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Effects of Karate Training on Basic Motor Abilities of Primary School Children

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Abstract

This study determined the relation between karate training and five specific motor abilities of primary school children with no previous karate experience. The motor abilities were tested before, at the end of, and one month after the intervention phase, during which subjects practiced karate dance or 5 minutes daily. Preliminary results showed that karate training improved children's performance in the long jump and 4 × 5 m shuttle run, but that the improvements waned one month after the intervention. Bivariate correlations showed that most of the motor ability tests correlated with each other, which was confirmed in linear regression models with medicine ball throwing as the outcome and body weight, 4 × 5 m shuttle run, and long jump as significant predictors. Factor analysis extracted a single latent factor from all five motor ability tests. In conclusion, karate training contributes to motor ability improvements among primary school karate beginners.

Keywords

Karate Training, Motor Abilities, Physical Activity, School Children

1. Introduction

Karate consists of kihon, kata, and kumite training. Kihon involves basic techniques, whereas kata and kumite are two types of competition. Kata best symbolizes the original tradition and principles of karate (Funakoshi, 1995), with more than 20 types of attack and defense technique used based on personal experience watching performances of kata. Kumite, by contrast, is a match between two opponents in which one symbolically destroys the other with technique and strategy. The discipline is complex and requires considerable physical and mental resources. It usually takes hard, long-term training to automatize and efficiently apply all the techniques (Katić, Blazević, Krstulović, & Mulić, 2005). However, early in the sport's career, the aim is to acquaint learners with a range of basic techniques and upgrade gradually to higher belt levels. Karate can have a significant impact on athlete development, improving the structure of psychosomatic status and anthropometric and motor dimensions (Žarko, Branimir, Vesela, Marko, & Nedeljko, 2013).

The fitness characteristics of an athlete are determined by endurance, flexibility, cardiorespiratory function, body composition, and muscular strength, whereas skill-related characteristics include agility, speed, power balance, coordination, and reaction time. In karate, being above average in some of these abilities is strongly associated with high quality performance, given that both reaction time and predicting and avoiding opponent attacks are vital for top results (Mori, Ohtani, & Imanaka, 2002). Specific motor abilities are crucial for success in many sports. Conditioned reflexes are acquired through unique training in movements adapted for competition on the foundation of basic motor abilities (Kahrović, Nurkic, Bratic, Jovanovic, & Radenkovic, 2014). In a study that investigated the influence of motor behavior on karate kata performance, it was found that 30 seconds of sit-ups, standing broad jump, 20-m run, and three other motor ability test results had the greatest and most significant influence on kata performance (Doder, Malacko, Stanković, & Doder, 2013). Mikić, Mehinović, and Shala (2009) reported a canonical correlation between basic motor abilities and karate competitor efficacy; more specifically, competition efficacy depends largely on the movement speed of arms and legs, the segmented speed of the arms, and the explosive strength of the lower extremities.

Between the ages of 3 and 7 years, children develop fundamental motor skills that enable them to move through space (Gallahue & Donnely, 2003) and react to external stimuli (Krebs, 2000). Among young karatekas, training influences motor skills such as flexibility, muscle strength, and balance (Violan, Small, Zetaruk, & Micheli, 1997). Preadolescent karatekas showed a significant improvement in static body balance after high intensity karate training lasting one week (Vando et al., 2013). However, the relationship between karate training and fundamental motor skills in primary school children is not explored. Therefore, the current study examined whether a significant relationship exists and investigated its duration; this also shed light on the intrinsic interactive characteristics of several motor ability tests.

2. Method

2.1. Trial Design

The study assessed the effect of karate training on a convenience sample of primary school students. No control group was involved.

2.2. Participants

The study subjects were primary three to primary five students (aged 8 - 12) from a primary school. Students with a medical history of heart disease or with previous karate experience were excluded. Ethical approval was provided by the Human Research Ethics Committee of the Education University of Hong Kong.

Consent forms were collected from both students' parents and the school.

2.3. Interventions

The intervention involved ten sessions. A 90-minute lecture on physical activity was given in each session. Study subjects practiced karate dance for 5 minutes daily after the first lecture in March until the last lecture in May.

2.4. Instruments

In addition to the anthropometric characteristics of the study subjects (weight and height), five motor fitness measurements were taken, according to a modified version of the European Physical Fitness Test (Nowak, 1994; Osiński, 2000), the International Physical Fitness Test (Pilicz, 2005), and the Sekita Test (Mamola, 2005; Nowak, 1994). These measurements were medicine ball throw, long jump, 4 × 5 m shuttle run, crossed-arm sit-ups, and sit and reach. All seven assessments were applied three times: before the intervention (between January and February, 2015), immediately after the intervention (in June), and one month after the intervention (in July).

2.5. Sample Size and Description

A total of 51 primary school students were recruited. This sample size was determined by the capacity of the research team, the availability of the students, and the statistical test chosen. All but one of the sessions had attendances higher than 50%. All subjects attended the baseline assessment, but only 46 remained in the post intervention and sustainability assessments. At the time of admission, the mean age was 8.8 years with a standard deviation of 1.0 (Table 1), and the mean height and weight were 137.6 cm and 34.6 kg with standard deviations of 9.8 cm and 11.0 kg, respectively. For the motor fitness measurements, medicine ball throwing was conducted three times at each assessment and the calculated mean taken as the final measurement; the same was done for long jump (three times) and sit and reach (two times).

2.6. Statistical Method

Paired *t* tests were performed to assess differences before and after the interven-

Table 1. Preintervention measurements.

	mean	sd
Age (y)	8.8	1.0
Height (cm)	137.6	9.8
Weight (kg)	34.6	11.0
Mean Medicine Ball Throwing (cm)	255.4	62.5
Mean Long Jump (cm)	102.7	21.1
Mean Sit and Reach (cm)	27.1	6.6
Sit-ups (time/30-sec)	15.8	4.2
4 × 5 m Shuttle Run (s)	8.6	0.7

tion, and also between the postintervention and sustainability tests. Linear regression models were fitted with the data. Factor analysis was conducted using the principal component analysis factor extraction method to identify latent factors in the five motor ability tests. All statistical tests were performed in SPSS (version 22.0, SPSS Inc., Chicago, IL, USA).

3. Results

The aggregated means and standard deviations for all measurements are given in Table 1.

At intervention completion, paired differences between preintervention and postintervention were observed (Table 2). Long jump in postintervention was 14.2 cm longer than that in preintervention, and 4 × 5 m shuttle run was 0.6 s faster, both measurements significant at the 0.05 level.

One month after intervention completion, the sustainability test was conducted and paired differences with postintervention were observed (Table 3). Long jump in the sustainability test was 6.6 cm shorter than that in postintervention, reaching nominal statistical significance. Sit-ups were 0.9 times/30-s faster than than that in postintervention (marginally significant), and the 4 × 5 m shuttle run was significantly longer (0.7 s).

Table 2. Paired samples test before and after intervention.

	Paired Differences				
			95% Confidence Interval of the Difference		
	Mean	*SD*	*Lower*	*Upper*	*p-value*[1]
Mean MBT[a] (cm)	3.8	38.0	−7.5	15.1	0.501
Mean LJ[b] (cm)	14.2	13.5	10.2	18.3	<0.001***
Mean SnR[c] (cm)	−0.3	3.8	−1.4	0.9	0.661
Sit-ups (times/30-sec)	0.04	2.8	−0.8	0.9	0.918
4 × 5 m Shuttle Run (s)	−0.6	0.8	−0.8	−0.4	<0.001***

[a]Medicine Ball Throwing, [b]Long Jump, [c]Sit and Reach[1] Paired t test used to determine p-values $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Table 3. Paired samples test between postintervention and sustainability test.

	Paired Differences				
			95% Confidence Interval of the Difference		
	Mean	*SD*	*Lower*	*Upper*	*p-value*[1]
Mean MBT[a] (cm)	4.0	34.1	−6.5	14.5	0.447
Mean LJ[b] (cm)	−6.6	13.1	−10.6	2.6	0.002**
Mean SnR[c] (cm)	−0.02	3.1	−1.0	0.9	0.965
Sit-ups (times/30-sec)	0.9	2.7	0.02	1.7	0.046*
4 × 5 m Shuttle Run (s)	0.7	1.0	0.4	1.0	<0.001***

[a]Medicine Ball Throwing, [b]Long Jump, [c]Sit and Reach[1] Paired t test used to determine p-values $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

To investigate the relationships between measurements, the bivariate intercorrelations are shown in Table 4. Medicine ball throwing was associated with most other measurements, as was mean long jump. The overall scatter plot (Figure 1) showed a strong linear relation between the 4 × 5 m shuttle run and long jump and between height and weight. Scatter plots stratified by sex showed that in addition to the 4 × 5 m shuttle run and long jump, another linear relationship was present between medicine ball throwing and long jump among girls (Figure 2).

Factor analysis of the five motor ability tests revealed a single factor (extracted on the basis of the scree plot in Figure 3) which explained 47% of the variance. Table 5 shows the factor loadings.

Two linear regression models were fitted with data. The overall regression model with Mean Medicine Ball Throwing as the outcome variable had an adjusted R square of 0.576 (Table 6). Bigger weight, longer time for 4 × 5 m Shuttle Run and longer Mean Long Jump were significantly associated with longer Mean Medicine Ball Throwing.

The regression model for girls with long jump distance as the outcome variable had an adjusted R squared of 0.716 (Table 7). Shorter times for 4 × 5 m shuttle run are positively associated with longer long jump distances with a nominal statistical significance.

4. Discussion

Our results indicate that the ten lecture sessions and 5 minutes of daily karate dance practice had an impact on primary school children's motor abilities, particularly for long jump and the 4 × 5 m shuttle run, in which subjects' per-

Table 4. Intercorrelations between measurements.

	Height	Weight	Sit-ups	4 × 5 SR[d]	MBT[a]	LJ[b]	SnR[c]
Age	0.41**	0.26	0.25	−0.15	0.48***	0.30*	0.12
Height	-	0.69***	0.10	−0.27	0.57***	0.17	0.06
Weight		-	−0.11	−0.01	0.52***	−0.28*	−0.05
Sit-ups			-	−.32*	0.34*	0.48***	0.24
4 × 5 SR				-	−0.16	−0.62***	−0.13
MBT					-	0.34*	0.30*
LJ						-	0.32*

[a]Medicine Ball Throwing, [b]Long Jump, [c]Sit and Reach[1d] Shuttle Run. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Table 5. Factor analysis results.

	Component
Mean Long Jump (cm)	0.849
Sit-up (times/30-sec)	0.716
4 × 5 m Shuttle Run (s)	−0.685
Mean Medicine Ball Throwing (cm)	0.595
Mean Sit and Reach (cm)	0.529

Table 6. Overall linear regression model with medicine ball throwing as the outcome.

	Coefficients	Std.Error	t	*p*-value
(Constant)	−404.67	156.38	−2.59	0.013*
Age	7.26	6.60	1.10	0.277
Height	0.45	0.94	0.48	0.637
Weight	3.45	0.88	3.94	<0.001***
Sit-ups	2.62	1.58	1.66	0.105
4 × 5 m Shuttle Run	22.14	10.68	2.07	0.044*
Mean Long Jump	1.45	0.46	3.12	0.003**
Mean Sit and Reach	1.31	0.93	1.41	0.166

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table 7. Linear Regression model for girls with long jump as outcome.

	Coefficients	Std.Error	t	*p*-value
(Constant)	169.47	87.26	1.94	0.069
Age	4.82	3.36	1.43	0.170
Height	−0.31	0.57	−0.54	0.595
Weight	−0.31	0.52	−0.61	0.553
Sit-ups	0.39	0.69	0.56	0.581
4 × 5 m Shuttle Run	−13.81	4.54	−3.04	0.007**
Mean Medicine Ball Throwing	0.14	0.08	1.79	0.092
Mean Sit and Reach	0.63	0.44	1.41	0.177

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

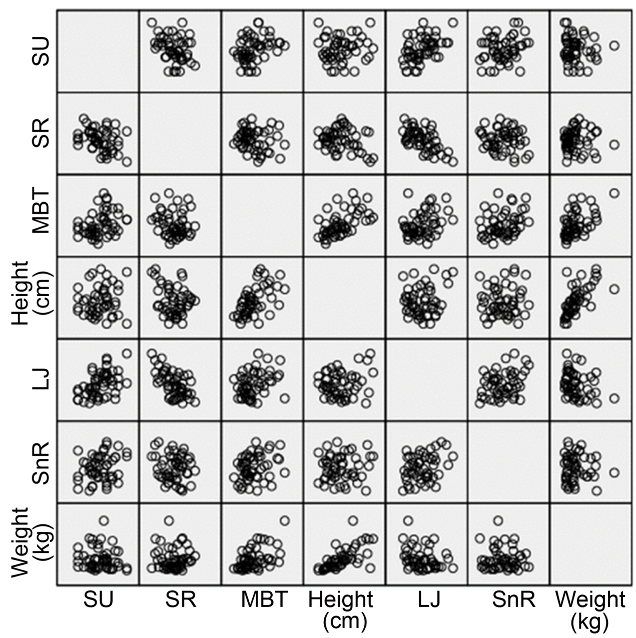

Figure 1. Overall scatter plot.

formance significantly improved at intervention completion. However, the effects

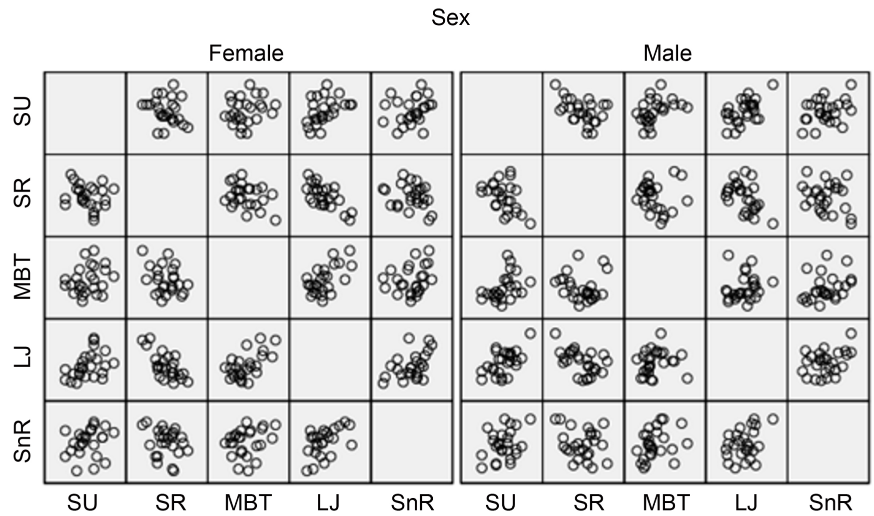

Figure 2. Scatter plots stratified by sex.

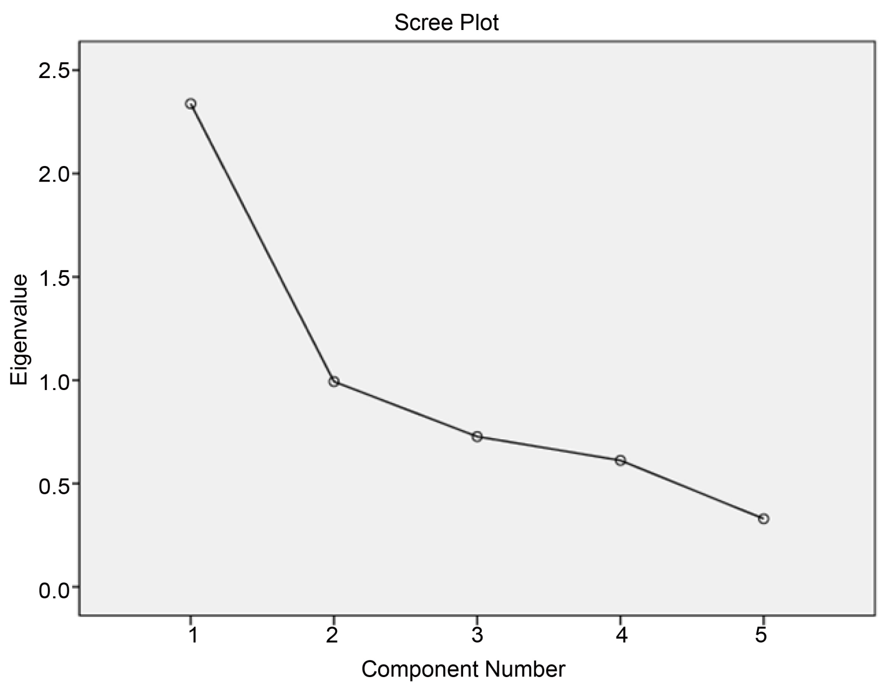

Figure 3. Scree plot of factor analysis.

may wane over time; our sustainability test results showed that both long jump and 4 × 5 m shuttle run performance relapsed one month after the end of the intervention phase. Among the few studies which investigated the relations between fundamental motor skills and specific karate technique, Božanić and Bešlija (2010) found karate skills to be significantly positively correlated with fundamental motor skills, and concluded that specific karate skills (or the specialized skills of other sports) might be a combination of those fundamental motor skills applied in a certain sport discipline. Our study not only corroborates theirs but also reveals that practicing karate skills is associated with improved fundamental motor skills. Another study confirmed that karate practitioners with different competition orientations varied in specific motor tests (Kahrović et al., 2014), suggesting that the competition disciplines reflect different technical bases; thus, karate training with a mix of orientations might produce improvements in multiple motor ability sets. Multiple regression analysis showed that a specific karate technique (dzakusuki) is significantly connected with a system of basic motor variables that measure three specific motor spaces of karate: rhythmic structure, frequency of segmented movements, and explosive power (Žarko et al., 2013). A classic canonical correlation analysis also revealed a significant linear combination between 11 motor ability tests and efficiency in karate cadets (Jukić & Čavala, 2013). Higher quality female karate athletes aged 14 - 16 possess higher technical efficiency and higher basic and specific motor efficiency (Jukić & Čavala, 2013). Among 9-year-old children, karate training also leads to physiological and psychological gains, with the children showing improved outcomes in reaction time, explosive leg strength, and coordination, in addition to better working memory, visual selective attention, and executive functions (Alesi et al., 2014).

In the current study, it reveals that most of the five motor ability tests are correlated, which is also observable in the scatter plots, accompanied by some differences between boys and girls. Factor analysis only extracted one latent factor, which was probably the karate skill factor, given that multiple studies have suggested these five tests as proper measurements for karate performance (Mamola, 2005; Nowak, 1994; Osiński, 2000; Pilicz, 2005). Our multiple regression analysis indicated that weight, 4 × 5 m shuttle run times, and long jump distances were strongly associated with the outcome of medicine ball throwing. Another regression model revealed a significant association between the 4 × 5 m shuttle run and long jump for girls.

To our knowledge, few studies have adopted the exact same set of motor ability tests when researching the associations between karate training and basic motor abilities or the intercorrelations between the motor tests, although we conducted several tests in common with these studies. Doder, Malacko, and Doder (2010) suggested standing broad jump, deep forward bend on the bench, and 30 s of sit-ups as three tests to assess free kata performance. Another study contrasting motor abilities between karatekas and nonathletes adopted standing long jump as a test of explosive strength, and found significant differences (Simonović, Bubanj, Projović, Kozomara, & Bubanj, 2011). Standing long jump had a higher coefficient of validity and reliability for assessing the rhythmic structure and explosive strength of 12-year-old karatekas (Kostovski & Georgiev, 2009). Sit and reach, standing long jump, and the 4 × 10 m shuttle run were adopted with many other tests by Ortega et al. (2008), who studied the reliability of these physical fitness tests and concluded that no learning or fatigue effects were exhibited while applying these tests repeatedly, and that the reliability of the tests was acceptable for both male and female adolescents. Popeska and Jovanova-Mitkovska (2014) proposed up to 17 motor tests with significant measurement-characteristics including the 4 × 10 m shuttle run, standing broad jump, and medicine ball throwing as adequate motor ability assessment tools for children (2014).

The relapse of the basic motor skill improvements ascribed to karate training is a new finding in this field. Short-term and immediate effects of karate training have been established by many others (e.g., Padulo et al., 2014), and it is acknowledged that high intensity karate training of short duration can enhance the muscular power and range of motion in 8 - 12-year-old karatekas, although the long-term effects of karate training are yet to be determined.

The primary limitation of the current study is the lack of a control group. The effectiveness of karate training compared to traditional physical education or any other motor ability training therefore requires further investigation. This shortcoming of our study is compensated by the considerable effect sizes of the long jump and 4 × 5 m shuttle run, although the results of other tests were not as promising. The underlying mechanism of karate training effects on these two specific motor ability tests should be established.

5. Conclusion

Karate training contributes to motor ability improvements among primary-school-age beginners, especially in long jump and the 4 × 5 m shuttle run, although the improvement ceases when training stops. Karate may therefore be a promising alternative in the physical education curriculum to improve the motor abilities of primary school children in the long run.

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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 and Tendons Journal, 4,* 114-120. https://doi.org/10.11138/mltj/2014.4.2.114

Božanić, A., & Bešlija, T. (2010). Relations between Fundamental Motor Skills and Specific Karate Technique in 5 - 7 Year Old Beginners. *Sport Science, 3,* 79.

Doder, D., Malacko, J., Doder, R. (2010). Predictive Validity of Morphological and Motor Variables for the Evaluation and Monitoring of the Karate Free Kata Performance. *Sport Science, 3,* 52.

Doder, D., Malacko, J., Stanković, V., & Doder, R. (2013). The Influence of Motor Behavior Variables on a Set Karate Kata Performance. *Physical Education and Sport, 11,* 43-50.

Funakoshi, G. (1995). *Karate-do Kyohan*. Tokyo: Kodonsha International.

Gallahue, D., & Donnely, F. (2003). *Developmental Physical Education for All children*. Champaign, IL: Human Kinetics.

Jukić, J., & Čavala, M. (2013). The Relations of Specific Motor Ability and Efficiency in Karate of Kadets. *Research in Physical Education, Sport and Health, 2,* 35.

Kahrović, I. H., Nurkic, M., Bratic, M., Jovanovic, S., & Radenkovic, O. (2014). Differences between Karate Practitioners of Varied Competition Orientations in Specific Motor

Tests Results. *Physical Education and Sport, 12,* 227-239.

Katić, R., Blazević, S., Krstulović, S., & Mulić, R. (2005). Morphological Structures of Elite Karateka. *Collegium Antropologicum, 29,* 79-84.

Kostovski, Ž., & Georgiev, G. (2009). Measure Characteristics of Motor Tests for Assessing Rhythmic Structure and Explosive Strength with Karate Athletes and Non-Athletes at the Age of 12. *Sport Scientific and Practical Aspects, 6,* 37-42.

Krebs, P. (2000). Mental Retardation. In J. P. Winnick (Ed.), *Adapted Physical Education and Sport* (pp. 111-126). Champaign, IL: Human Kinetics.

Mikić, D. B., Mehinović, J., & Shala, S. (2009). Canonical Correlation between Basic-Motor Abilities and Karate Competitor's Efficacy. *Sport Scientific and Practical Aspects, 6,* 33.

Mori, S. Y., Ohtani, K., & Imanaka, K. (2002). Reaction Times and Anticipatory Skills of Karate Athletes. *Human Movement Science, 21,* 213-230.

Ortega, F. B., Artero, E. G., Ruiz, J. R., Vicente-Rodriguez, G., Bergman, P., Hagströmer, M., Ottevaere, C., Nagy, E., Konsta, O., Rey-López, J. P., Polito, A., Dietrich, S., Plada, M., Béghin, L., Manios, Y., Sjöström, M., & Castillo, M. J. (2008). Reliability of Health-Related Physical Fitness Tests in European Adolescents. The HELENA Study. *International Journal of Obesity, 32,* S49-S57. https://doi.org/10.1038/ijo.2008.183

Padulo, J., Chamari, K., Chaabène, H., Ruscello, B., Maurino, L., Syloslabini, P., & Migliaccio, G. M. (2014). The Effects of One-Week Training Camp on Motor Skills in Karate Kids. *Journal of Sports Medicine and Physical Fitness, 54,* 715-724.

Popeska, B., & Jovanova-Mitkovska, S. (2014). Draft Battery of Tests for Evaluation of Motor Abilities in 6 Years Old Children. *Research in Kinesiology, 4,* 15-21.

Simonović, Z., Bubanj, S., Projović, A., Kozomara, G., & Bubanj, R. (2011). Differences in Motor Abilities between Karate Athletes and Non-Athletes. *Sport Scientific and Practical Aspects, 8,* 15-19.

Vando, S., Filingeri, D., Maurino, L., Chaabène, H., Bianco, A., Salernitano, G., Foti, C., & Padulo, J. (2013). Postural Adaptations in Preadolescent Karate Athletes Due to a One Week Karate Training Camp. *Journal of Human Kinetics, 38,* 45-52. https://doi.org/10.2478/hukin-2013-0044

Violan, M. A., Small, E. W., Zetaruk, M. N., & Micheli, L. J. (1997). The Effect of Karate Training on Flexibility, Muscle, Strength, and Balance in 8- to 13-Year-Old Boys. *Pediatric Exercise Science, 9,* 55-64. https://doi.org/10.1123/pes.9.1.55

Žarko, K., Branimir, M., Vesela, K., Marko, Z., & Nedeljko, S. (2013). The Influence of Some Motor Abilities on the Specific Karate Precision with Hand and Leg. *Sport Scientific and Practical Aspects, 10,* 67.