Contents lists available at Islamic World Science Citation Center (ISC)

International Journal of Motor Control and Learning (IJMCL)

Journal Homepage: http://www.ijmcl.com

The Effect of Karate Exercises (Kata and Kihun) on Children's Dynamic Balance

Mohammad Javad Younesi [a], Gholam Hossein Nazemzadegan [b, *], Parichehr Farhangiyan [a]

[a] Master of Motor Control and Learning, Department of Behavioral Sciences, Faculty of Educational Sciences and Psychology, Shiraz University, Shiraz, Iran
[b] Assistant Professor, Department of Behavioral Sciences, Faculty of Educational Sciences and Psychology, Shiraz University, Shiraz, Iran

ARTICLE INFO

Article history:
Received: 2022/03/25
Accepted: 2022/07/26
Available online: 2022/08/19

Keywords:
Dynamic balance
Children
Karate
Kata

ABSTRACT

Background: Dynamic balance is a crucial variable in lower limb maneuvering in different age groups and different sports, and is a framework for other movements in adulthood. Therefore, the present study was conducted to determine the effect of basic karate exercises on children's dynamic balance.

Methods: The sample size consisted of 30 boys aged 6 to 12 years (8.7 ± 1.47) without any experience in karate practice, which was purposefully selected from the students in the city of Sedeh, that they were matched into two experimental (n=15) and control (n=15) groups after taking the balance pre-test (5-line star test). The experimental group performed basic karate exercises at the level of the yellow belt for four weeks (3 sessions of 90 minutes), and the control group performed, physical training exercises and school games. The post-test was taken at the end of the training session.

Results: Mixed analysis of variance showed that main effect of time (p=0.001) and group (p= 0.048) was significant. The results of paired t-test showed there was a significant difference between the pre-test and post-test scores in the experimental group (P= 0.001). Also, independent t-test showed experimental group compared to control was a higher score at the post test (p=0.01).

Conclusions: Based on the research findings, it can be suggested that physical education instructors and teachers can use it to improve the dynamic balance in their students due to the ease of performing karate exercises and no need for special facilities.

1. Introduction

Balance means the ability to maintain a position to perform voluntary activities and deal with internal or external disturbances (Hosseini, 2007; Khoda vaisi, 2008). Postural control is a complex skill based on the interaction of dynamic sensorimotor processes, whose main functional objective involves postural orientation and postural balance (Martins et al., 2019). Balance requires information processing through the somatosensory, visual, and vestibular systems (Shumway-Cook & Woollacott, 2007; Vuillerme & Nougier, 2004). Vision is the primary system in designing movements and avoiding obstacles in the environment. The vestibular system is responsible for sensing angular and linear acceleration in head movements, and the proprioception system is responsible for the position and speed of body parts in contact with external objects (such as the ground) and also determines the position of these organs relative to each other and the force of gravity. Dynamic balance refers to a person's ability to maintain balance while moving from one point to another (Galaho & Azmon, 2011). This ability is vital in performing lower limb movement and maneuvering skills and is also a key factor in the performance of athletes of different age groups; this is especially important in children because it affects their motor development, based on motor experiences and can also be the basis for all movements in adulthood.

Many researchers have studied the effect of deliberated training and organized physical activity on balance in different age groups and even unexpected individuals. Training allows sportsmen to acquire new balance control abilities, possibly differing according to the discipline practiced (Perrin, Deviterne, Hugel, & Perrot, 2002). Perceptual-motor exercises, core stability, roping, gymnastics, and martial arts have shown the improvement of motor skills in children, including posture control and balance abilities (Alesi et al., 2014; Amiri, Hatami, Tahmasbi, & Pourmoradkohan, 2019; Gahriz Sangi, 2012). It has also been shown that martial arts can affect cognitive and physical factors in children. In Taekwondo, for example, balance is considered one of the most important abilities of elite athletes (Fong et al., 2013). Judokas also need to control their dynamic position effectively because the techniques specific to this field are based on frequent shifts to upset the opponent's balance (Perrin et al., 2002). In a study, the effect of educational judo exercises on the movement abilities of 7-12-year-old children was investigated. This study was conducted during twelve months. According to the data obtained from the research and comparing the pre-test and post-test of the experimental group, it was shown that judo training helps a lot in the development of movement skills. As a result of this study, it can be said that static and dynamic balance parameters have been established in male and female judokas (Demiral, 2011). In a study on two groups of 11-13-year-old boys, they were asked to stand with both feet and one foot on a force plate with their eyes open and closed. Positional control was evaluated with a center of pressure. The results showed that kung fu practitioners had significantly better balance than the control group (Sahli, Baccouch, Borji, Sassi, & Rebai, 2021). Despite dealing with martial arts and the existing cognitive dimension and the importance of balance in karate,

* Corresponding author. **Gholam Hossein Nazemzadegan,** Assistant Professor, Department of Behavioral Sciences, Faculty of Educational Sciences and Psychology, Shiraz University, Shiraz, Iran.
E-mail addresses: ghnazem@gmail.com

the impact of this sport on balance has not yet been specifically studied.

In karate, controlling the position and maintaining balance is very important, and in order to move instantly or perform attractive techniques, strong and fast maneuvers of the upper and lower limbs are required along with maintaining the body position. Karate training are divided into committee (two-person fight) and kata (dramatic movements or fighting an imaginary opponent). Kata (meaning form) is a Japanese word and is a set of pre-designed movements that can be performed individually or in groups. Although Kihun and Kata are performed in a relatively short period of time, the performances require maximum intensity and a high level of motor and functional abilities, including speed, muscle strength, power, flexibility, agility, coordination and balance (Filingeri, Bianco, Zangla, Paoli, & Palma, 2012). Given that kata is a combination of different techniques in the face of a powerful (Unreal opponent), it requires high cognitive processes and deployment while performing bursting techniques in it requires control and maintaining a dynamic balance. It seems that kata training can be an effective stimulus for the growth of the frontal cortex (which is related to the processing of cognitive needs and the presence of the motor cortex in this area of the brain) and thus improve motor function in young children (Qasemian Moghadam, 2017). Therefore, the present study aimed to quantitatively investigate the effect of basic karate (kata) training on children's dynamic balance. The question that arises here is whether the use of kata can be expected to make significant changes in children's balance?

2. Materials and Methods

2.1. Subjects

After obtaining permission from the relevant agencies from the statistical population of students in Sedeh, 30 boys aged 6 to 12 years (mean age 8.73 and standard deviation of age 1.47), without any experience in karate practice and without any history of specific diseases or taking medication during the training period were purposefully selected. Before conducting the research, the research and the role of the subjects were clearly explained. In this research, both in the pre-test and post-test stages, as well as in the training stages, the subjects were threatened with danger and harm, and with full consent, they were free to leave the research for any reason or without reason at any stage. After the pretest, the subjects were matched into two experimental and control groups (n=15) by G-power software and labeled randomly.

2.2. Apparatus and task

A 5-line star excursion test balance (SETB) was taken to determine the balance of participants. This test has a grid with five lines in different directions with an angle of 36 degrees. The person stands with one foot in the center of the net and moves the other foot along the lines as far as possible without hitting the ground. The subject repeats the test 3 times, and the average achievement intervals are recorded as the raw dynamic equilibrium score. In order to normalize the data, the length of the subject's leg was measured. Then the mean achievement distance (raw equilibrium score) was divided by the leg length, and the resulting number was multiplied by 100 to calculate the subject score. The reliability of the SETB and the internal correlation coefficient has been reported in the range of 0.69 to 0.89 (Ayazi vanani, 2013).

2.3. Procedures

According to the Previous study, the students in the experimental group participated in basic karate training designed according to the principles of training for four weeks (three 90-minute sessions per week). The training was performed by teaching the basic techniques of karate and Heian Shodan Kata. The level of training was in line with the skills required to receive the yellow belt. The control group participated in individual elementary school games and physical training according to training principles. The number of sessions and period of time were similar to the experimental group; at the end of the training period, a post-test of the subjects was performed.

2.4. Data analysis

After checking the normality distribution of the data by the Shapiro-Wilk test, in order to analyze them the Levene's test was used for the assumption of equality of variances. By observing the normality distribution of the data, the mixed analysis of variance was used, and the t-test was used to check for inter and intra-difference groups. Data analysis was done with SPSS version 26 software at a significance level of $p \leq 0.05$.

3. Results

The demographic characteristics of the subjects can be seen in the table 1.

Table 1. Mean and standard deviation of demographic characteristics.

Group	n	Age (Year)	Weight (kg)	Birth weight (kg)	Height (cm)	Foot length (cm)
Experiment (karate)	15	8.5 ±1.12	24.7±5.3	3.04±0.49	127±7	62± 5
Control (school games)	15	9±1.81	28.8±6.8	3.16 ± 0.57	131±7	64± 4

Mixed analysis of variance showed that main effect of time (p=0.001) and group (p= 0.048) was significant. (Table 2). The results of paired t-test showed there was a significant difference between the pre-test (78.24) and post-test (85.39) scores in the experimental group (P= 0.001). Also, independent t-test showed experimental group (85.39) compared to control (77.37) was a higher score at the post test (p=0.01) (Figure 1).

Table 2. Results of mixed ANOVA for dynamic balance.

Variable	Factor	F	p	Eta
Dynamic balance	Time	14.839	0.001	0.346
	Group	4.257	0.048	0.132
	Interaction	1.794	0.191	0.060

* Intragroup significance (p<0.05).

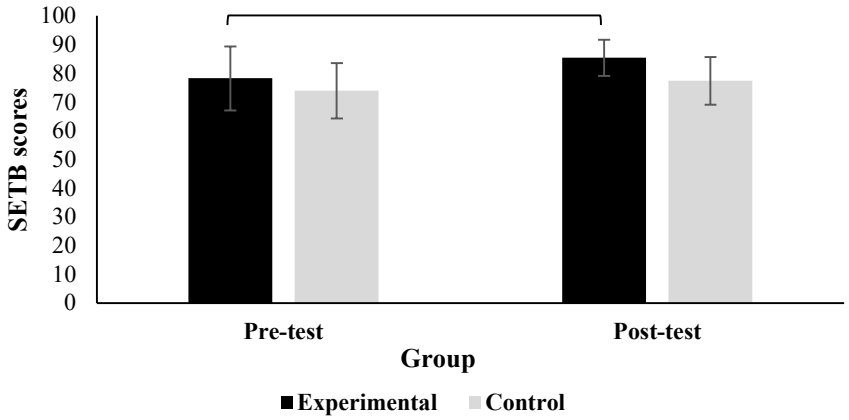

Figure 1. Mean and standard deviation of dynamic balance test scores.

4. Discussion and Conclusion

This study aimed to determine the effect of a karate training course (Kata and Kihun) on the dynamic balance of 6- to 12-year-old boys. We hypothesized that children could have better balance by practicing Kata and that there could also be a relationship between this skill and dynamic balance. As a result, in addition to directly measuring balance ability, we examined their effects on children's functional superiority by performing kata training. The results of this study showed that there is a significant difference between the experimental and control groups under the influence of Kihun and Kata exercises. According to the results of some research on the effect of martial arts exercises on balance, especially dynamic balance, it was predicted that karate, as one of the martial arts disciplines, would have a positive and significant effect on improving this control variable in children; so that, in some studies researchers reported that martial arts, in addition to improving some cognitive factors, improves motor performance, including balance (Sahli et al., 2021). However, there is still a lack of well-designed studies focusing on the effect of Kata and Kihun training on children's dynamic balance. In confirmation of the present study's findings, we can refer to the study of Matthew Zago et al. (2015), who examined the balance variable as a determining and critical factor in the performance of elite karatekas (Zago et al., 2015). Assuming that higher-level athletes show better balance ability, the results show that elite karatekas improve and maintain dynamic balance control by increasing support levels and lower limb muscle activity (Zago et al., 2015). The findings of this study support the hypothesis that karate exercises (Kihun and Kata) physiologically strengthen the muscles of the lower limb and cognitively lead to more activity of the Prefrontal cortex and motor areas of the brain, and consequently may increase the level of maintaining dynamic balance when performing techniques (Filingeri et al., 2012). In Kata, in addition to explosive power and correct execution of techniques, karateka is evaluated in terms of balance control. Because the Kihon and Kata movements involve speed, rotation, and sometimes jumping movements, the position of the head relative to the torso is constantly changing during the performance, which causes the athlete to be constantly in an unbalanced position unless certain control systems are running continuously. These control systems can adapt to internal and external changes and depend on cooperation between sensory systems, including the visual, vestibular, and the proprioception systems, the organization of which affects postural control (Leong, Fu, Ng, & Tsang, 2011). Balancing is a complex function that integrates the processing of mechanical, sensory, and motor stimuli (Origua Rios, Marks, Estevan, & Barnett, 2018). According to the sensory systems involved in various types of balance, it can be said that during the performance and physical disturbances caused by Kata and Kihon movements, one should be able to prepare the body in a suitable position to perform the movement and subsequent techniques. These exercises can create a large set of posture and balance strategies. In fact, practicing karate and proprioception through specific and correct movements in line with the body improves balance (Violan, Small, Zetaruk, & Micheli, 1997). Moreover, karatekas can hold their bodies steady while exerting large force (Cesari & Bertucco, 2008).

Due to the fact that the components of dynamic balance are regulated by different neuromuscular mechanisms (Muehlbauer, Besemer, Wehrle, Gollhofer, & Granacher, 2013), it can be said that practicing martial arts such as karate, mainly with sensory inputs (proprioception, changes in joint angles, vertical alignment) can cause long-term changes in the positional control system, and then allows the balance to be well maintained after the disorder (Juras et al., 2013). The positive effects of karate practice (Kihon and kata) on dynamic balance support a systematic review that reported improved posture control of karate practice in professional athletes. In line with the results of this study, studies have been found that compare the performance of martial arts practitioners with untrained people of the same age and show positive effects in controlling balance and body posture in karate practitioners (Fong et al., 2013; Krampe, Smolders, & Doumas, 2014; Leong et al., 2011; Perrin et al., 2002). Eventually This study showed that training martial arts, especially karate (Kihun and Kata), improves the dynamic balance in children.

Considering that the karate exercises in this research were specific to Kata exercises, it can be suggested for future research to conduct a similar study that examines karate exercises in the Kumite section. Also, due to the short duration of the training protocol and the fact that the research is only conducted on boys, it is suggested to conduct research with a long-term training protocol on girls as well.

Conflict of interests

The authors have no conflict of interests.

Acknowledgment

The volunteers are thanked for their participation.

References

Alesi, M., Bianco, A., Padulo, J., Vella, F. P., Petrucci, M., Paoli, A., . . . Pepi, A. (2014). Motor and cognitive development: the role of karate. Muscles, ligaments and tendons journal, 4(2), 114.

Amiri, M., Hatami, F., Tahmasbi, F., & Pourmoradkohan, P. (2019). The impact of brain gym on Body balance of Non athlete female students. Rooyesh-e-Ravanshenasi Journal (RRJ), 8(7), 49-58.

Ayazi vanani, Z. (2013). The effect of gymnastics exercises on the balance of female students aged 9 to 15 years with maturity control. (Master Thesis), Shiraz university, Shiraz.

Cesari, P., & Bertucco, M. (2008). Coupling between punch efficacy and body stability for elite karate. Journal of science

and medicine in sport, 11(3), 353-356.
Demiral, S. (2011). The study of the effects of educational judo practices on motor abilities of 7-12 years aged judo performing children. Asian Social Science, 7(9), 212-219.
Filingeri, D., Bianco, A., Zangla, D., Paoli, A., & Palma, A. (2012). Is karate effective in improving postural control?
Fong, S. S., Guo, X., Cheung, A. P., Jo, A. T., Lui, G. K., Mo, D. K., . . . Tsang, W. W. (2013). Elder Chinese martial art practitioners have higher radial bone strength, hand-grip strength, and better standing balance control. International Scholarly Research Notices, 2013.
Gahriz Sangi, G. S., Hamid; Heydari, Leila (2012). The effect of a rhythmic movement program on the perceptual-motor abilities of educable mentally retarded children Growth and Motor-Sports Learning, 92-75.
Galaho, D. L., & Azmon, J. C. (2011). Understanding motor development in different stages of life. . Tehran: Science and Movement.
Hosseini, M. (2007). The investigation vital capacity, agility and balance in gilrs with pes planus and pes vavus. (Doctoral dissertation, MSc thesis), Tehran University,
Juras, G., Rzepko, M., Krol, P., Czarny, W., Bajorek, W., Slomka, K., & Sobota, G. (2013). The effect of expertise in karate on postural control in quiet standing. Archives of Budo, 9(3), 205-209.
Khoda vaisi, H. (2008). Investigation impact of pes planus and Pes cavus on posture Anomalies. (Master thesis), Bu Ali University, Hanedan.
Krampe, R. T., Smolders, C., & Doumas, M. (2014). Leisure sports and postural control: Can a black belt protect your balance from aging? Psychology and aging, 29(1), 95.
Leong, H.-T., Fu, S. N., Ng, G. Y., & Tsang, W. W. (2011). Low-level Taekwondo practitioners have better somatosensory organisation in standing balance than sedentary people. European journal of applied physiology, 111(8), 1787-1793.
Martins, H. S., Lüdtke, D. D., de Oliveira Araújo, J. C., Cidral-Filho, F. J., Salgado, A. S. I., Viseux, F., & Martins, D. F. (2019). Effects of core strengthening on balance in university judo athletes. Journal of bodywork and movement therapies, 23(4), 758-765.
Muehlbauer, T., Besemer, C., Wehrle, A., Gollhofer, A., & Granacher, U. (2013). Relationship between strength, balance and mobility in children aged 7–10 years. Gait & posture, 37(1), 108-112.
Origua Rios, S., Marks, J., Estevan, I., & Barnett, L. M. (2018). Health benefits of hard martial arts in adults: a systematic review. Journal of sports sciences, 36(14), 1614-1622.
Perrin, P., Deviterne, D., Hugel, F., & Perrot, C. (2002). Judo, better than dance, develops sensorimotor adaptabilities involved in balance control. Gait Posture, 15(2), 187-194. doi:10.1016/s0966-6362(01)00149-7
Qasemian Moghadam, H. (2017). The effect of Paryad perceptual-motor exercises on executive functions of children with learning disabilities. (Master Thesis), Ferdowsi University, Mashhad.
Sahli, S., Baccouch, R., Borji, R., Sassi, B., & Rebai, H. (2021). Postural control and neuromuscular responses in young Kung-Fu practitioners. Science & Sports, 36(2), 112-119.
Shumway-Cook, A., & Woollacott, M. H. (2007). Motor control: translating research into clinical practice: Lippincott Williams & Wilkins.
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(1), 55-64.
Vuillerme, N., & Nougier, V. (2004). Attentional demand for regulating postural sway: the effect of expertise in gymnastics. Brain Research Bulletin, 63(2), 161-165.
Zago, M., Mapelli, A., Shirai, Y. F., Ciprandi, D., Lovecchio, N., Galvani, C., & Sforza, C. (2015). Dynamic balance in elite karateka. Journal of electromyography and kinesiology, 25(6), 894-900.