This article is protected by copyright. To share or copy this article, please visit copyright.com. Use ISSN#1078-6791. To subscribe, visit alternative-therapies.com

META-ANALYSIS

The Value of Sports and Functional Exercise on Preventing Falls in Elderly Patients with Cognitive Impairment: A Systematic Review and Meta-Analysis

Sulan Long, PhD(c); Khanitta Nuntaboot, PhD; Suvapat Nakrukamphonphatn, PhD(c); Threenush Kumtanat, PhD(c); Wangqiao Zhu, PhD(c); Yinghui Hu, MM; Huan Xie, MM

ABSTRACT

Objective • To explore the value of sports and functional exercises in preventing falls in elderly patients with cognitive impairment.

Methods • PubMed, EMBASE, Cochrane Library, China National Knowledge Infrastructure, VIP, Wanfang Database, and China Biomedical Literature Database (CBM), from inception to January 2023, were used to search the randomized controlled trials (RCTs) of sports and functional exercises in elderly patients with cognitive impairment. Two independent researchers extracted the data and evaluated the quality of the included literature. RevMan5.4 software was adopted for data analysis.

Results • The results indicated that exercise combined with functional exercise could noticeably enhance the fall effect score and shorten the Timed Up and Go Test (TUGT) time of elderly patients with cognitive impairment compared to simple drug treatment ($P < .05$). Our results showed that the exercise combined with functional exercise can noticeably prolong the standing time of elderly patients with cognitive impairment upon monocular eye closure. Our results also showed that exercise combined with functional exercise can noticeably improve the fear of falls in elderly patients with cognitive impairment.

Conclusion • Sports and functional exercise intervention can promote the balance ability and fall self-efficacy of elderly patients with cognitive impairment and have a positive effect on enhancing patients' fear of falls. The findings need to be further verified and methodological quality needs to be improved. In addition, longer intervention times are required to verify the findings. (*Altern Ther Health Med.* [E-pub ahead of print.])

Sulan Long, PhD Candidate, Faculty of Nursing, Khon Kaen University, Khon Kaen Province, Khon Kaen, Thailand; Faculty of Nursing, Nanchang Medical College, Jiangxi Province, Nanchang, China. **Khanitta Nuntaboot, PhD; Suvapat Nakrukamphonphatn,** PhD Candidate**; Threenush Kumtanat,** PhD Candidate**; Wangqiao Zhu,** PhD Candidate**;** Faculty of Nursing, Khon Kaen University, Khon Kaen Province, Khon Kaen, Thailand. **Yinghui Hu, MM,** Faculty of Nursing; **Huan Xie, MM,** Academic Affairs Office; Nanchang Medical College, Jiangxi Province, Nanchang, China.

Corresponding author: Yinghui Hu, MM
E-mail: huyinghui1103@163.com
Corresponding author: Huan Xie, MM
E-mail: xie_huan@ncmc.edu.cn

INTRODUCTION

A serious tumble can lead to catastrophic events such as fractures and even death in the elderly, which is an urgent public health problem to be solved today.[1] There are many studies on the incidence of tumble among the elderly. However, because the study of the elderly population is different, the research results are also different. Every year, about 1/3 of people over the age of 65 years tumble which is accompanied by serious physical injuries. Some studies have indicated that the incidence of tumble in elderly women is higher than that in men and the incidence of tumble increases gradually with the increase of age.[2] Tumbles are steadily increasing in both developed and developing countries and falls and injuries among the elderly are increasing as well.[3,4]

Tumbles mainly occur at home, on roads, in hospitals, in nursing homes, in bedrooms, and in other adverse living environments. The studies have indicated that about 44% of tumbles among the elderly in China occur in their own homes and living rooms, restaurants, and bedrooms are the most obvious indoor places. About 22% to 67% of tumbles occur on outdoor streets or sidewalks.[5] After an elderly individual tumbles, soft tissue injury and even fracture can be caused, in which hip fracture is one of the most common and serious injuries.[6] In addition, after a tumble, there will be persistent physical pain, even paralysis and other health problems and eventually the elderly may lose the ability to live independently.[7] The key source of income among the aged in our country is

This article is protected by copyright. To share or copy this article, please visit copyright.com. Use ISSN#1078-6791. To subscribe, visit alternative-therapies.com

family pension. Once the elderly at home falls, it will increase the economic burden on the family.

Cognitive impairment is a vital risk factor for tumbles in the elderly. The incidence of tumbles in the elderly with moderate to severe cognitive impairment is at least twice that of the healthy elderly and the annual fall rate of the former is as high as 60% to 80%.[8] The consequences of tumbles in the elderly with cognitive impairment are very serious. Compared with the elderly without dementia symptoms, the incidence of hip fracture in patients with senile dementia is 3 times higher.[9] However, since their recovery after the tumble is not promising, they need to enter professional nursing institutions for long-term rehabilitation treatment. Thus, it can be noticed that the incidence of tumbles in the elderly with cognitive impairment is higher and the harm is greater. In China, the research on tumbles in the elderly started relatively late and related studies focused on the effects of traditional sports such as epidemiology, risk factors, preventive measures, and tai chi on body balance and muscle strength of lower extremities. Some scholars on the tumble of the elderly suggested preventive measures and multiple combined exercises derived from general sports to special exercises and core strength exercises.[10] In addition, some studies have also discussed the tumble risk factors of the elderly from different angles, and some of the research results have been widely adopted. It has provided a certain theoretical and practical basis for research on the prevention of falls by exercise.[11] The exercise methods include aerobic exercise, resistance exercise, core strength, and balance exercises. Using the meta-analysis method, we evaluated the existing research on sports and functional exercises in elderly cognitively impaired patients. The clinical value of sports and functional exercise have been evaluated in preventing tumbles among elderly patients with cognitive impairment to obtain more reliable conclusions and the best evidence.

MATERIALS AND METHODS

Sources and retrieval methods of documents

PubMed, EMBASE, Cochrane Library, China National Knowledge Infrastructure, VIP, Wanfang Database, and China Biomedical Literature Database (CBM), from inception to January 2023, were used to search the randomized controlled trials (RCTs) on sports and functional exercises in elderly patients with cognitive impairment. Literature retrieval was conducted when forming free and subject words, with the keywords: functional exercise; sports; and cognitive impairment.

Inclusion and exclusion criteria

Inclusion criteria. (1) The type of study: all RCTs of sports and functional exercise in elderly patients with cognitive impairment in China. There was only one language available, Chinese; (2) subjects: elderly patients with Parkinson's disease (PD) met the diagnostic criteria of PD made by the neurology branch of the Chinese Medical Association and Parkinson's disease group;[12] (3) intervention: based on simple drug treatment, the treatment group combined with sports and functional exercise such as Taijiquan, Baduanjin, and yoga, while the control group only received simple drug treatment.

Exclusion criteria. (1) No randomized control trial was conducted; (2) incomplete report; (3) the content of the research was repeated and the most recent research was presented; (4) the study did not seem to have a noticeable curative effect.

Quality evaluation and data extraction

(1) Bias risk assessment contained in the study: To conduct the evaluation, Cochrane System Review Manual 5.3 recommended that bias risk assessment be adopted. (2) Literature screening and data extraction: it was conducted independently by two authors who screened literature, gathered data, assessed quality, and compared the results. It is important to resolve differences of opinion or seek the help of a third researcher when there are differences. A document management system called Note Express was used to manage and extract research data, along with Excel's Office suite for data analysis. Should the literature contain incomplete data, the writer of the article will be contacted. During data extraction, we gathered (1) basic information such as author, publication date, and number of cases; (2) intervention measures such as dose and course of treatment; and (3) outcome index.

Statistical analysis

Meta-analysis was carried out using RevMan 5.4 software. The mean difference (MD) along with 95% CIs was calculated for continuous data. Cochrane's Q, tau-squared, and *I*-squared (I^2) were used to assess the heterogeneity. Heterogeneity values of 25%, 50%, and 75% are indicative of low, moderate, and high heterogeneity, respectively. $P > .10$, $I^2 < 50\%$ showed that research results did not reveal statistical heterogeneity, and in such cases, combined analyses were conducted using the fixed-effect model; otherwise, the random-effect model was used. To assess funnel plot asymmetry, Eggers' test was used.

RESULTS AND ANALYSIS

The literature retrieval and the basic situation of literature inclusion

An analysis of 2783 articles was conducted using a computer database; 312 were selected after eliminating repeated studies; and 103 titles and abstracts were collected from preliminary reading literature. Several irrelevant studies, reviews, case reports, and control literature were excluded from the review. In the beginning, there were 57 articles included in the review. After carefully reading the full texts, 50 articles with incomplete data or no key outcome indicators were eliminated, leaving 7 RCTs.[13-19] Meta-analysis included 575 samples in total. Table 1 summarizes some of the main characteristics of the literature.

This article is protected by copyright. To share or copy this article, please visit copyright.com. Use ISSN#1078-6791. To subscribe, visit alternative-therapies.com

Table 1. Basic Characteristics of Literature

Include the literature	Year of publication	n (C/T)	Intervention method		Outcome index	Experimental time	Random or not	Blind or not
			Control group	Treatment group				
Song Bo	2020	55/55	Routine health guidance	Routine health guidance + moderate physical exercise	①②	12 months	Yes	No
Guan Xihong	2017	40/40	Basic drug therapy + routine walking	Basic drug therapy + simplified 24-style Taijiquan training	①③④	24 weeks	Yes	No
Li Bo	2017	30/30	Routine treatment in the Department of Neurology	Routine treatment + Taijiquan training	①③④	12 weeks	Yes	No
Zhu Xiaogang	2017	50/50	Routine nursing in the Department of Neurology	Routine nursing + yoga training in Department of Neurology	①②③④⑤	24 weeks	Yes	No
Shi Xiaoyan	2017	52/52	Walking practice	Baduanjin Movement	①③④⑤	12 weeks	Yes	No
Ji Suqiong	2016	19/19	Basic drug therapy	Basic drug therapy + Taijiquan training	①②④	3 months	Yes	No
Zhang Xiya	2020	41/42	Balance pad training	Balance pad training + Baduanjin exercise	②⑤⑥	3 months	Yes	No

Abbreviations: C is control group; T is treatment group; ① Balance function score; ② Fall rate; ③ MFES score; ④ FOF cases; ⑤ TUGT time; ⑥ Walking ability

Figure 1. Risk of Bias Chart

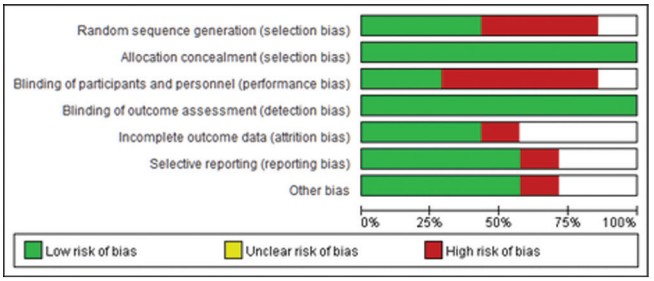
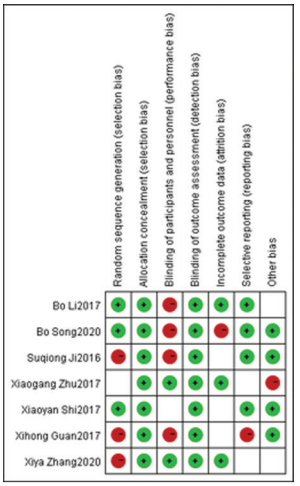


Figure 2. Risk of Bias Summary Chart



Evaluation of the quality of the methodology contained in the literature

The literature review found seven RCTs, of which one involved "random assignment" with no explanation. The interventions and follow-up periods of 7 RCTs were detailed. A total of seven RCTs failed to explain in detail why blind methods were used or why follow-up was lost or withdrawals occurred. Jadad's scale indicates that 7 articles have RCTs ≤ 2 points. In Figures 1 and 2, we show the results of the risk bias analysis.

Results of meta-analysis

Balance score. There were seven RCT studies contained, with 575 samples. The balance ability score of the meta-analysis indicated that $\chi^2 = 1014.48$, df = 4, $P < .00001$, $I^2 = 100\%$, indicating that the research data used in the study showed distinct heterogeneity. In the test of combined effect dose (weighted mean difference, WMD), Z = 12.57 was used as the combined effect dose test, which was derived using the fixed effect model ($P < .00001$). Compared with drug therapy alone, there exhibited a noticeable difference in the effect of sports and functional exercise on the balance ability of elderly patients with cognitive impairment. The 95% confidence line of WMD fell to the right of the invalid line, showing that increasing sports and functional exercise based on routine basic drug therapy could remarkably promote the balance ability of elderly patients with cognitive impairment, as indicated in Figure 3.

Figure 3. Forest Plot of Meta-Analysis of Balance Ability Score

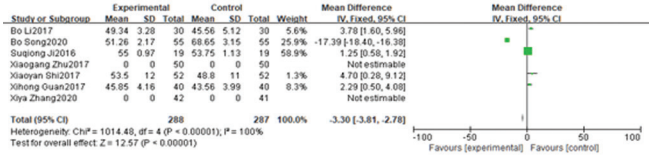
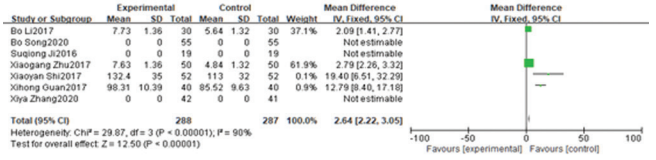


Figure 4. Forest Plot of Meta-Analysis of Fall Performance Score



Fall performance score. Seven RCT studies contained a total of 575 samples. The fall performance score was measured by meta. The results of the heterogeneity test indicated that: $\chi^2 = 29.87$, df = 3, $P < .00001$, and $I^2 = 90\%$ with heterogeneity among the research data. The test of combined effect dose WMD was Z = 12.50 ($P < .00001$). Compared with basic drug therapy alone, sports combined with functional exercise could remarkably enhance the fall performance score of elderly patients with cognitive impairment. As the 95% confidence horizontal line of WMD falls on the right of the invalid line, and hence the conclusion is invalid ($P < .05$), as indicated in Figure 4.

Timed Up and Go Test (TUGT) time. The TUGT time between meta-analyses was used. The results of the heterogeneity test indicated that the research data contained distinct heterogeneity. $\chi^2 = 7.94$, df = 1, $P = .005$, $I^2 = 87\%$. This indicated that the research data contained in the study showed distinct heterogeneity. An analysis of the combined effect dose (WMD) was conducted using a random effect model. WMD (combined effect dose) was calculated at Z = 4.51 ($P < .00001$). It was considered that there exists a

This article is protected by copyright. To share or copy this article, please visit copyright.com. Use ISSN#1078-6791. To subscribe, visit alternative-therapies.com

Figure 5. Forest Plot of Meta-Analysis of TUGT Time

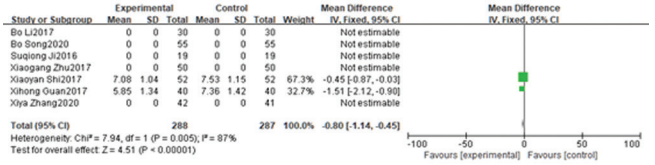


Figure 6. Forest Plot of Meta-Analysis of Standing Time with One Eye Closed

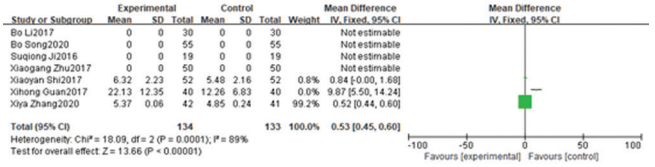


Figure 7. Forest Plot of Meta-Analysis of FOF Score

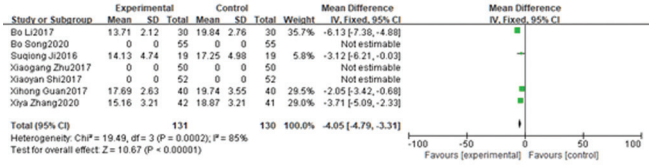
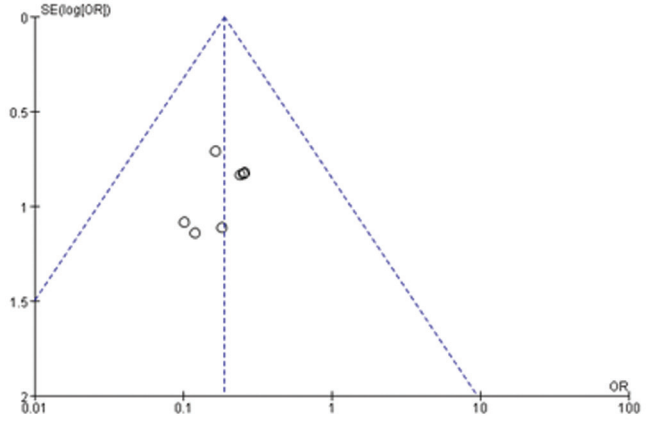


Figure 8. Inverted funnel Plot of Fall Rate in Elderly Patients with Cognitive Impairment



noticeable difference in the TUGT time of sports and functional exercise intervention in elderly patients with cognitive impairment compared with basic drug therapy alone, indicating that exercise and functional exercise intervention could remarkably shorten the TUGT time of elderly patients with cognitive impairment, as indicated in Figure 5.

Standing time with one eye closed. Meta was adopted to analyze the standing time with one eye closed. The results of the heterogeneity test indicated that $\chi^2 = 18.09$, df = 2, $P = .0001$, and $I^2 = 89\%$, implying that the research data contained distinct heterogeneity. Random effect models were used to calculate the combined effect dose WMD. The combined effect dose (WMD) was calculated as Z = 13.66 ($P < .00001$). It was considered that there exists a noticeable difference in the WMD of standing time with monocular eye closing in elderly patients with cognitive impairment treated with sports and functional exercise compared with basic drug therapy alone, indicating that sports and functional exercise intervention could remarkably prolong the standing time with monocular eye closure in elderly patients with cognitive impairment, as indicated in Figure 6.

Fear of fall (FOF) score. The results of the heterogeneity test indicated that $\chi^2 = 19.49$, df = 3, $P = .0002$, and $I^2 = 85\%$, indicating that the research data used in the study has distinct heterogeneity. A random effect model was used to calculate the combined effect dose WMD. In the combined effect dose test (WMD), the Z value was 10.67 ($P < .00001$). It was considered that there exists a noticeable difference in WMD of FOF score between sports and functional exercise intervention in elderly patients with cognitive impairment compared with basic drug therapy alone, indicating that sports and functional exercise intervention could remarkably enhance the fear of fall score in elderly patients with cognitive impairment, as indicated in Figure 7.

Publication bias. Based on the study of the patient's tumble rate as the outcome index, the publication bias analysis was carried out by using the inverted funnel chart. The results indicated that in addition to Egger's test showing $P = .0005$, there may be some publication bias in the figure, as indicated in Figure 8.

ANALYSIS AND DISCUSSION

Tumbles are usually the result of a combination of risk factors, including muscle strength, history of falls, gait disorders, balance disorders, visual disorders, arthritis, depression, cognitive impairment, age, and external environment. With the increase in the number of fall risk factors, the fall risk increases gradually. Cognitive impairment is also a potential risk factor for falls among the elderly, as pointed out by a recent review study.[20] In addition, Park et al. confirmed that global cognitive impairment was combined with an augmented risk of tumble and fracture caused by the fall.[21] Among them, attention and executive function are most related to tumbles. The incidence of tumbles in the elderly with moderate to severe cognitive impairment is at least twice as high as that in the healthy elderly and is more harmful.[11] The annual fall rate of the former is even as high as 60%-80%.[22]

In recent years, with the continuous development of fall self-efficacy research, the research focus has gradually shifted from medical care to exercise. However, different exercise methods have differences in outcomes concerning improving the fear of falls among the elderly. The common tools for evaluating the fall self-efficacy of the elderly include the fall self-efficacy scale, the Modified Falls Efficacy Scale (MFES), the international fall self-efficacy scale, and the Chinese version of MFES, but there is still a lack of self-designed tools to evaluate the social background of aging in China.[23] The Chinese version of MFES was introduced and translated by Chinese scholars with good reliability and validity. It is suitable for the elderly in China and can be adopted as a tool for evaluating fall self-efficacy.

This article is protected by copyright. To share or copy this article, please visit copyright.com. Use ISSN#1078-6791. To subscribe, visit alternative-therapies.com

At present, the research on the influencing factors of fall self-efficacy of the elderly includes age, sex, fall history, disease, physical activity, psychology, and so on. The fear of tumbles in the elderly will lead to a decrease in fall efficiency, which will lead to a series of negative physical and psychological effects. The research on tumble self-efficacy started early in some countries, and the content is also more in-depth. Li et al.[24] through the study of 59 elderly people in the community who were afraid of tumbles over 65 years old, the control group did not take exercise intervention, while the intervention group received balance exercises 3 times a week 45 minutes each time for 3 months.[24] The results indicated that the score of the international fall efficacy scale in the intervention group was remarkably improved, indicating that balance exercise reduced the fear of tumbles in the elderly. Shen et al. conducted a study in which the elderly were treated with physiotherapy and Pilates exercise for 6 weeks respectively.[25] The results indicated that after the implementation of Pilates exercise, the psychological fear of tumbles in the elderly was remarkably reduced.

At present, Chinese scholars' research on fall self-efficacy is mainly based on risk factors from the aspects of health education, psychotherapy, cognitive behavioral therapy, and scientific exercise by reducing risk factors. Taijiquan exercise, as a continuous aerobic exercise, has been adopted by most scholars and applied to the study of the impact of falls on the elderly. Chinese scholar Ma et al.[26] visited and investigated the elderly in the elderly activity center and community.[26] 53 elderly volunteers were included in the exercise intervention experiment. The control group maintained their normal living habits. 10 weeks later, the one-leg support time, 10 m round-trip walking time, straight flexion flexibility, and reaction ability were evaluated, and the Taijiquan group was compared with the control group. The balance ability, lower limb muscle strength, flexibility, and reaction ability were remarkably enhanced in the Taijiquan group, and the anti-fall ability was remarkably promoted. In another study, 32 elderly people were chosen and assigned to a control group (n = 16) and an experimental group (n = 16). The control group maintained their normal living habits and the experimental group performed Taijiquan exercises 3 times a week, each of 1 hour time duration for 16 weeks. Self-efficacy tests were performed before and after the experiment which included standing on one foot with eyes closed, sitting up 5 times, sitting forward, standing up-walking, and dual-task walking. The results indicated that Taijiquan improved the lower limb muscle strength, balance ability, posture control ability, and fall self-efficacy of the elderly in the experimental group and effectively reduced the risk of tumbles and fear of fall.[27]

Thus, it can be noticed that physical exercise is important in preventing falls among the elderly population.[28,29] Sports can reduce the occurrence of falls by improving motor function and balance ability. In addition, there is evidence that exercise intervention can also enhance cognitive function, reduce reaction time, promote the executive function of protective reflexes, and thus reduce the injury caused by falls.[30]

This study statistically measures the combined effect dose using the fixed effect model, and there were noticeable differences in the effects of exercise and functional exercise on the balance ability of elderly patients with cognitive impairment compared with simple drug therapy. Meta-analysis indicated that exercise combined with functional exercise could noticeably enhance the fall effect score of elderly patients with cognitive impairment compared with simple drug treatment ($P < .05$). From the meta-analysis of TUGT time, a noticeable difference can be observed in the WMD between exercise and functional exercise intervention in elderly patients with cognitive impairment, suggesting that exercise and functional exercise intervention can noticeably shorten the TUGT time in elderly patients with cognitive impairment. The current meta-analysis also reveals that the WMD of the standing time of monocular closed eyes in elderly patients with cognitive impairment after exercise and functional exercise therapy is noticeably different from that of basic drug therapy, suggesting that exercise and functional exercise intervention can noticeably prolong the standing time in elderly patients with cognitive impairment upon monocular eye closure. There exhibited a noticeable difference in the WMD of FOF score in elderly patients with cognitive impairment after exercise and functional exercise, suggesting that exercise and functional exercise intervention can noticeably improve the fear of falls in elderly patients with cognitive impairment.

The study performs the publication bias analysis using the inverted funnel chart and the resulting graph obtained was not completely symmetrical, and Egger's test showed $P = .0005$. This implies that the publication bias may impact the current meta-analysis results. Hence, the conclusions should be drawn carefully due to a few limitations of this study. The key limitation is that most of the references cited in this study pertain to single-center research, and there is a certain amount of variation in the sample size. To overcome this shortcoming, as part of our future research, we will conduct many prospective studies, and this will hopefully enable us to draw valuable conclusions from our work.

CONCLUSION

The study conclusively shows that sports and functional exercise have high application value in preventing tumbles in elderly patients with cognitive impairment, which can remarkably reduce the fall rate, enhance their balance ability, and effectively alleviate the patients' fear of tumbles. Further verification will require more studies and follow-ups of higher methodological quality.

FUNDING

This work was supported by the key project of science and technology research projects from the Department of Education of Jiangxi Province in 2021, project no. GJJ218905.

AUTHOR DISCLOSURE STATEMENT

No conflicts of interest exist among the authors.

ACKNOWLEDGEMENT

The authors would like to thank the support of the key project of science and technology research projects from the Department of Education of Jiangxi Province in 2021 (no. GJJ218905).

This article is protected by copyright. To share or copy this article, please visit copyright.com. Use ISSN#1078-6791. To subscribe, visit alternative-therapies.com

REFERENCES

1. Meekes WMA, Leemrijse CJ, Korevaar JC, Stanmore EK, van de Goor LIAM. Implementing Falls Prevention in Primary Care: barriers and Facilitators. *Clin Interv Aging*. 2022;17:885-902. doi:10.2147/CIA.S354911
2. Taylor ME, Wesson J, Sherrington C, et al. Tailored Exercise and Home Hazard Reduction Program for Fall Prevention in Older People With Cognitive Impairment: The i-FOCIS Randomized Controlled Trial. *J Gerontol A Biol Sci Med Sci*. 2021;76(4):655-665. doi:10.1093/gerona/glaa241
3. Adam CE, Fitzpatrick AL, Leary CS, et al. The Association between Gait Speed and Falls in Community Dwelling Older Adults with and without Mild Cognitive Impairment. *Int J Environ Res Public Health*. 2021;18(7):3712. doi:10.3390/ijerph18073712
4. Yin M, Chen Z, Liu F, Li XD. The aging trend of Chinese population and the prediction of aging population in 2015 to 2050. *Chinese Journal of Social Medicine*. 2018;35(5):480-483.
5. Rossler A, Thiamwong L, Xie R, et al. Fear of falling, fall risk, depression, and anxiety in community-dwelling older adults. *Innov Aging*. 2021;5(suppl 1):1033-1034. doi:10.1093/geroni/igab046.3697
6. Meng D, Luo TT, Tian XC, et al. Epidemiological characteristic of injuries in elderly aged 60 or elder in Qingdao from 2015 to 2017. *Mod Prev Med*. 2019;46(4):2646-2649.
7. Smirmaul BPC, Tiedemann A, Sherrington C. Infographic: exercise to prevent falls in older adults. *Br J Sports Med*. 2019;53(6):337-338. doi:10.1136/bjsports-2018-099384
8. Racey M, Markle-Reid M, Fitzpatrick-Lewis D, et al. Fall prevention in community-dwelling adults with mild to moderate cognitive impairment: a systematic review and meta-analysis. *BMC Geriatr*. 2021;21(1):689. doi:10.1186/s12877-021-02641-9
9. Jones M, Paulson S, Gills J, et al. The Effects of Mild Cognitive Impairment on Fall Severity in Older Adults. *Innov Aging*. 2021;5(suppl 1):698. doi:10.1093/geroni/igab046.2617
10. Boswell A, Ibrahim K, Owen C, Roberts HC. 126. Are fear of falling and caregiver burden associated with cognitive impairment among people with Parkinson's disease? *Age Ageing*. 2019;48(suppl 1):i36. doi:10.1093/ageing/afy205.03
11. Saikia AM, Das AK, Goswami K. Predictors of falls and falls-related injury in elderly with mild cognitive impairment. *International Journal of Health Research and Medico Legal Practice*. 2018;4(2):50-52.
12. Chen SD. Guidelines for the treatment of Parkinson's disease in China (third Edition). *Chinese Journal of Neurology*. 2014;47(6):428-433.
13. Song B, Liu CZ, Lyu SJ. The role of moderate physical exercise in reducing the fall rate and improving cognitive function of the elderly. *Zhongguo Laonianxue Zazhi*. 2020;40(4):807-810.
14. Guan XH, Wu HM, Liu GL, et al. Effect of Taijiquan training on balance function and fear of falling in patients with early Parkinson's disease. *Jiangxi Medical Journal*. 2017;52(11):1124-1127.
15. Li B, Zhong QL, Yu H, et al. Influence of Taiji exercise on balance ability and fear of falling of patients with Parkinson's disease. *Chinese Journal of Rehabilitation Medicine*. 2017;32(3):309-312.
16. Guan XH, Zhu XG, Liu JM, et al. Influence of yoga on balancing ability and fear of falling in patients with early Parkinson's disease. *Nursing Research of China*. 2017;31(10):1274-1276.
17. Shi XY. Study on the effect of Baduanjin exercise therapy on preventing falls in the elderly. *Modern diagnosis and treatment*. 2017;28(2):222-223.
18. Ji SQ, Mao ZJ, Yang QM, et al. Observation on the curative effect of Taijiquan exercise on patients with Parkinson's disease. *Chinese Journal of Rehabilitation*. 2016;31(1):51-53.
19. Zhang XY, Zhou XX, Zhuo XF. Effect Analysis of Baduanjin Combined with Balance Pad Training in Improving Elderly Patients Balance Function with Parkinson Disease. *Chinese and Foreign Medical Research*. 2020;18(35):92-94.
20. Gray-Miceli D, Kris A. Accuracy of Nurses' Fall Prevention Interventions in Patients With Cognitive Impairment and Behavioral Symptoms. *Innov Aging*. 2020;4(suppl 1):233-234. doi:10.1093/geroni/igaa057.753
21. Park M, Lee D-W, Jeong M-B. The Effect of Coordinative Locomotor Training on Physical Factors for Falls in the Elderly with Mild Cognitive Impairment. *Korean Society of Physical Medicine*. 2020;15(2):65-73. doi:10.13066/kspm.2020.15.2.65
22. Scott AB, Maher J, Little K, et al. Fall risk in community dwelling persons with cognitive impairment and dementia: a across-sectional survey. *Alzheimers Dement*. 2019;15(15):1573-1577. doi:10.1016/j.jalz.2019.08.188
23. Okoye EC, Akosile CO, Maruf FA, Onwuakagba IU, Urama ST. Validation of Igbo version of the modified falls efficacy scale among community-dwelling older adults: a validation study. *Health Qual Life Outcomes*. 2020;18(1):294. doi:10.1186/s12955-020-01547-1
24. Li Q, Liu J, Dai F, Dai F. Tai Chi versus routine exercise in patients with early- or mild-stage Parkinson's disease: a retrospective cohort analysis. *Braz J Med Biol Res*. 2020;53(2):e9171. doi:10.1590/1414-431x20199171
25. Shen X, Wong-Yu IS, Mak MK. Effects of Exercise on Falls, Balance, and Gait Ability in Parkinson's Disease: A Meta-analysis. *Neurorehabil Neural Repair*. 2016;30(6):512-527. doi:10.1177/1545968315613447
26. Ma ZY, Ma HB, Yang XY, et al. Effect of core muscle strength combined with Taijiquan exercise on walking ability and fall risk of the elderly. *Ningxia Medical Journal*. 2022;44(3):237-240.
27. Zhang JP, Li XY, Zhang YR, et al. Effect of aerobic exercise combined with resistance training on limb motor function of elderly people practicing Taijiquan for a long time. *Chinese Journal of Physical Medicine and Rehabilitation*. 2021;43(9):834-836.
28. Peng J, Shen LJ, Hu Y. Research progress of physical exercise in reducing fall fear in the elderly. *Journal of Nurses Training*. 2019;34(22):2050-2053.
29. Liu AH. Effect of exercise program on the prevention of fall in elderly: a Meta-analysis. *Clin Nurs Res*. 2019;33(20):3488-3492.
30. Zang M, Jiang JH, Guo W. Research progress of different exercise methods in delaying cognitive aging. *Zhongguo Laonianxue Zazhi*. 2021;41(24):5778-5782.