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Original Article

Effectiveness of Tai Chi as a non-invasive intervention for mild cognitive impairment in the elderly: A comprehensive review and meta-analysis

Derren DCH. Rampengan[1], Felicia A. Gunawan[1], Jade AH. Rampengan[2], Roy N. Ramadhan[3], Muhammad Iqhrammullah[4] and Amanda Yufika[5,6*]

[1]Faculty of Medicine, Universitas Sam Ratulangi, Manado, Indonesia; [2]Faculty of Medicine, Universitas Atma Jaya, Jakarta, Indonesia; [3]Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia; [4]Postgraduate Program of Public Health, Universitas Muhammadiyah Aceh, Banda Aceh, Indonesia; [5]Department of Family Medicine, Faculty of Medicine, Universitas Syiah Kuala, Banda Aceh, Indonesia; [6]Physical Medicine and Rehabilitation Residency Program, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia

*Corresponding author: amandayufika@usk.ac.id

Abstract

The aging population warrants the increase of mild cognitive impairment (MCI) prevalence, a condition that could progress to dementia. Efforts have been made to improve the MCI and prevent its progression, including the introduction of Tai Chi, a Chinese traditional exercise. The aim of this systematic review and meta-analysis was to evaluate the efficacy of Tai Chi in attenuating MCI among the elderly population. Records investigating the effect of Tai Chi exercise intervention on cognitive function among elderly patients were searched systematically from PubMed, ScienceDirect, Google Scholar, and Europe PMC as of April 13, 2023. The risk of bias (RoB 2.0) quality assessment was employed in the quality appraisal of the studies included. Review Manager 5.4.1 was used for data extraction and meta-analysis, where the standard mean difference (SMD) and 95% confidence interval (95%CI) were computed. Eight randomized control trials with a total of 1379 participants were included in this meta-analysis. Six trials assessed Montreal Cognitive Assessment scores, where its pooled analysis suggested that Tai Chi was as effective as conventional exercise (SMD=0.15, 95%CI: -0.11 to 0.40, p=0.26). However, pooled analysis of the Mini-Mental Status Examination suggested that Tai Chi intervention more effectively improved cognitive function and reduced the rate of cognitive impairment in elderly patients (SMD=0.36, 95%CI: 0.18 to 0.54, p<0.01) as compared to the control group. This systematic review and meta-analysis suggest that, in some extent, Tai Chi is efficacious in improving cognitive function and slowing down the rate of cognitive impairment among elderly patients.

Keywords: Elderly, cognitive impairment, non-invasive treatment, Chinese traditional exercise, Tai Chi exercise

Introduction

Mild cognitive impairment (MCI) was introduced as a classification for the elderly experiencing slight cognitive decline without reaching the level of dementia, where there is a decline in memories and thinking abilities that happens within age [1,2]. The progressive decline in cognitive function poses the risk of eventual dementia onset in patients [3]. Apparently, there is no exact cause for developing MCI [2]. According to a cohort study of memory in an international

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consortium (COSMIC), MCI prevalence is estimated to range from 6–12% globally [4]. The prevalence of MCI is likely to increase in the coming years due to the aging of the global population. Therefore, it is crucial to develop effective strategies to prevent or delay cognitive declining state.

There are no effective medications yet approved [3], but accumulating evidence from randomized clinical trials (RCTs) indicated that physical activity could benefit the cognitive functions in MCI patients. According to the meta-analysis by Zhou *et al.*, [5] the process of movement actuates the relevant brain areas and stimulates the excitability of brain cells, which helps strengthen the brain, maintain its perceptual functions, and improve the memory of the elderly. Hence, Tai Chi can be one of the strategies to lower the cognitive deterioration process [5]. Tai Chi is capable of training cognition, postponing, and counteracting the detrimental effects of neurocognitive illnesses, and improving cognitive function in individuals [6]. However, Tai Chi differs from other types of exercise in several aspects, as it incorporates the theory of five traditional Chinese medicine elements, which consist of water, wood, fire, metal, and earth that become the foundation for each movement. It also combines physical movement with respiration, mind with consciousness, consciousness with the body, and *qi* with the body [5]. The novelty of using Tai Chi as a treatment for MCI lies in its unique combination of physical exercise and mind-body practice that can be adapted to different levels of physical ability, which may have limitations in mobility or balance. This mind-body exercise is non-invasive and can be easily adapted for anyone, especially elderly patients. The aim of this systematic review and meta-analysis was to evaluate the efficacy of Tai Chi in improving MCI among the elderly population.

Methods

Study design and protocol registration

A systematic review and meta-analysis were conducted to assess the potency of Tai Chi as one of the non-invasive alternative treatments for MCI among elderly. This systematic review and meta-analysis followed the preferred reporting items for systematic reviews and meta-analysis protocol (PRISMA). This study was registered in PROSPERO with registration number CRD42023489212.

Study eligibility criteria

The inclusion criteria of this meta-analysis refer to the patient, intervention, control, outcome, time, and settings (PICOTS) framework. The patients were elderly with mild cognitive impairment with Tai Chi exercise as an intervention. The control included the conventional exercise group, patients who received education regarding fall prevention and cognition exercise, and the patient group who were given no treatment. The primary outcome was improved global cognitive function measured by the Montreal Cognitive Assessment (MoCA), mini-mental state examination (MMSE), and Trail Making Test B-A (TMT B-A). The time was from 2014 to 2023, and the setting was RCT. After assessing the eligibility of each study, studies with MCI cases caused by cerebral space-occupying lesion or craniocerebral trauma, those non-retrievable/incomplete studies, and non-English literature were excluded.

Search strategy

Two authors (FAG and JAHR) independently performed the literature searches and analysis through four databases, PubMed, ScienceDirect, Google Scholar, and Europe PMC, as of April 13, 2023. The keywords that were used were: "Tai Chi “AND "mild cognitive impairment" OR "MCI" AND "Elderly" OR “Elders” OR “geriatric patients". A detailed search strategy used in each database is presented in **Table 1**.

Table 1. Search strategy used in each database

Database	Keywords
PubMed	#1 mild cognitive impairment [MeSH Terms] #2 ((mild cognitive impairment*[Title/Abstract] OR (“MCI” [Title/Abstract])) #3#1 OR #2 #4 “Tai Chi” [Supplementary Concept] #5 ((“Tai Chi “[Title/Abstract]) OR (Tai Chi exercise [Title/Abstract]))) #6#4 OR #5 #7 ((“Elderly” [Title/Abstract] OR “Elders” [Title/Abstract] OR “Geriatric Patients” [Title/Abstract])) #8#3 AND #6 AND #7 #9#3 AND #6 AND #7, Filter: randomized controlled trial
ScienceDirect	("Tai Chi “) AND ("mild cognitive impairment") OR ("MCI") AND ("Elderly") OR ('Geriatric Patients") AND (“Randomized Controlled Trial”) OR (“RCT”)
Google Scholar	("Tai Chi “) AND ("mild cognitive impairment") OR ("MCI") AND ("Elderly") OR ('geriatric patients") AND (“randomized controlled trial”) OR (“RCT”)
Europe PMC	("Tai Chi “) AND ("mild cognitive impairment") OR ("MCI") AND ("Elderly") OR ('geriatric patients")

Data extraction

After analyzing and assessing the studies’ eligibility, two authors (FAG and DDCHR) strained the data, and all the disagreements during the process were discussed with the other two authors (JAHR and RNR). Eligible studies were screened based on the inclusion criteria and eliminated based on the exclusion criteria. Included studies were assessed further with quantitative and qualitative synthesis. The authors then examined the characteristics of the studies, the experimental and the control group, the follow-up characteristics, and the risk of bias from all of the included studies in this meta-analysis.

Quality assessment

The risk of bias in included studies was assessed using the revised Cochrane risk-of-bias tool for randomized trials (RoB 2.0). Afterward, the results were inputted into the "bias" section of the spreadsheet. The spreadsheet was then uploaded to the ROBVIS website to effectively display the assessment result using the traffic light system.

Quantitative synthesis

Review Manager 5.4 software (Cochrane collaboration, Oxford, UK) was used for the meta-analysis. Clinical outcomes from continuous data were reported as standardized mean difference (SMD) and 95% confidence interval (CI) and presented using a forest plot. The I^2 method was used to calculate statistical heterogeneity (I^2>50% was p<0.1). A random effect model was used to conduct additional analysis when the meta-analysis revealed significant heterogeneity. Publication bias based on Begg’s funnel plot would be assessed if at least ten studies were included.

Results

Study selection process

The database search, consisting of PubMed, ScienceDirect, Europe PMC, and ClinicalKey yielded a total of 985 articles. The articles were exported and followed by duplication removal. Two independent authors (FAG and JAHR) screened the articles by going through the title and abstracts. The number of articles remaining for retrieval was 164. Some of the articles that cannot be retrieved due to access restriction nor having no full-text were removed. Eighty full-text reports were assessed for eligibility. A total of 72 articles were removed based on inclusion and exclusion criteria due to wrong study design, wrong comparator, wrong outcome, and the studies retrieved were not written in English, leading to 8 studies included in this study. The summary of the screening and selection process is illustrated in the PRISMA schematic diagram presented in **Figure 1**.

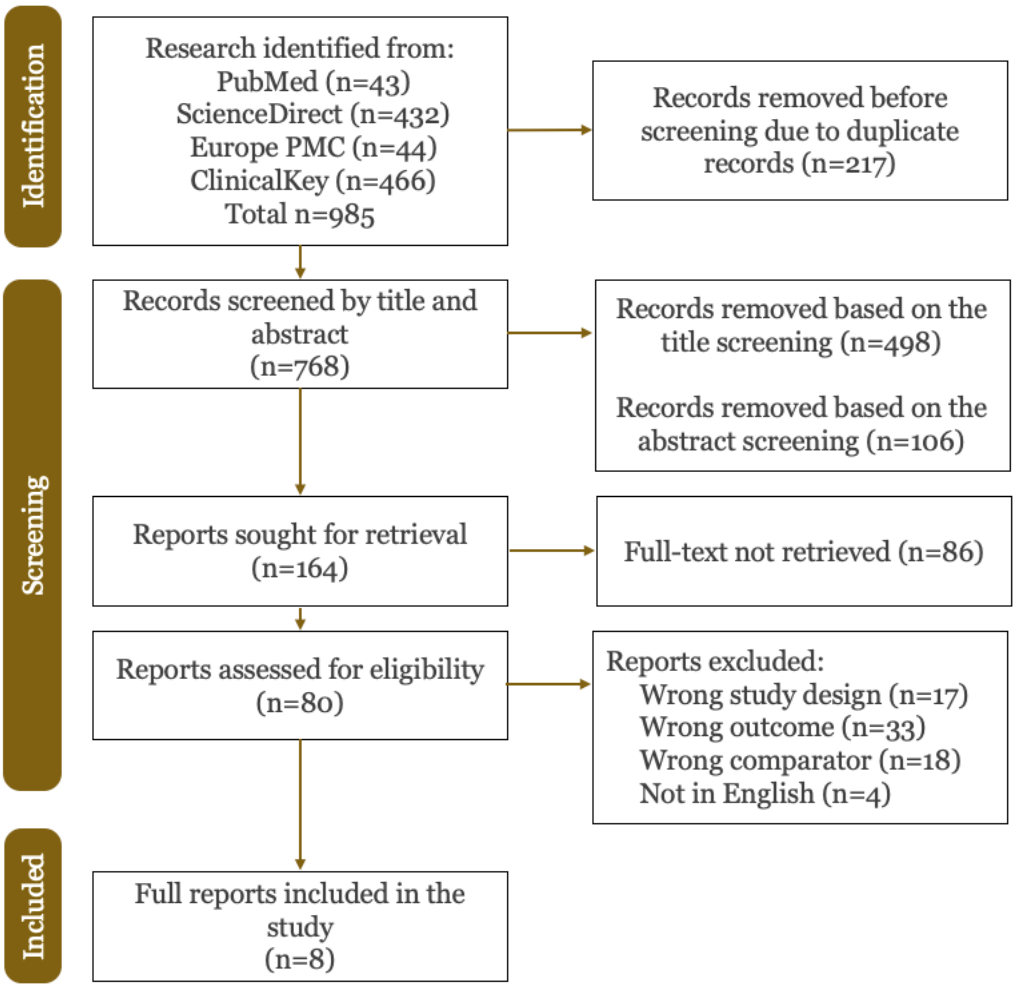

Figure 1. PRISMA schematic diagram for the screening and selection of eligible studies.

Characteristics of the included studies

All the included studies are randomized controlled trials. Out of eight RCTs, five were reported from China [7,8,9,12,13], one from Taiwan [14], one from Australia [10], and one from Thailand [11]. Most of the training interventions programs used in the studies were Tai Chi training style, except one study from Xia *et al.*, [12] that used Baduanjin exercise training. MoCA and MMSE, the primary outcomes, were utilized to measure global cognitive function in .

The primary outcome that measures global cognitive function used in all studies is MoCA and MMSE. As for the secondary outcomes, measurements include TMT B-A, Instrumental Activities of Daily Living (IADL), Timed Up and Go Test (TUGT), Victoria Stroop test, Digit-Span Forward Test, and Digit-Span forward-backward Test. All of the included study characteristics are presented in **Table 2**.

Quality assessment

The risk of bias (RoB 2.0) quality assessment was employed to assess the quality of the included trials, where the results are presented in **Figure 2** and **Figure 3.** All the included studies are of low risk of bias under all domains except the bias in selection of the reported results with only 75% being low risk. The risk of bias itself assessed five different domains, including the bias arising from the randomization process, bias due to deviations from intended interventions, bias due to missing outcome data, bias in measurements outcome, and bias in the selection of the reported result.

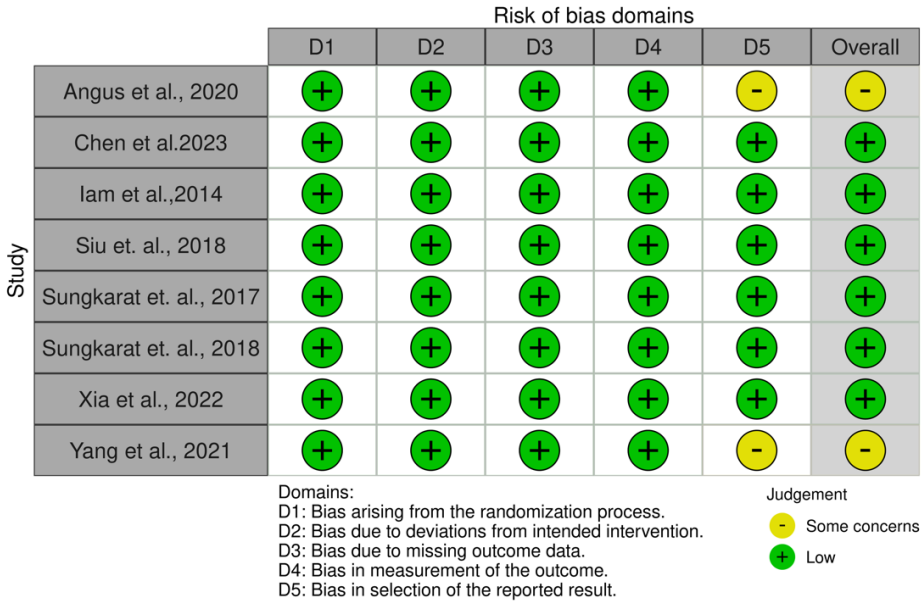

Figure 2. Risk of bias quality assessment graph.

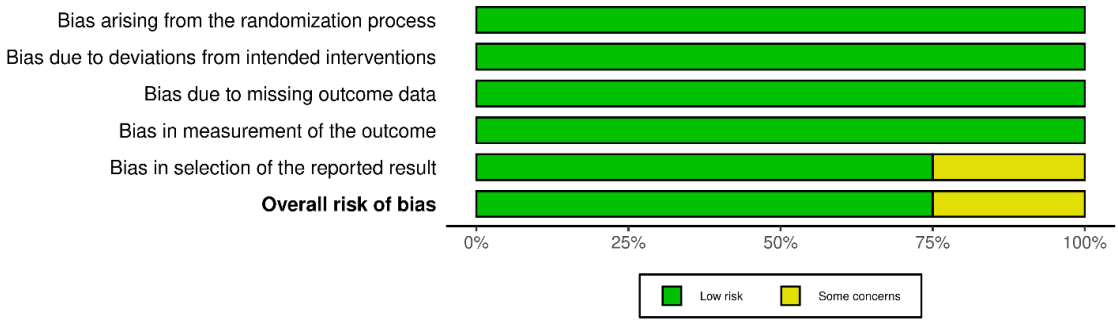

Figure 3. Percentage of the quality assessment according to the five domains.

Effectiveness of Tai Chi based on Montreal Cognitive Assessment

Six trials were included in the meta-analysis to assess the effectiveness of Tai Chi training style on MoCA scores, where the results are presented in **Figure 4**. The results suggested that Tai Chi was not significantly different in improving cognitive function and reduced the rate of cognitive impairment among elderly patients as compared to the control group (SMD=0.15, 95%CI: -0.11 to 0.40, p=0.26). The heterogeneity among the studies was found to be low and non-significant (I^2=44%, p= 0.11).

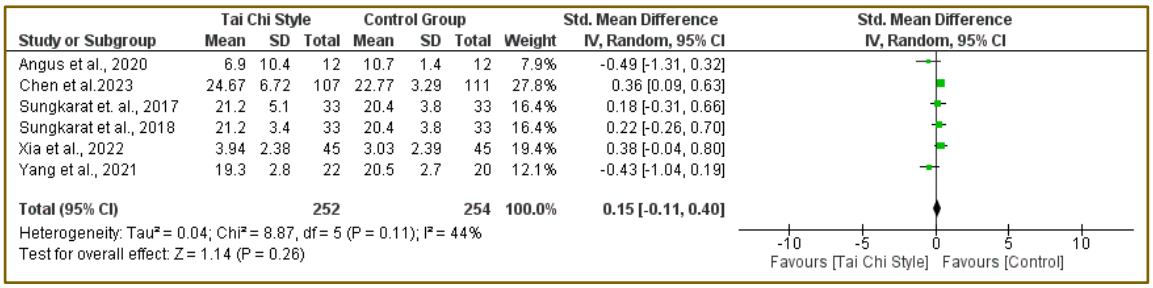

Figure 4. Forest plot showing the effectiveness of Tai Chi to reduce cognitive impairment in the elderly assessed using MoCA scores compared to control.

Table 2. Characteristics of the included randomized controlled trials

Author [Ref]	Year	Country	Intervention training received	Control group	Total patients, n	Age (year)	Primary outcome	Secondary outcome	Follow-up period
Angus *et al.* [7]	2020	China	Tai Chi style	Conventional exercise	34	≥ 50	MoCA	TMT B-A, Victoria Stroop test, DST (forward and backward)	24 weeks
Chen *et al.* [8]	2023	China	Tai Chi	Fitness group, control group	328	≥60	MoCA	Wechsler memory quotient, digit symbol substitution test, Trail-Making Test (part B), Boston Naming Test, Rey-Osterrieth Complex Figure Test	24 weeks
Siu *et al.* [9]	2018	China	Yang-style simple form of Tai Chi	Recreational activity	160	≥60	MMSE	Instrumental activities of daily living-CV	16 weeks
Sungkarat *et al.* [10]	2017	Australia	Tai Chi	Control group	66	60 (5.9)	MoCA, MMSE	TMT B-A, DST (forward and backward)	12 weeks
Sungkarat *et al.* [11]	2018	Thailand	Tai Chi	Control group	66	68.3 (6.7)	MoCA, MMSE	TMT B-A, DST (forward and backward)	3 weeks
Xia *et al.* [12]	2022	China	Baduanjin exercise training	Brisk walking	135	66.16 (4.16)	MoCA	None	24 weeks
Lam *et al.* [13]	2014	Hong Kong, China	Tai Chi	Stretching and relaxation exercise	548	≥ 65	MMSE	Alzheimer's Disease Assessment Scale-Cognitive Subscale, DST (backward), visual span (backward)	1 year
Yang *et al.* [14]	2021	Taiwan	Tai Chi style multi-component exercise program	Conventional care	42	83.1 (5.7)	MoCA, MMSE	TMT A-B, DST (forward and backward)	24 weeks

DST, digit span test; MMSE, mini-mental state examination; MoCA, Montreal Cognitive Assessment; TMT B-A, trail making test B minus A.

Effectiveness of Tai Chi based on mini-mental state examination

In the meta-analysis of MMSE, five trials were included. The results showed that Tai Chi significantly improved cognitive function and slow down the rate of cognitive impairment among elderly patients (SMD=0.36, 95%CI 0.18 to 0.54, p<0.01). The heterogeneity among the studies was found to be low and non-significant (I^2=11%, p=0.34) (**Figure 5**).

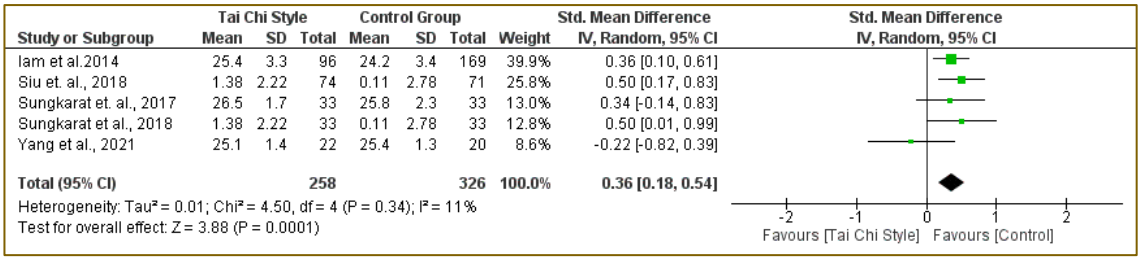

Figure 5. Forest plot showing the effectiveness of Tai Chi to reduce cognitive impairment in elderly assessed using MMSE compared to control.

Effectiveness of Tai Chi based on Trail Making Test B minus A

Five trials were included in the meta-analysis assessing the effectiveness of Tai Chi on TMT B-A, and the results show that Tai Chi improved cognitive performance and rate of cognitive impairment in elderly patients as effectively as other physical exercises (SMD=-1.21, 95%CI: -3.19 to 0.77, p=0.23). The heterogeneity of the pooled estimates was non-negligible (I^2=98%, p=0.23) (**Figure 6**).

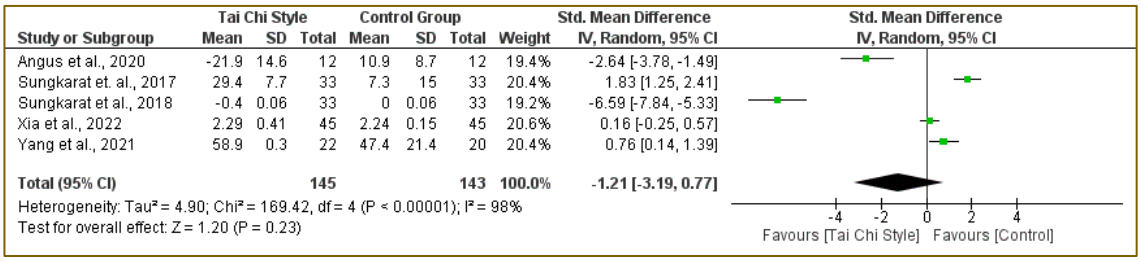

Figure 6. Forest plot showing the effectiveness of Tai Chi to reduce the rate of cognitive impairment in the elderly assessed using trial making test B minus A (TMT B-A) compared to the control.

Effectiveness of Tai Chi based on digit span backward

Five trials were included in the meta-analysis assessing the effectiveness of Tai Chi on Digit Span Backward. The results indicated no significant difference in cognitive performance and rate of cognitive impairment among elderly patients as compared to control group (SMD=0.51, 95%CI: -0.09 to 1.12, p=0.10). Significantly high heterogeneity was found among the pooled trials (I^2=87%, p<0.01) (**Figure 7**).

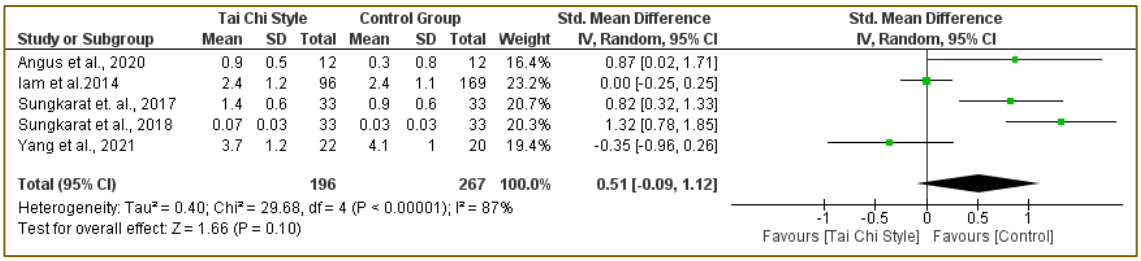

Figure 7. Forest plot of digit span backward that assessed cognitive function between the two groups.

Other cognitive function measurements (Qualitative)

Herein, meta-analysis could not be performed on other cognitive function measurements such as the Victoria Stroop test, verbal fluency test, TUG test, and IADL due to a small number of trials.

However, one of the trials by Siu *et al.* [9] found Tai Chi training helped participants to maintain functional abilities assessed using IADL score in elderly patients with cognitive impairment.

Analysis of the publication bias

Begg's funnel plot was not constructed because the number of the included studies did not reach ten. A previous study has concluded that publication bias analysis consisting of less than ten studies would not be reliable [15].

Discussion

The present systematic review and meta-analysis showed that elderly patients with mild cognitive impairment who practiced Tai Chi had a better improvement within their cognition when compared to control group based on the MMSE score. However, a significant difference between Tai Chi and the control group was not found for MoCA. This result appears due to one of the pooled studies, Chen *et al.* [8], which recruited MCI patients with type 2 diabetes mellitus (a condition that can affect the patients' cognition, memory, and other executive functions) [16]. The results of the present study align with the study by Liu *et al.* [17] which reported the improved executive functions within elderly patients who practiced Tai Chi as compared to the control group. The result from Nguyen *et al.* [18] also suggested a similar result where Tai Chi group has better outcome in executive functions, which is represented by the TMT B-A test result as the test represents the ability cognitive flexibility of the patients [18,19].

Tai Chi effectively addresses age-related physiological changes, especially contributing to improved cardiovascular and lung function. As individuals age, there is a gradual degeneration of physiological functions [20]. The practice of Tai Chi involves gentle and uniform motions, fostering a peaceful and concentrated state of mind that reduces stress on the exerciser's autonomic nerve centers in the brain. This reduction in stress positions leads to decreased activation of nerve endings, releasing norepinephrine and promoting the secretion of statins by the myocardium. Consequently, cardiovascular motor nerves are stabilized, the elasticity of cardiovascular smooth muscle is improved, total peripheral resistance is reduced, and cardiovascular reactivity is enhanced, particularly in terms of diastolic ability. Studies have consistently demonstrated a positive correlation between Tai Chi exercise and improved cardiovascular and lung function in the elderly, showcasing its potential to positively influence blood conditions, arterial blood pressure, endothelial diastolic function, atherosclerosis reduction, respiratory ease, lung function, and cardiac function index [20]. A meta-analysis by Nichols *et al.*, [21] reported the positive effects of Tai Chi on blood pressure (BP) control, where reductions were found in both systolic and diastolic BP levels. In individuals with prehypertension and hypertension, Tai Chi training has demonstrated the potential to lower BP, offering a valuable approach to managing this cardiovascular risk factor, as well as Tai Chi emerging as an antihypertensive lifestyle therapy [22,23].

A study demonstrated Tai Chi efficacy in lowering anxiety and stress, expressing its impact on neuropsychiatry field [24]. Patients who received Tai Chi as the intervention also experienced significant improvement in Quality of Life (QoL). Taylor and Finley [25] discovered that people with coronary heart disease in the Tai Chi groups reported considerably better mental health QoL than participants in the control groups. In addition, Tai Chi also demonstrates favorable effects on musculoskeletal health. Previous study demonstrates that Tai Chi improves balance ability among older adults with MCI due to its movements [10,26]. Tai Chi has shown potential in improving balance ability, muscle strength and endurance around the knee, flexibility of the knee joint, and cardiopulmonary function in individuals with knee osteoarthritis [10,26]. Some studies have suggested that Tai Chi exercise has positive effects on knee osteoarthritis [27,28]. The improvements in knee joint proprioception and knee extension strength, as well as the reduction in postural sway, are probably due to the features of Tai Chi, which emphasize sequential movements carried out with alternate flexion and extension of lower limb joints, changing the direction of limb movements, dynamic weight shifting, and single limb support [10]. Tai Chi integrates diaphragmatic breathing and relaxation with slow, gentle movements, encompassing both isometric and isotonic exercises, all while maintaining proper postures. Tai Chi features weight-bearing steps on both lower extremities, characterized by a gentle heel strike facilitated

by deliberate foot placement. The slow, controlled motions of Tai Chi serve as a low-impact exercise, reducing the risk of musculoskeletal injuries [28]. This makes Tai Chi an accessible option for individuals across various age groups and fitness levels, contributing to the overall health of the musculoskeletal system.

The present study is subject to certain limitations. A low number of studies included along with high heterogeneity in the pooled analysis suggests the evidence is moderate. Variables that affected the heterogeneity were not analyzed in this study. We did not contact the experts researching Tai Chi to manage MCI, which may result in selection bias. Selection bias might also be derived from the limited database used to identify the published records.

Conclusion

The implementation of Tai Chi in elderly patients with MCI has been demonstrated to enhance cognitive function and potentially mitigate the rate of cognitive decline, as evidenced by the pooled MMSE scores. It is noteworthy that pooled analyses of other cognitive measures indicated that Tai Chi yielded similar benefits to other forms of physical exercise. However, due to its nature of being low-impact exercise, Tai Chi can be recommended for MCI management among elderly. Considering high heterogeneity in several pooled analyses, it is better to interpret our findings with cautions. Further RCTs with robust and uniform designs are still required to reveal the potential of Tai Chi for the MCI management.

Ethics approval

Not required.

Acknowledgments

We have no acknowledgements to declare.

Competing interests

All the authors declare that there are no conflicts of interest.

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Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request.

How to cite

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References

1. MayoClinic. Mild cognitive impairment (MCI). Available from: https://www.mayoclinic.org/diseases-conditions/mild-cognitive-impairment/symptoms-causes/syc-20354578. Accessed: 28 March 2023.
2. Portet F, Ousset PJ, Visser PJ, *et al*. Mild cognitive impairment (MCI) in medical practice: A critical review of the concept and new diagnostic procedure. Report of the MCI working group of the european consortium on alzheimer's disease. J Neurol Neurosurg Psychiatry 2006;77(6):714-718.
3. National Institute of Aging. What Is Mild Cognitive Impairment? 2021. Available from: https://www.nia.nih.gov/health/what-mild-cognitive-impairment. Accessed: 28 March 2023.
4. Hampel H, Lista S. The rising global tide of cognitive impairment. Nat Rev Neurol 2016;12:131-132.
5. Zou L, Loprinzi PD, Yeung AS, *et al*. The beneficial effects of mind-body exercises for people with mild cognitive impairment: A systematic review with meta-analysis. Arch Phys Med Rehabil 2019;100(8):1556-1573.

6. Lin R, Cui S, Yang J, *et al*. Effects of Tai Chi on patients with mild cognitive impairment: A systematic review and meta-analysis of randomized controlled trials. BioMed Res Int 2021;2021:5530149.
7. Angus YP, Chin EC, Yu DJ, *et al*. Tai Chi versus conventional exercise for improving cognitive function in older adults: A pilot randomized controlled trial. Sci Rep 2022;12(1):8868.
8. Chen Y, Qin J, Tao L, *et al*. Effects of Tai Chi Chuan on cognitive function in adults 60 years or older with type 2 diabetes and mild cognitive impairment in China. JAMA Netw Open 2023;6(4):e237004.
9. Siu M, Lee DTF. Effects of Tai Chi on cognition and instrumental activities of daily living in community-dwelling older people with mild cognitive impairment. BMC Geriatr 2018;18(1):37.
10. Sungkarat S, Boripuntakul S, Chattipakorn N, *et al*. Effects of Tai Chi on cognition and fall risk in older adults with mild cognitive impairment: A randomized controlled trial. J Am Geriatr Soc 2017;65(4):721-727.
11. Sungkarat S, Boripuntakul S, Kumfu S, *et al*. Tai Chi improves cognition and plasma BDNF in older adults with mild cognitive impairment: A randomized controlled trial. Neurorehabil Neural Repair 2018;32(2):142-149.
12. Xia R, Wan M, Lin H, *et al*. Effects of mind-body exercise Baduanjin on cognition in community-dwelling older people with mild cognitive impairment: A randomized controlled trial. Neuropsychol Rehabil 2023;33(8):1368-1383.
13. Lam LC, Chan WM, Kwok TC, Chiu HF. Effectiveness of Tai Chi in maintenance of cognitive and functional abilities in mild cognitive impairment: A randomised controlled trial. Hong Kong Med J 2014;20(3 Suppl 3):20-23.
14. Yang SY, Lee HC, Huang CM, *et al*. Efficacy of Tai Chi-style multi-component exercise on frontal-related cognition and physical health in elderly with amnestic mild cognitive impairment. Front Aging 2021;2:636390.
15. Lau J, Ioannidis JPA, Terrin N, *et al*. The case of the misleading funnel plot. BMJ 2006: 333(7568):597.
16. Aderinto N, Olatunji G, Abdulbasit M, *et al*. The impact of diabetes in cognitive impairment: A review of current evidence and prospects for future investigations. Medicine 2023 Oct 27;102(43):e35557.
17. Liu CL, Cheng FY, Wei MJ, Liao YY. Effects of exergaming-based Tai Chi on cognitive function and dual-task gait performance in older adults with mild cognitive impairment: A randomized control trial. Front Aging Neurosci 2022;14:761053.
18. Nguyen MH, Kruse A. A randomized controlled trial of Tai Chi for balance, sleep quality and cognitive performance in elderly Vietnamese. Clin Interv Aging 2012;7:185-190.
19. Arbuthnott K, Frank J. Trail making test, part B as a measure of executive control: Validation using a set-switching paradigm. J Clin Exp Neuropsychol 2000;22(4):518-528.
20. Sun L, Zhuang LP, Li XZ, *et al*. Tai Chi can prevent cardiovascular disease and improve cardiopulmonary function of adults with obesity aged 50 years and older. Medicine 2019;98(42):e17509.
21. Nichols M, Townsend N, Scarborough P, *et al*. Trends in age-specific coronary heart disease mortality in the European Union over three decades: 1980–2009. Eur Heart J 2013;34(39):3017-3027.
22. Lan C, Chen SY, Wong MK, *et al*. Tai Chi Chuan exercise for patients with cardiovascular disease. Evid Based Complement Alternat Med 2013;2013:983208.
23. Wu Y, Johnson BT, Chen S, *et al*. Tai Ji Quan as antihypertensive lifestyle therapy: A systematic review and meta-analysis. J Sport Health Sci 2021;10(2):211-221.
24. Yang G, Li W, Klupp N, *et al*. Does Tai Chi improve psychological well-being and quality of life in patients with cardiovascular disease and/or cardiovascular risk factors? A systematic review. BMC Complement Med Ther 2022;22(1):3.
25. Taylor-Piliae RE, Finley BA. Tai Chi exercise for psychological well-being among adults with cardiovascular disease: A systematic review and meta-analysis. Eur J Cardiovasc Nurs 2020;19(7):580-591.
26. Hu L, Wang Y, Liu X, *et al*. Tai Chi exercise can ameliorate physical and mental health of patients with knee osteoarthritis: Systematic review and meta-analysis. Clin Rehabil 2021;35(1):64-79.
27. Kong LJ, Lauche R, Klose P, *et al*. Tai Chi for chronic pain conditions: A systematic review and meta-analysis of randomized controlled trials. Sci Rep 2016;6:25325.
28. Mudano AS, Tugwell P, Wells GA, *et al*. Tai Chi for rheumatoid arthritis. Cochrane Database Syst Rev 2019;9(9):CD004849.