authors either overlook the sensitive periods for developing specific physical qualities or fail to provide a detailed description of training load components for full implementation of the experimental program.[2,5,7]

The scientific novelty of this study is that it offers sets of physical exercises that promote targeted development of speed-strength abilities of 13-14-year-old children practicing karate. Each physical exercise includes defined training load components.

The results obtained during the study should be compared with the control standards for 8th grade schoolchildren aged 13-14, which all schoolchildren complete annually (Table 3).

Table 3. Control standards of speed-strength abilities of schoolchildren aged 13-14 in a comprehensive school (grade 8)

Tests	Unit of measurement	Grade «5»	Grade «4»	Grade «3»
Torso exercise	number of times	48	43	38
Shuttle run	number of seconds	7,7	8,5	9,2
Press-ups	number of times	25	20	15

The analysis of Table 3 allows us to draw the following conclusions:

1. Although the young athletes in the control group, who followed the standard program, only slightly improved their speed-strength abilities, they achieved one grade higher in the school system in two of the three tests. The speed-strength abilities of the arm and leg muscles initially corresponded to grade "3", and by the end of the study had improved to grade "4". As for the test for the strength of the torso muscles, the school grade for its result did not change and remained at the level of "4".

2. Athletes from the experimental group not only significantly improved their speed-strength abilities but also raised their school grades in all tests. Initially, the level of all speed-strength indicators corresponded to the school grade "3", but after using special sets of physical exercises, the indicators of the torso and arm muscles improved to the grade "5", and the work of the leg muscles in the shuttle run test became higher and reached the grade "4".

The results of the study may be useful for sports therapists. For example, physical exercise complexes can be used for injury prevention or motor training of athletes. The proposed exercises can be modified and applied by physiotherapists to support motor development in the context of martial arts.

The training effect was achieved within four months, which is a fairly optimal option in comparison with other studies.[1-3]

Thus, the use of special sets of physical exercises in the training process of young athletes who do karate allows not only to improve speed-strength indicators, but also to increase the assessment score in physical education classes at school.

CONCLUSION

The boys in the experimental group, who did the exercise complexes the authors developed, significantly surpassed their peers in the control group, who were engaged in the usual training program in speed-strength abilities.

The proposed sets of physical exercises are effective and recommended for developing speed-strength abilities in 13–14-year-old boys practicing karate. It is recommended to perform the exercise complexes 3 times a week for 20 minutes. The use of the experimental set of physical exercises will not only enhance speed-strength indicators but also academic performance in physical education.

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Conflict of Interest: The author declares that there is no conflict of interest.

Ethical clearance: All procedures complied with the ethical standards of the Helsinki Declaration and were approved by the ethics committee of the local university. Informed consent was obtained from each parent. Students of the school could opt out of participating in the study at any time.

Author's contribution: GP: Data gathering and idea owner of this study, study design, data gathering, writing and submitting manuscript, editing and approval of final draft.

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