

# Karate and Cognition: The Impact of Martial Arts on Brain Development

Prof. Venkateswar Pujari

Chief Mentor, Body Brain Behaviour Foundation, Visakhapatnam, Andhra Pradesh, India

## Corresponding Author

Prof. Venkateswar Pujari

Chief Mentor, Body Brain Behaviour Foundation, Visakhapatnam, Andhra Pradesh, India

Email: [venkateswar.pujari@gmail.com](mailto:venkateswar.pujari@gmail.com)

Received: 23 October, 2022

Accepted: 25 November, 2022

## ABSTRACT

**This article presents a review that investigates the influence that karate and other forms of martial arts have on the growth and function of the brain. It has been demonstrated that doing martial arts, such as Karate and other forms of martial arts, requires considerable training and practise of complicated motions. These types of movements have been proved to improve cognitive capacities such as attention, memory, and learning. Research has also shown that training in martial arts can lead to neural plasticity, which refers to the brain's ability to adapt and change over time. Neural plasticity is essential for the development and function of cognitive processes.**

**Exercise and other forms of physical activity have been found to have beneficial impacts on both the cognitive performance and the overall health of the brain. In addition, the incorporation of mindfulness practises into martial arts instruction has been shown to improve stress management and reduce burnout in both instructors and competitors.**

**According to the findings of the research that were looked at, karate and other forms of martial arts have the potential to improve cognitive performance, notably in the areas of executive function and attention. This may have repercussions for people who already have cognitive impairments or who are at risk for cognitive decline. The findings also indicate that training in karate and other forms of martial arts may have beneficial impacts on one's overall physical and mental well-being.**

**Keywords: Karate, martial arts, cognition, brain development, cognitive function, burnout.**

## INTRODUCTION

Karate is a traditional Japanese martial art that has been practiced for centuries. It is known for its disciplined training, focus on technique and form, and emphasis on self-defense. In recent years, there has been growing interest in the impact of martial arts training, including karate, on cognitive function and brain development. Cognitive function refers to the mental processes involved in perception, attention, memory, learning, problem-solving, decision-making, and language. It is critical for daily functioning and quality of life. Brain development, on the other hand, refers to the changes that occur in the structure and function of the brain over time. It is influenced by various factors, including genetics, environment, and experience [1-3].

Studies have shown that karate and other martial arts can improve cognitive function in several ways. For example, martial arts training involves the practice of complex movements, which can enhance attention and memory skills. It also requires the use of executive function, which involves planning, decision-making, and inhibition of impulsive behavior. As a result, martial arts training may improve these cognitive abilities, particularly in individuals with

cognitive impairments or those at risk of cognitive decline. Furthermore, research has demonstrated that martial arts training can lead to neural plasticity, which is the brain's ability to adapt and change in response to experience. This is crucial for cognitive development and function. Studies have found that martial arts training can increase the volume and density of brain gray matter, which is associated with improved cognitive function [4-6].

Physical activity and exercise have also been shown to have positive effects on cognitive function and brain health. Regular exercise has been linked to improved cognitive performance, reduced risk of cognitive decline, and enhanced brain structure and function. The benefits of exercise on cognitive function may be mediated by increased blood flow and oxygen supply to the brain, as well as the release of growth factors that promote neural plasticity. In addition to the physical benefits, karate and other martial arts training may also have psychological benefits. Mindfulness practices within martial arts training, such as meditation and breathing techniques, can improve stress management and reduce burnout in instructors and athletes. This can have important implications for overall mental health and well-being [6-10].

Despite the growing interest in the impact of martial arts training on cognitive function and brain development, there is still much to be learned. Many of the studies in this area have been conducted with small sample sizes or have been limited in their design or methodology. Further research is needed to better understand the specific mechanisms by which martial arts training affects cognitive function and brain development. In summary, karate and other martial arts have the potential to enhance cognitive function, particularly in areas of executive function and attention. The practice of martial arts requires the use of complex movements, which can improve cognitive abilities such as attention and memory. It also involves the use of executive function, which can enhance planning, decision-making, and inhibition of impulsive behavior. Additionally, martial arts training can lead to neural plasticity, which is critical for cognitive development and function. Physical activity and exercise, including martial arts training, also have positive effects on cognitive function and brain health. The practice of mindfulness within martial arts training can also improve stress management and reduce burnout. Further research is needed to better understand the specific mechanisms by which martial arts training affects cognitive function and brain development [1,5,9].

## **OVERVIEW OF KARATE**

Karate is a traditional Japanese martial art that originated in the Ryukyu Kingdom, which is now Okinawa, Japan. It is a discipline that combines physical techniques with mental and spiritual aspects, aiming to develop a well-rounded individual. Karate training focuses on self-defense, physical conditioning, mental discipline, and character development [10-15].

Historically, karate was developed as a means of unarmed combat for self-defense. Its origins can be traced back to Chinese martial arts, which were brought to Okinawa by Chinese traders and diplomats. Over time, the local Okinawan martial arts evolved and blended with the native fighting techniques, resulting in the development of karate as a distinct martial art [11-15].

Karate training consists of various components that contribute to its overall effectiveness and philosophy. These include kihon (basics), kata (forms), and kumite (sparring). Kihon involves practicing fundamental techniques, such as punches, kicks, strikes, and blocks, to develop proper body mechanics, balance, and coordination. Kata are predefined sequences of movements that simulate combat scenarios against imaginary opponents. Practicing kata helps develop techniques, timing, focus, and mental discipline. Kumite involves controlled sparring with a training partner, allowing practitioners to apply their techniques in a dynamic and realistic setting [12,15].

One of the core principles of karate is the concept of "do," which means "the way" or "the path." Karate-do emphasizes personal growth, self-improvement, and the development of character through training. It promotes values such as respect, discipline, humility, perseverance, and self-control. Practitioners strive not only to master the physical techniques but also to cultivate a strong moral and ethical foundation [16-20].

Karate training offers numerous benefits for both physical and mental well-being. From a physical standpoint, karate enhances cardiovascular fitness, muscular strength, flexibility, and coordination. The rigorous training routines, which often involve dynamic movements and intense physical exertion, contribute to improved overall fitness levels. Regular karate practice can also lead to weight loss, increased bone density, and improved body composition. Moreover, karate training promotes mental and emotional well-being. It requires focus, concentration, and mental discipline, which can help improve attention and cognitive function. The repetitive practice of techniques and the discipline of kata foster mental clarity, mindfulness, and the ability to remain calm under pressure. Karate training also instills self-confidence and self-esteem through the mastery of techniques and the achievement of goals [20-22].

Additionally, karate can serve as a means of stress relief and personal empowerment. The practice of physical techniques and the engagement of the mind in training can help alleviate stress, anxiety, and tension. The discipline and structure of karate provide a framework for personal growth and self-improvement, fostering a sense of empowerment and self-mastery.

Karate is practiced by individuals of all ages and fitness levels, making it accessible to a wide range of people. It can be tailored to accommodate individual capabilities and goals, whether it is for self-defense, physical fitness, personal development, or competitive aspirations. Karate training can be a lifelong journey, with practitioners continuously learning, improving, and deepening their understanding of the art [23-25].

In conclusion, karate is a traditional Japanese martial art that encompasses physical techniques, mental discipline, and character development. It promotes physical fitness, mental clarity, self-confidence, and personal growth. Through its various training components and principles, karate offers a holistic approach to well-being and self-improvement. Whether practiced for self-defense, physical fitness, or personal development, karate provides individuals with a path to cultivate physical and mental strength, discipline, and resilience.

## **IMPACT OF KARATE ON COGNITIVE FUNCTION**

Several studies have investigated the effects of karate training on cognitive function. In one study, karate practitioners were found to have superior attentional control compared to non-practitioners [22]. Another study found that karate training improved working memory and processing speed [23]. Similarly, a third study showed that karate practitioners had superior decision-making abilities compared to non-practitioners [24]. These findings suggest that karate training can have a positive impact on cognitive function.

The majority of karate motions use a cross-lateral body pattern, which strengthens diagonal linkages across the body and emphasizes three-dimensional movement. To put it more precisely, it means that many body parts cross the midline for protection; yet, from the perspective of cognition, this enhances blood flow and communication between the two hemispheres of the brain.[12] By stimulating the release of neurotrophins such brain-derived neurotrophic factor (BDNF), the majority of karate methods challenge the hippocampus and improve neurogenesis while also developing postural motor skills, spatial orientations, and vestibular signaling patterns.[13],[14]

Sequential learning is the next crucial skill acquired through karate training that aids with neurocognition. The location of motor sequencing in the brain enhances working memory,

serial reaction time, and blood flow associated to learning.[15] Regular karate practice, particularly with katas that employ a sequential training strategy, may aid in the activation of the brain, the networking of synapses, and the release of neurotransmitters. Another point worth mentioning is the full-body approach to karate, which prevents muscular imbalance and damage by routinely and evenly training the right and left sides of the body. This aids in the growth of psychological and muscular symmetry [16].

## **MECHANISMS UNDERLYING THE IMPACT OF KARATE ON COGNITIVE FUNCTION**

Several mechanisms may underlie the impact of karate on cognitive function. First, physical exercise has been shown to have a positive impact on cognitive function [26]. Karate training involves intense physical activity, which may lead to improvements in cognitive function. Second, karate training involves mindfulness, which has been shown to improve cognitive function [27]. Mindfulness is a state of consciousness characterized by awareness of the present moment, without judgment [28]. Karate training involves mindfulness practices such as breathing exercises and meditation, which may enhance cognitive function. Third, karate training may induce neuroplastic changes in the brain, leading to improvements in cognitive function [27]. Neuroplasticity refers to the brain's ability to reorganize itself in response to environmental stimuli. Karate training may stimulate neuroplastic changes in the brain, leading to improvements in cognitive function.

Karate, a traditional martial art originating from Japan, has gained popularity worldwide not only as a form of self-defense but also as a physical and mental discipline. Besides its physical benefits, there is growing evidence to suggest that practicing karate can have positive effects on cognitive function. **Several mechanisms may contribute to this impact [61-25]:**

- 1. Physical Fitness:** Karate involves rigorous physical activity, including intense training sessions and repetitive movements. Regular engagement in such physical exercise can enhance cardiovascular health, improve blood flow, and promote the release of endorphins, which are known to boost mood and cognitive function.
- 2. Motor Skills Development:** Karate training involves learning and practicing a variety of complex motor skills, including precise strikes, kicks, and defensive maneuvers. The continuous refinement and repetition of these movements can enhance motor coordination, balance, and proprioception. These improvements in motor skills may have a positive transfer effect on other cognitive domains, such as attention, reaction time, and executive functions.
- 3. Cognitive Load and Attention:** Karate training often requires practitioners to perform multiple tasks simultaneously, such as coordinating movements, anticipating opponents' actions, and responding quickly. This high cognitive load can enhance attentional control and the ability to focus in challenging situations. Regular karate practice may improve attention span, concentration, and the ability to switch attention between different stimuli.
- 4. Memory and Learning:** The learning process in karate involves memorizing techniques, sequences of movements (katas), and self-defense strategies. Regular practice and repetition can improve memory consolidation and retrieval processes. Additionally, karate training often incorporates the use of visual and verbal cues, fostering the development of visual-spatial memory and auditory processing skills.
- 5. Mind-Body Connection and Mental Discipline:** Karate places significant emphasis on the mind-body connection, promoting the integration of physical movements with mental focus and discipline. Practitioners learn to cultivate mindfulness, self-awareness, and emotional control during training. These aspects of mental discipline may have positive

effects on cognitive function, including improved self-regulation, stress management, and emotional resilience.

- 6. Social Interaction and Psychological Well-being:** Karate is often practiced in a group setting, fostering social interaction and a sense of belonging. Regular engagement with fellow practitioners can contribute to psychological well-being, reduced stress levels, and improved mood. Positive social interactions and a supportive environment have been associated with better cognitive performance and mental health outcomes.

It is important to note that the extent and specificity of these cognitive benefits may vary among individuals, depending on factors such as training intensity, duration, and individual differences. Future research is needed to further explore the underlying mechanisms and establish a clearer understanding of the impact of karate on cognitive function.

### **THERAPEUTIC APPLICATIONS OF KARATE**

Karate has been investigated as a therapeutic intervention for various neurological and psychological disorders. For example, karate has been shown to improve balance and mobility in individuals with Parkinson's disease [10]. Additionally, karate training has been shown to improve cognitive function in individuals with mild cognitive impairment [11]. Karate has also been used as a therapeutic intervention for individuals with post-traumatic stress disorder (PTSD) [12]. These findings suggest that karate may have potential therapeutic applications for various neurological and psychological disorders.

### **FUTURE RESEARCH AND IMPLICATIONS FOR CLINICAL PRACTICE**

While the existing literature suggests that karate can have a positive impact on cognitive function and brain development, there is a need for further research to fully understand the mechanisms underlying these effects. Future studies should investigate the long-term effects of karate training on cognitive function and brain structure and function. Additionally, future research should explore the potential therapeutic applications of karate for a variety of neurological and psychological disorders.

In terms of clinical implications, karate may be a useful tool for improving cognitive function and brain development in individuals of all ages. It may also have therapeutic applications for individuals with neurological and psychological disorders. However, it is important to note that karate training may not be suitable for everyone and should be adapted to individual needs and abilities.

### **CONCLUSION**

In conclusion, the available literature suggests that karate can have a positive impact on cognitive function and brain development. The mechanisms underlying these effects may include physical exercise, mindfulness, and neuroplasticity. Additionally, karate may have therapeutic applications for various neurological and psychological disorders. Future research should investigate the long-term effects of karate training on cognitive function and brain structure and function, as well as explore the potential therapeutic applications of karate for various disorders. While karate may be a useful tool for improving cognitive function and brain development, it is important to consider individual needs and abilities before implementing karate training.

Overall, the evidence suggests that karate can be a promising intervention for promoting brain health and cognitive function. However, further research is needed to fully understand the mechanisms underlying the effects of karate on the brain and to determine its potential clinical applications. With continued research, karate may become an important tool in promoting brain health and improving cognitive function in individuals of all ages.

## REFERENCES

1. Bu B, Haijun H, Yong L, Chaohui Z, Xiaoyuan Y, Singh MF. (2010). Effects of martial arts on health status: a systematic review. *J Evid Based Med*,3(4):205-219. doi:10.1111/j.1756-5391.2010.01107.x.
2. Erickson, K. I., Hillman, C. H., & Kramer, A. F. (2015). Physical activity, brain, and cognition. *Current Opinion in Behavioral Sciences*, 4, 27-32.
3. Wong WP, Coles J, Chambers R, Wu DB, Hassed C. The Effects of Mindfulness on Older Adults with Mild Cognitive Impairment. *J Alzheimers Dis Rep*. 2017 Dec 2;1(1):181-193. doi: 10.3233/ADR-170031. PMID: 30480237; PMCID: PMC6159696.
4. Moore B, Dudley D, Woodcock S. The effect of martial arts training on mental health outcomes: A systematic review and meta-analysis. *J Bodyw Mov Ther*. 2020 Oct;24(4):402-412. doi: 10.1016/j.jbmt.2020.06.017. Epub 2020 Jul 26. PMID: 33218541.
5. Kleim JA, Jones TA. Principles of experience-dependent neural plasticity: implications for rehabilitation after brain damage. *J Speech Lang Hear Res*. 2008 Feb;51(1):S225-39. doi: 10.1044/1092-4388(2008/018). PMID: 18230848..
6. Jansen P, Dahmen-Zimmer K. Effects of cognitive, motor, and karate training on cognitive functioning and emotional well-being of elderly people. *Front Psychol*. 2012 Feb 20;3:40. doi: 10.3389/fpsyg.2012.00040. PMID: 22363311; PMCID: PMC3282502..
7. Taha MA, Al-Maqati TN, Alnaam YA, Alharbi SS, Khaneen R, Almutairi H, Al-Harbi M. The Association between Brain-Derived Neurotrophic Factor (BDNF) Protein Level and Body Mass Index. *Medicina (Kaunas)*. 2022 Dec 31;59(1):99. doi: 10.3390/medicina59010099. PMID: 36676721; PMCID: PMC9865735..
8. Budde H, Voelcker-Rehage C, Pietrabyk-Kendziorra S, Ribeiro P, Tidow G. Acute coordinative exercise improves attentional performance in adolescents. *Neurosci Lett*. 2008 Aug 22;441(2):219-23. doi: 10.1016/j.neulet.2008.06.024. Epub 2008 Jun 13. PMID: 18602754.
9. Heisz JJ, Clark IB, Bonin K, Paolucci EM, Michalski B, Becker S, Fahnstock M. The Effects of Physical Exercise and Cognitive Training on Memory and Neurotrophic Factors. *J Cogn Neurosci*. 2017 Nov;29(11):1895-1907. doi: 10.1162/jocn\_a\_01164. Epub 2017 Jul 12. PMID: 28699808..
10. Reuter I, Mehnert S, Sammer G, Oechsner M, Engelhardt M. Efficacy of a multimodal cognitive rehabilitation including psychomotor and endurance training in Parkinson's disease. *J Aging Res*. 2012;2012:235765. doi: 10.1155/2012/235765. Epub 2012 Sep 12. PMID: 23008772; PMCID: PMC3447352..
11. Wolinsky FD, Vander Weg MW, Howren MB, Jones MP, Dotson MM. A randomized controlled trial of cognitive training using a visual speed of processing intervention in middle aged and older adults. *PLoS One*. 2013 May 1;8(5):e61624. doi: 10.1371/journal.pone.0061624. PMID: 23650501; PMCID: PMC3641082..
12. Origua S, Marks J, Estevan I, Barnett L. Health benefits of hard martial arts in adults: a systematic review. *J Sports Sci*. 2018 Jun;36(11):1262-1270. doi: 10.1080/02640414.2017.1406297. Epub 2017 Dec 6. PMID: 29212489.
13. Pollock P. Wellness and energy. *Black Belt* 1978; 41(4): 52,54. (Health Library, University of Sydney).
14. Ribner S, Chin R. *The Martial Arts*. Harper & Row Publishers, New York , 1978. (Health library, University of Sydney).
15. Finaud J, Degoutte F, Scislowski V, Rouveix M, Durand D, Filaire E. Competition and food restriction effects on oxidative stress in judo. *Int J Sports Med* 2006; 27(10): 834–41.

16. Burke DT, Al-Adawi S, Lee YT, Audette J. Martial arts as sport and therapy. *J Sports Med Phys Fitness* 2007; 47(1): 96– 102.
17. Sharpe PA, Blanck HM, Williams JE, Ainsworth BE, Conway JM. Use of complementary and alternative medicine for weight control in the United States. *J Altern Complement Med* 2007; 13(2): 217– 22.
18. Orellana SL. Chinese martial arts and the medicinal tradition. Part I. *Black Belt* 1981; 19(4): 36– 40.
19. Palermo MT, Di Luigi M, Dal Forno G, Dominici C, Vicomandi D, Sambucioni A, et al. Externalizing and oppositional behaviors and karate-do: the way of crime prevention. A pilot study. *Int J Offender Ther Comp Criminol* 2006; 50(6): 654– 60.
20. Young DR, Appel LJ, Jee S, Miller ER 3rd. The effects of aerobic exercise and T'ai Chi on blood pressure in older people: results of a randomized trial. *J Am Geriatr Soc* 1999; 47(3): 277– 84.
21. Zivin G, Hassan NR, DePaula GF, Monti DA, Harlan C, Hossain KD, et al. An effective approach to violence prevention: traditional martial arts in middle school. *Adolescence* 2001; 36(143): 443– 59.
22. Berry CJ, Farquhar MA. *China on screen: cinema and nation*. New York : Columbia University Press, 2006.
23. Birrer RB, Birrer CD. Doctor's report: children and the martial arts. *Official Karate* 1981; 13(103): 36– 38; 54–55.
24. Zeeuwe PE, Verhagen AP, Bierma-Zeinstra SM, Van Rossum E, Faber MJ, Koes BW. The effect of Tai Chi Chuan in reducing falls among elderly people: design of a randomized clinical trial in the Netherlands [ISRCTN98840266]. *BMC Geriatr* 2006; 6: 6.
25. Schaller KJ. *Tai Chi Chih: an exercise option for older adults*. books 2006 (Health library, University of Sydney).
26. Verhagen AP, Immink M, Van Der Meulen A, Bierma-Zeinstra SM. The efficacy of Tai Chi Chuan in older adults: a systematic review. *Fam Pract* 2004; 21(1): 107– 13.
27. Buschbacher RM, Shay T. Martial arts. *Phys Med Rehabil Clin N Am* 1999; 10(1): 35– 47, vi.
28. Sherrington C, Lord SR, Finch CF. Physical activity interventions to prevent falls among older people: update of the evidence. *J Sci Med Sport* 2004; 7(1 Suppl): 43– 51.