Journal of Physical Education and Sport ® (JPES), Vol. 22 (issue 10), Art 307, pp. 2406 - 2412, October 2022
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Speed abilities in Kyokushin karate at the stage of initial training in 9-10-year-old boys

ELENA ROMANOVA[1], MIKHAIL KOLOKOLTSEV[2], ANTON VOROZHEIKIN[3], GALINA PURTOVA[4], VITALY ZOTIN[5], TATIANA VRACHINSKAYA[6], SVETOSLAV GAROV[7], ATANAS SARANDEV[8], SERGEY AGANOV[9]
[1] Department of Physical Education, Altai State University, Barnaul, RUSSIA
[2] Department of Physical Culture, Irkutsk National Research Technical University, RUSSIA
[3] Department of Information Technologies, Kaliningrad Institute of Management, RUSSIA
[4] Department of Physical Culture, Siberian Federal University, Krasnoyarsk, RUSSIA
[5] Department of Physical Culture and Health, Reshetnev Siberian State University of Science and Technology, Krasnoyarsk, RUSSIA
[6] Institute of Education, Immanuel Kant Baltic Federal University, Kaliningrad, RUSSIA
[7] Department of Medical Pedagogy, Medical University - Sofia, BULGARIA
[8] Department of Bioethics, Medical University - Sofia, BULGARIA
[9] Department of Physical Training, GPS Emercom of Russia St. Petersburg University, RUSSIA

Published online: October 31, 2022
(Accepted for publication October 15, 2022)
DOI:10.7752/jpes.2022.10307

Abstract:
All elements of defense and attack in karate are performed with maximum speed and considerable force. Therefore, speed and speed-strength qualities development in an athlete is an important direction of the training process. *Purpose:* To develop and test a training program for improving the speed qualities of the initial stage of sports training in karate for 9-10-year-old boys. M*aterials and methods*. 22 boys aged 9-10 years of the second year of Kyokushin karate took part in the research project. In the control group, 11 children were engaged in the program of the federal standard of Russia in the sport "karate". The training process in the experimental group was carried out according to our proposed program for the development of speed abilities. The training provided for an increase in time and funds aimed at the development of speed and speed-strength qualities in general physical training, as well as the use of the method of circular training in the special physical training of karatekas. In both groups, a milestone testing of speed and speed-strength fitness was carried out, as well as an expert assessment of the technical qualities of athletes in the «kata» and «kumite» exercises. *Results.* At the end of the research project, the athletes of the experimental group found a significant improvement and increase in the values of test indicators of speed and speed-strength fitness. In special speed tests for martial artists, the expert assessment of technical readiness significantly increased ($p < 0.05$), compared with the results of testing athletes in the control group. *Conclusions.* The program we proposed showed its effectiveness in comparison with the traditional training program and can be used to develop high-speed qualities in other types of martial arts.
Key Words*:* **karate, physical training, speed qualities, speed-strength qualities**

Introduction

Karate, a new Olympic sport, refers to full-contact martial arts (Ioannides et al., 2019) and is divided into 2 exercises: «kata» (performed in a demonstration manner) and «kumite», when sparring is held between two athletes (Chaabène et al., 2019).

Scientists' studies have established the positive impact of karate classes on human health (Greco, & De Ronzi, 2020) and cognitive functions development (Alesi et al., 2014). The participants showed a decrease in aggressiveness and an improvement in their psycho-emotional state (Jansen et al., 2017; Chang et al., 2018). There is a decrease in the risk of being a victim of violence and bullying. After a 12-week training in «kata» techniques, the socio-emotional state and executive functioning of children with autism improves (Greco, & De Ronzi, 2020). The great popularity of karate classes in various countries of the world poses the task of sports experts to comprehensively study the peculiarities of designing a training process in children, adolescents and youth (Coppola et al., 2019), which should ensure the achievement of not only a high athletic result, but also the safety of training and performances (Teixeira et al., 2011). The latter is largely determined by the level of technical and tactical training of the athlete (Nugroho et al., 2021).

The data of scientific literature sources indicate that in all martial arts, a key role in the training process is given to the development and improvement of speed qualities, which makes it possible to more effectively increase an athlete's technical and tactical training level (Vorozheikin et al., 2020; Tyupa, & Vorozheikin, 2021).

Corresponding Author: ELENA ROMANOVA, E-mail: romanovaev.2007@mail.ru

According to Ioannides et al. (2020), the result of sports activity in karate depends on aerobic abilities and, especially, on the state of an athlete's explosive strength. In studies by Nowakowska et al. (2017); Suchomel et al. (2019), it was found that plyometric training increases the power, strength and explosive athletic abilities of the lower extremities of karate athletes, compared with traditional training. There is evidence of a positive use of functional strength training for the development of athletes' speed qualities (Fathir et al., 2021). The ability of the athlete's neuromuscular apparatus to perform muscle contraction in the shortest period of time is characterized as «explosive strength» (Maffiuletti et al., 2016). In a karate duel, all the attacking and defensive actions of an athlete are performed at maximum speed (Kavvoura et al., 2018), so explosive strength can be regarded as a sport success factor. Singh et al. (2021) found that a good result of the explosive strength development of the lower extremities muscles of schoolchildren aged 12-14 appears after their 6-week online training in vinyasa yoga, when the training regime was observed five days a week for 30 minutes.

As noted by Nugroho et al. (2021), physical qualities are the basis for the development of technique, tactics, strategy and psychology of a martial artist. Well-developed physical abilities prevent an athlete's fatigue, increase endurance, form optimism and confidence in victory (Fachrezzy et al., 2021). Therefore, athletes need to constantly pay attention to improving motor qualities in order to maintain good physical shape (Jariono et al., 2020). To develop speed abilities, a different number of means and methods of sports training are used, which are based on taking into account the athlete's functional and psycho-physiological characteristics. There are numerous software manuals, textbooks and recommendations for the development of this motor quality in various sports. The scientific literature does not fully cover the issues of development and improvement of the speed abilities of children aged 9-10 engaged in karate. This age is sensitive for the development of speed qualities. According to the observations of Kaya (2016), children at this age have the highest speed of visual-auditory motor reaction, which is favorable for the development and improvement of speed qualities. According to the author, the greatest speed at this age is observed in boys, compared with girls.

When planning the educational process in karate according to the traditional program, coaches have difficulties in determining the orientation of the training vector. Often, accents in the formation of physical or technical and tactical training are done intuitively and not always correctly, which reduces the effectiveness of the training process. We believe that our research project will expand the methodology for the development and improvement of speed qualities in boys aged 9-10 engaged in karate and improve the results of tactical and tactical training of young athletes for competitive activities.

Purpose is to develop and test a training program for improving the speed qualities of boys aged 9-10 in the second year of the initial stage of sports training in karate.

Material & methods

The research project was carried out in the 2021-2022 academic year in the Siberian Federal District (Russia) on the sports base of a secondary school. A control group (CG) and an experimental group (EG) of 11 boys aged 9-10 who were engaged in the second year of Kyokushin kaikan karate at the stage of initial sports training were formed by random sampling. The parents gave their written consent to the examination of the children. The principles and rules of the organization of biomedical research, which are reflected in the documents of the Helsinki Declaration (2003), have not been violated. In both groups of children, training lessons were held 4 times a week for 120 minutes (the Federal Standard of sports training in the sport of karate, 2017), according to the sections «kata» and «kumite». According to the program proposed by us, the time and means aimed at improving the speed qualities in general physical training and the circular training method use at four stations in special physical training of karate are increasing. The working time at each station was 2 minutes, followed by a rest of 2 minutes; then another set of training was repeated using the circular method.

Table 1. Circular training method use for improving young karate athletes' speed qualities

Focus of training	Stations			
	I	II	III	IV
Speed qualities	Impact exercises using sports shells			
Defense reaction		Performing slippings and drop-aways during a partner's attack		
Movement speed in a stance			Movements repetition after a partner	
Speed and strength training («explosive strength»)				Performing makiwara strikes in pairs with maximum speed and strength, in series of 10 seconds

The orientation of the training load was a complex of special preparatory means (75%) and general preparatory ones (25%). Gymnastic and acrobatic exercises, elements of athletics and outdoor games were used to develop the boys' basic physical qualities. Among all the general training facilities, 2/3 was occupied by games according to simplified rules (rugby, basketball and football).

Visual motor stimuli predominate in karate sports activities. Therefore, to develop the athletes' speed capabilities, exercises performed with a partner were used. The main tactical options for carrying out retaliatory actions were: advancing and counterattack, counterattack and retaliatory attack. We used sets of physical exercises to develop the speed abilities of karate («shadow fight», «jumping rope», «tornado», performing accelerations while running and other exercises). The assessment of the young karate athletes' from CG and EG speed capabilities was carried out according to the results of the high-stakes testing of physical, technical and tactical readiness. To assess the level of physical fitness of young karate athletes, tests were used, Table 2. The program of our research included special tests for contact martial arts and «shock» tests: the number of kicks and blows on makiwara in 5, 15 seconds and 3 minutes, Table 3. The technical readiness of young karate athletes was evaluated by experts of the Kyokushin Kaikan Karate Federation on a five-point system according to the results of two exercises: «kata» and «kumite».

Generally accepted statistical methods of processing data obtained using the STATISTICA 10.0 application software package were used. The differences were statistically significant at $p < 0.05$.

Results

The high-stakes testing results of the speed indicators of CG and EG karate athletes are presented in Table 2.

Table 2. High-stakes testing results of the athletes' speed qualities (M±m)

Tests		CG (n=11)		EG (n=11)	
		At the beginning of the experiment	At the end of the experiment	At the beginning of the experiment	At the end of the experiment
Speed qualities					
1. Run 30 m, s		5.32±0.04	5.27±0.05	5.29±0.04	5.05±0.02*
2. Shuttle run 3x10 m, s		13.35±0.45	13.06±0.59	13.25±0.38	11.66±0.36*
Speed-strength qualities					
3. Standing long jump, cm		169.30±6.53	173.50±8.82	170.30±5.23	184.2±7.43*
4. Modified pull-up for 20 s, number of times		7.73±0.19	8.25±0.25*	8.15±0.25	9.63±0.24*
Flexion-extension, the number of times in 20 s	5.Push-ups	14.25±1.35	14.96±1.95	13.50±1.44	16.66±1.21*
	6.Abdominal crunch	10.50±1.77	11.07±1.02	10.15±1.55	13.23±1.30*

Note.* significant difference in the test indicators values after the experiment ($p< 0.05$)

At the beginning of the research project, the young karate athletes' level of speed qualities development in CG and EG was approximately the same, $p > 0.05$. At the end of the research, an increase in the values of the indicators of speed and speed-strength training of boys SP and UP was established. Significantly increased values of indicators in all tests were shown only in EG athletes, $p < 0.05$. In CG, the value of the indicator significantly increased only in one test, «Modified pull-up». In all tests, the increase in the values of speed and speed-strength qualities was higher in EG athletes, compared with the increase in the same indicators in CG boys, Figure 1.

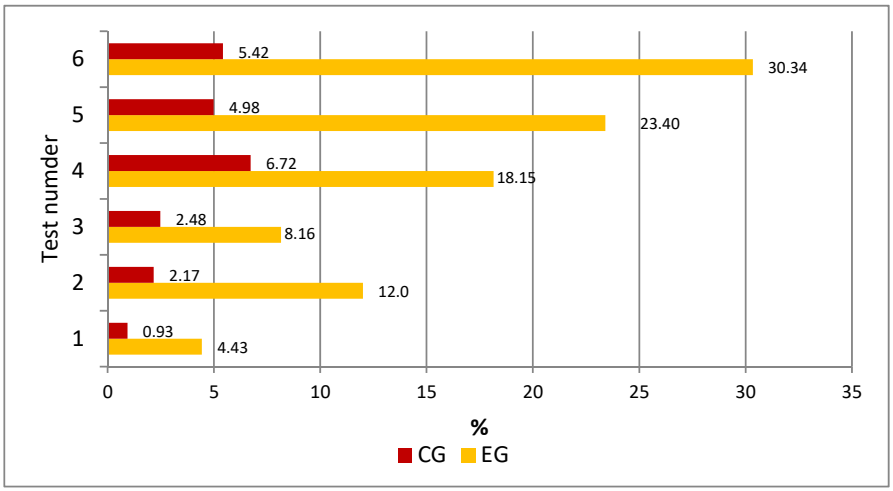

Fig. 1. The increase in the indicators values of speed and speed-strength tests by the end of the research project

The greatest increase in the indicators values was noted in EG athletes in tests No. 5 («Push-ups») and No. 6 («Abdominal crunch»), which were 5.5 and 4.7 times greater, respectively, than in CG athletes. After the experiment, an improvement in the values of the boys' special speed qualities indicators was found in both groups, Table 3.

Table 3. The high-stakes indicators values of the karate athletes' special speed and speed-strength training (M±m)

Control exercises		CG (n=11)		EG (n=11)	
		At the beginning of the experiment	At the end of the experiment	At the beginning of the experiment	At the end of the experiment
1.Tap test (the frequency of hand movements in 10 seconds, the number of times)		58.7±2.6	59.4±2.7	61.5±2.4	62.4±2.9
2.Motor reaction to a falling object, m\s		2.03±0.03	1.8±0.02	2.1±0.04	2.0±0.02*
Number of strikes on makiwara					
Blows	3. For 5 seconds	18.6±1.1	19.0±1.3	17.9±1.3	21.3±1.4*
	4. For 15 seconds	55.5±4.5	59.6±4.3	55.3±4.5	70.6±5.5*
	5. For 3 minutes	**433.3±23.0**	**458.7±23.1**	428.0±22.1	506.3±25.6*
Kicks	6. For 15 seconds	22.6±2.7	23.6±2.3	22.4±2.4	27.4±2.5*
	7. For 3 minutes	224.6±9.5	228.7±10.4	223.3±9.3	258.9±11.2*

Note.* significant difference in the test indicators values after the experiment ($p < 0.05$)

Carrying out the training process according to the experimental program for the development of speed qualities proposed by us allowed significantly improving the indicators values of special speed readiness of EG boys in 6 out of 7 tests, $p < 0.05$.

There were no significant improvements in the values of speed test indicators in CG athletes, $p > 0.05$. The increase in the values of the indicators of special speed training in athletes of the EG turned out to be greater than in CG ones, Figure 2.

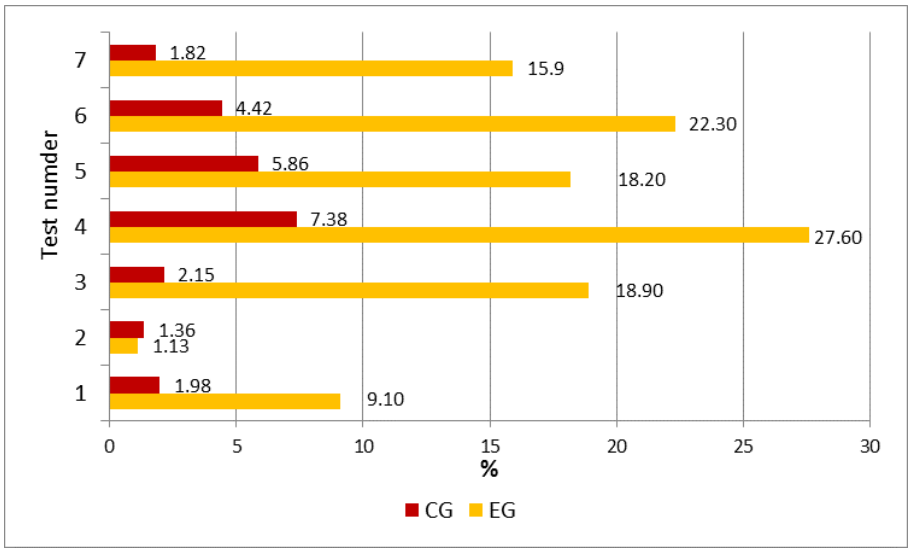

Fig. 2. The increase in the indicators values of special speed and speed-strength tests by the end of the research project

The greatest increase in the indicators values was noted in EG athletes in tests No. 4 (the number of blows on makiwara in 15 seconds) and No. 6 (the number of kicks on makiwara in 15 seconds), which were 3.7 and 5.0 times higher, respectively, than in CG ones.

The results of the expert assessment of the experiment participants' technical readiness when performing the control exercises «kata» and «kumite» are shown in Figure 3.

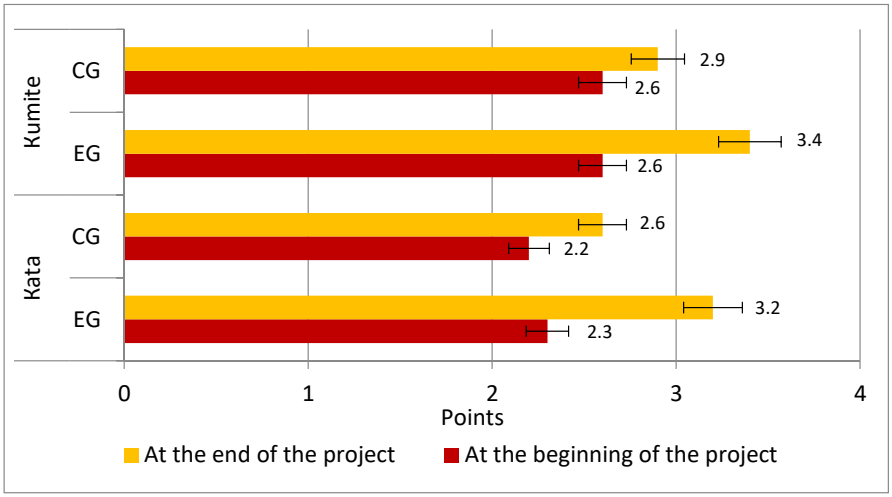

Fig. 3. High-stakes assessment of the level of mastery in «Kata» and «Kumite» technique by the athletes

Technical readiness of the boys in both groups at the beginning of the project was about the same. At the end of the research project, CG boys had an increase in the assessment of performing «kata» technique from 2.2±0.3 to 2.6±0.4 points (18.2%), $p > 0.05$. EG boys showed a significant improvement in the assessment of technical readiness in «kata» from 2.3±0.2 points to 3.2± 0.4 points (39.1%), $p < 0.05$. At the end of the experimental macrocycle, athletes in CG had an increase in technical readiness assessment in «kumite» of 11.5% (from 2.6±0.3 to 2.9± 0.3 points), $p > 0.05$. In EG, a significant increase in the evaluation of performing «kumite» technique was established by 30.7% (from 2.6 ± 0.3 to 3.4± 0.4 points), $p < 0.05$.

Dicussion

The need to develop speed capabilities in karate comes from the peculiarities of this sport, where this quality is the main factor in ensuring success in a duel (Kavvoura et al., 2018). Therefore, the development of new and optimization of existing training programs for improving young karate athletes' speed and speed-strength qualities is an urgent and timely scientific theme for the sports community.

According to experts in the field of sports, a person's speed abilities are difficult to develop. This is due to the fact that the manifestation of speed qualities depends on the state of the central nervous system and the neuromuscular apparatus, on the ratio of fast and slow fibers, muscle strength, energy reserves in the muscle, on the degree of mobility in the joints, coordination abilities during high-speed work, a person's age and gender, genetic makings for high-speed qualities (Felice Di Domenico, & Tiziana D'isanto, 2019).

In recent years, innovative methods have been proposed for this motor quality development in adult karate athletes (Nowakowska et al., 2017; Suchomel et al., 2019; Ioannides et al., 2020). For young karate athletes, the issues of improving speed qualities have not been fully studied.

The program of karate players' aged 9-10 speed and speed-strength qualities development and improvement proposed by us provides for an increase in time and means aimed at developing speed and speed-strength qualities in general physical training and using the circular training method in special physical training of karate athletes. Taking into account the athletes' children age, a significant share in the means of developing speed qualities was given to the game method, which showed high efficiency for the development of speed by other authors (Singh et al., 2021).

At the end of our research project, a significant increase and growth in the values of all indicators of testing speed and speed-strength training in children in the experimental group was established, compared with the results of athletes of the control one who were engaged in traditional training methods. The athletes of the experimental group significantly increased the indicators of special speed and speed-strength fitness, which is consistent with the conclusions of Kaya (2016) about the most favorable development of speed qualities in children, aged 9-10. Training according to our proposed program increased the athletes' speed and rapidity while striking with their arms and feet from various positions, which confirms the conclusions of Ioannides et al. (2020). The authors believe that all offensive and defensive actions in «kumite» should be performed with maximum speed and strength, so it is important to develop these qualities in athletes. In our project, an increase in the level of the EG athletes' speed abilities led to an improvement in their technical qualities in the exercises «kata» and «kumite». The technique improvement in martial arts as a result of an increase in physical qualities is noted by Fachrezzy et al. (2021), which is consistent with our data.

The Kyokushin kaikan karate program, proposed by us for boys' aged 9-10 speed abilities development at the stage of initial sports training allowed increasing the effectiveness of the training process, the level of speed and technical readiness of the EG athletes, compared with the traditional training program in karate.

Conclusions

Increasing the level of speed and speed-strength abilities development of athletes in karate is a key task of the educational and training process in this sport. We have proposed and tested a training program to improve the speed and speed-strength abilities of children aged 9-10 at the stage of initial training. To do this, the time was increased and the arsenal of general physical training tools was expanded, the method of circular training was used in special physical training of young athletes.

At the end of our research, it was found that the children of the experimental group significantly increased the indicators values of speed and speed-strength fitness. The number of blows and kicks on makiwara in 15 seconds increased by 3.7 and 5.0 times, respectively, the expert assessment of the technical qualities of performing the exercises «kata» became 2.1 times more, «kumite» 2.7 times more than the athletes of the control group, where the training process was carried out according to the traditional method.

We believe that the program we have proposed is effective and it can be used to develop the speed qualities and technical readiness of athletes in other types of martial arts.

Conflicts of interest. The authors declare no conflict of interest.

References:

Alesi, M., Bianco, A., Padulo, J., Vella, F. P., Petrucci, M., Paoli, A., Palma, A., & Pepi, A. (2014). Motor and cognitive development: the role of karate. *Muscles Ligaments Tendons J.,* 4(2), 114-120. DOI:10.11138/MLTJ/2014.4.2.114

Chaabène, H., Negra, Y., Capranica, L., Prieske, O., Granacher, U., (2019). A needs analysis of karate kumite with recommendations for performance testing and training. *Strength and Conditioning Journal*, 41(3), 35-46. DOI: 10.1519/SSC.0000000000000445

Chang, Y. C., Yeh, T. M., Pai, F. Y., & Huang, T. P. (2018). Sport Activity for Health!! The Effects of Karate Participants' Involvement, Perceived Value, and Leisure Benefits on Recommendation Intention. *International journal of environmental research and public health, 15(5), 953. Cohen, J. (1992). A power primer. Psychological bulletin*, 112(1), 155-159.

Coppola, S., Montemarano, L., Albano, D., Vastola, R. (2019). Potential of motion analysis technologies in the quantitative study of karate technique: an experimental approach for the jump of Unsu Kata. *Journal of Physical Education and Sport,* Vol 19 (Supplement issue 3), Art 121, pp 841 - 846, 2019. DOI:10.7752/jpes.2019.s3121

Fachrezzy, F., Maslikah, U., Safadilla, E., Reginald, R., & Hendarto, S. (2021). Physical fitness of the poomsae taekwondo athletes in terms of agility, balance and endurance. *Kinestetik : Jurnal Ilmiah Pendidikan Jasmani,* 5(1), 111-119. DOI: 10.33369/jk.v5i1.14364

Fathir, L. W., Hartanto, S., & Kusnanik, N. W. (2021). Strength, endurance and speed development using functional strength training (FST) program for recreational runners performance. *Journal of Physical Education and Sport*, Vol 21 (Suppl. issue 4), Art 330, pp. 2453 – 2457, DOI:10.7752/jpes.2021.s4330

Federal standard for sports training in the sport «Karate» (2018). *Approved by order of the Ministry of Sports of Russia.* Dated September 20, N 813 (in Russian)

Felice Di Domenico, & Tiziana D'isanto (2019). Role of speed and agility in the effectiveness of motor performance. *Journal of Physical Education and Sport*, Vol.19 (Supplement issue 5), Art 271, pp. 1836-1842. DOI:10.7752/jpes.2019.s5271.

Greco, G., & Roberto De Ronzi (2020). Effect of Karate training on social, emotional, and executive functioning in children with autism spectrum disorder. *Journal of Physical Education and Sport*, Vol.20 (4), Art 223, pp. 1637-1645. DOI:10.7752/jpes.2020.04223

Ioannides, C., Apostolidis, A., Hadjicharalambous, M., & Zaras, N. (2020). Effect of a 6-week plyometric training on power, muscle strength, and rate of force development in young competitive karate athletes. *Journal of Physical Education and Sport*, Vol.20 (4), Art 236 pp. 1740 - 1746, DOI:10.7752/jpes.2020.04236

Jansen, P., Dahmen-Zimmer, K., Kudielka, B. M., & Schulz, A. (2017). Effects of karate training versus mindfulness training on emotional well-being and cognitive performance in later life. *Research on aging*, 39(10), 1118-1144. DOI: 10.1177/0164027516669987

Jariono, G., Nursubekti, N., Indarto, P., Hendarto, S., Nugroho, H., & Fachrezy, F. (2020). Analisis kondisi fisik menggunakan software Kinovea pada atlet taekwondo Dojang Mahameru Surakarta. *Transformasi: Jurnal Pengabdian Masyarakat.* DOI:10.20414/transformasi.v16i2.2635

Kavvoura, A., Zaras, N., Stasinaki, A-N., Arnaoutis, G., Methenitis, S., & Terzis, G. (2018). The importance of lean body mass for the rate of force development in taekwondo athletes and track and field throwers. *J Funct Morphol Kinesiol*, 3, 43. DOI:10.3390/jfmk3030043

Kaya, M. (2016). Effect of Reaction Developing Training On Audio-Visual Feet Reaction Time.

Maffiuletti, N., Aagaard, P., Blazevich, A., Folland, J., Tillin, N., Duchateau, J. (2016). Rate of force development: Physiological and methodological considerations. *European journal of Applied Physiology*, 116, 1091-1116. DOI:10.1007/s00421-016-3346-6

Nowakowska, M., Zatoń, M., & Wierzbicka-Damska, I. (2017). Effects of plyometric training on lower and upper extremity power in karate practitioners. *Journal of Combat Sports and Martial Arts*, 2(8), 89-93

Nugroho, H., Gontara, S. Y., Angga, P. D., Jariono, G., & Maghribi, I. L. (2021). Quality of physical condition of youth pencak silat athletes reviewed from speed, power, and strength. *Kinestetik: Jurnal Ilmiah Pendidikan Jasmani,* 5 (1), 154–*162.* DOI:10.33369/JK.V5I1.14376

Singh, V., Acharya, J., & Bhutia, T. N. (2021). Effect of 6 weeks of online vinyasa training on explosive leg strength of school children during COVID-19 – A pilot study. *Journal of Physical Education and Sport*, Vol 21 (Suppl. issue 4), Art 304, pp. 2276 – 2282. DOI:10.7752/jpes.2021.s4304

Suchomel, T., Wagle, J.P., Douglas J., Taber, C.B., Harden, M., Haff, G., & Stone, M. (2019). Implementing Eccentric Resistance Training-Part 1: A Brief Review of Existing Methods*. Journal of Functional Morphology and Kinesiology,* 4, 38. DOI:10.3390/jfmk4020038

Teixeira, L.A., De Oliveira, D.L., Romano, R.G., & Correa, S.C. (2011). Leg preference and interlateral asymmetry of balance stability in soccer players. *Res Q Exerc Sport*, 82 (1), 21-7

Tyupa, P., & Vorozheikin, A. (2021). Substantiation of the need to develop a methodology for the formation of an individual manner of conducting a competitive combat among athletes in hand-to-hand combat. *Health, Physical Culture and Sports*, 23(3), 49-56. DOI:10.14258/zosh(2021)3.07. Retrieved from http://hpcas.ru/article/view/10467

Vorozheikin, A. V., Тарасов, A. B., & Volkov, A. P. (2020). Analysis of the level of physical development and physical fitness of girls at the stage of initial training in the sport of hand-to-hand combat. *Health, Physical Culture and Sports*, 20(4), 92-110. DOI:10.14258/zosh(2020)4.12