

Original Research

Effects of Qigong Exercises on Patients with Parkinson's Disease: A Follow-up Study

Xiaolei Liu ¹, Yanjie Zhang ^{2,*}, Xiru Du ³, Yongzhi Ma ⁴, Ruike Jiang ¹, Shihui Chen ^{5,*}, Yongtai Wang ⁶

1. Chinese Traditional Regimen Exercise Intervention Research Center, Beijing Sport University, Beijing, China; E-Mails: liuxiaolei000@bsu.edu.cn; u1818010107@163.com
2. Physical Education Unit, School of Humanities and Social Science, the Chinese University of Hong Kong-Shenzhen, Shenzhen, China; E-Mail: elite_zhangyj@163.com
3. College of Sport Arts, Guangzhou Sport University, Guangzhou, China; E-Mail: 11116@gzsport.edu.cn
4. Department of Physical Education, Tsinghua University, Beijing, China; E-Mail: myz@tsinghua.edu.cn
5. Department of Kinesiology, Texas A&M University Texarkana, TX, USA; E-Mail: schen@tamut.edu
6. College of Health Sci. and Tech., Rochester Institute of Technology, NY, USA; E-Mail: ytwchst@rit.edu

* **Correspondences:** Yanjie Zhang and Shihui Chen; E-Mails: elite_zhangyj@163.com; schen@tamut.edu

Academic Editor: Gerhard Litscher

OBM Integrative and Complementary Medicine
2023, volume 8, issue 1
doi:10.21926/obm.icm.2301008

Received: September 24, 2022**Accepted:** January 17, 2023**Published:** January 28, 2023

Abstract

Qigong, a traditional Chinese exercise routine, has been used as a treatment for Parkinson's disease (PD) in many studies, and the results have confirmed its effectiveness in reducing the symptoms of PD. However, no study has yet investigated the long-term effects and benefits of Qigong practices in improving the symptoms of PD. The purpose of this follow-up evaluation was to investigate the long-term effects of Qigong practices in improving the symptoms of PD. In this randomized controlled trial (RCT), patients in the moderate stage of PD (N = 15), who had been practicing Qigong exercises, agreed to participate in this follow-up measurement after the intervention. Two important indicators, the Timed Up and Go test



© 2023 by the author. This is an open access article distributed under the conditions of the [Creative Commons by Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium or format, provided the original work is correctly cited.

(TUG) and the One-legged Blind Balance test, were used to measure the patients' functional coordination and progressive balance capabilities. Results one year following the intervention were compared with data from the same patients at the 5th and 10th weeks in the previous RCT experimental group using repeated measures ANOVA. The results showed that the patients in this study demonstrated a significant improvement in the TUG test ($P < 0.01$) and balance ability test ($P < 0.05$). Qigong exercises can significantly improve the patients' functional coordination and balance capabilities with moderate PD. Therefore, the Qigong exercise routine can be used as an effective long-term rehabilitation therapy for PD.

Keywords

Parkinson's disease; Qigong exercises; long-term rehabilitation; functional coordination; progressive balance; health

1. Introduction

Parkinson's disease (PD) is a progressive, age-related chronic disorder characterized by static tremors, rigidity, impaired muscular coordination, and postural disturbances [1]. People with PD demonstrate some types of movement impairment that result in rapid decreases in muscle capacity, muscle hardness, sense of balance, motor skills, language, sleep, and daily living abilities [2]. Because PD is associated with an inability to coordinate movements and maintain balance, most patients experience a range of walking, gait, and balance difficulties, resulting in distinctive fall problems [3, 4]. PD may also cause psychological and sociological problems, such as depression and fatigue, lowering self-esteem and, eventually, affecting the quality of life [5, 6]. Individuals with PD should receive rehabilitation treatment to delay the further deterioration of their motor function [7].

Over the past years, progress in the treatment of PD has been made in physical therapy, which may include. However, it is not limited to, symptomatic reduction, mind-body interaction, physical functional recovery, and post-deep-brain stimulation interventions [8]. For PD patients, movement disorders are common symptoms that affect their daily life. Thus, exercise therapy has been integrated into regular therapy in clinical settings [9]. According to recent research, exercises can effectively improve the clinical symptoms of PD, including postural instability, rigidity, muscle tremors, and slowness of movement, as well as physical abilities, such as muscle functions and sense of balance [10-13].

Qigong, like Tai Chi, is a traditional Chinese exercise routine [14]. Qigong's effects as a treatment for PD have recently been investigated, and its effectiveness in reducing the symptoms of PD has been confirmed [12, 15, 16]. Qigong is a specific physical therapy exercise routine derived from traditional Chinese medicine. It combines various postures, movements, and breathing techniques with meditation [17-20]. The Chinese Health Qigong Association has recognized Qigong as an exercise routine characterized by the energy cultivation and relaxation of the mind and body, and the relief of body tension and pressure.

For patients with PD, Qigong has an advantage over medication treatments in having fewer side effects [21]. The ten Health Qigong movements that were modified and used in a previous 10-week

experimental study [12] were: 1) Qian Yuan Qi Yun; 2) Shuang Shou Tuo Tian Li San Jiao; 3) XU exercises; 4) Cuan Quan Nu Mu Zeng Qi Li; 5) Niao Xi; 6) Long Deng; 7) Wu Lao Qi Shang Wang Hou Qiao; 8) Chu Zhao Liang Chi Shi; 9) Yun Duan Bai He; 10) XI exercises.

Previous studies have found that the Qigong exercise routine benefits balance, cardiopulmonary fitness, and functional capacities in healthy adults and patients with chronic disease [22-26]. In our previous randomized controlled trial (RCT), 54 patients with PD were studied over a 10-week intervention period [12]. PD patients demonstrated significant improvements in muscle hardness, one-legged blinded balance, the Timed Up and Go test (TUG; physical coordination), and stability. We concluded that Health Qigong exercises could reduce the symptoms of PD and improve the body functions of PD patients in both the mild and moderate stages of the disease. There were no significant changes for the control group compared with the experimental group [12].

A recent systematic review and meta-analysis also reported promising results for Qigong exercise in positively contributing to the motor symptoms and quality of life of patients with PD [27]. However, most of these studies were short in duration, for example, only 10–12 weeks [17, 28]. It was proposed that ten weeks is too short to determine intervention and that the observed effects of Qigong exercises in reducing the symptoms of PD would be even better if patients continued the exercise program for a longer time.

Data from existing studies to evaluate the long-term efficacy of Qigong exercises in treating PD are scant. Given the expansion of research on the effects of Qigong on the functional motor abilities of PD patients over the past years, the purpose of this follow-up study was to investigate the long-term effects of Qigong exercises in improving the movement coordination and balance of patients with PD.

2. Materials and Methods

2.1 Participants and Instruments

Fifteen patients with PD (11 of whom were female) in the Hoehn and Yahr staging Scale of Parkinson's Disease (II–III) with an average age of 66.5 from Yan Tai Mountain Hospital, were participants in a previous RCT [12], agreed to participate in this follow-up study. The following inclusion criteria were used for the enrollment of the participants: 1) the participants must have been included in the experimental group in the previous RCT and self-reported continuing Qigong exercises after the intervention for about one year; 2) the ability to walk independently; 3) in a normal state of mental health; 4) on medication and have no other complications; and 5) be able to perform the required test items. Researchers and medical staff in charge at the hospital screened and interviewed all participants regarding the inclusion criteria. Since these patients were regular outpatients and Qigong program practitioners, their mental health and other health conditions have been routinely monitored. Two important indicators, the Timed Up and Go (TUG) and the One-legged Blind Balance test, were used to evaluate functional coordination and progressive balance capabilities relating to PD symptoms. The data were collected by laboratory technicians and project assistants [12, 29-32].

“Effect of Health Qigong Exercise on Dysfunction in Patients with Parkinson's Disease” was approved by the Sports Science Experimental Ethics Committee of Beijing Sport University (2019034H).

2.2 Intervention

The patients were required to practice the Health Qigong movements by the protocol of the previous study [12]. Each patient practiced the movements for 60 minutes in each session for five days per week. Each session consisted of a 10-minute warm-up, a 40-minute Qigong exercise, and a 10-minute relaxation period. The detailed intervention has been published elsewhere [12].

2.3 Measurement Procedures and Data Analysis

Two measurements were conducted at the exercise center during the regular Qigong practice at the hospital. The procedures of the two tests were carried out according to the instructions of the test instrument, as previously reported [12].

The TUG was used to evaluate physical coordination relating to walking ability. A chair was placed against a wall, and a distance of 3 meters from the chair was marked with a traffic cone. The patient sat on the chair, and the timer was started once the patient stood up. The patient needed to walk to the 3-meter mark, turn around, return to the chair, and sit down again. The timer was stopped at the sitting point. The testers recorded the completed time in the experiment and observed the patient's balance, gait, and stride while walking.

The One-legged Blind Balance test was used to measure balance capabilities on each leg separately. The eyes of the patient were covered with a blindfold. The data were analyzed using repeated measures ANOVA and compared the performance of patients at the 5th and 10th weeks after the intervention with performance after one year. The primary analysis aimed to identify any long-term effects and significant differences regarding physical coordination and balance capabilities after completing one year of the Qigong program. The means and standard deviations for each test at each time point were calculated and compared [33, 34].

3. Results

3.1 Effect of Qigong Exercises on Functional Coordination and Walking Abilities after One Year

PD patients who had practiced Qigong exercises five times per week, for 60 minutes per session, over one year were analyzed. Gait, stride, and walking abilities were measured using the TUG. The results of the TUG test are shown in Table 1 and Figure 1.

Table 1 Timed Up and Go results (seconds).

Time	Follow-up Group (N = 15)			
	Pre-test	5 th week	10 th week	1 year
Results	12.20 ± 1.71	9.98 ± 2.55**	8.57 ± 2.45**	8.46 ± 2.67**

Note: * p < 0.05; ** p < 0.01.

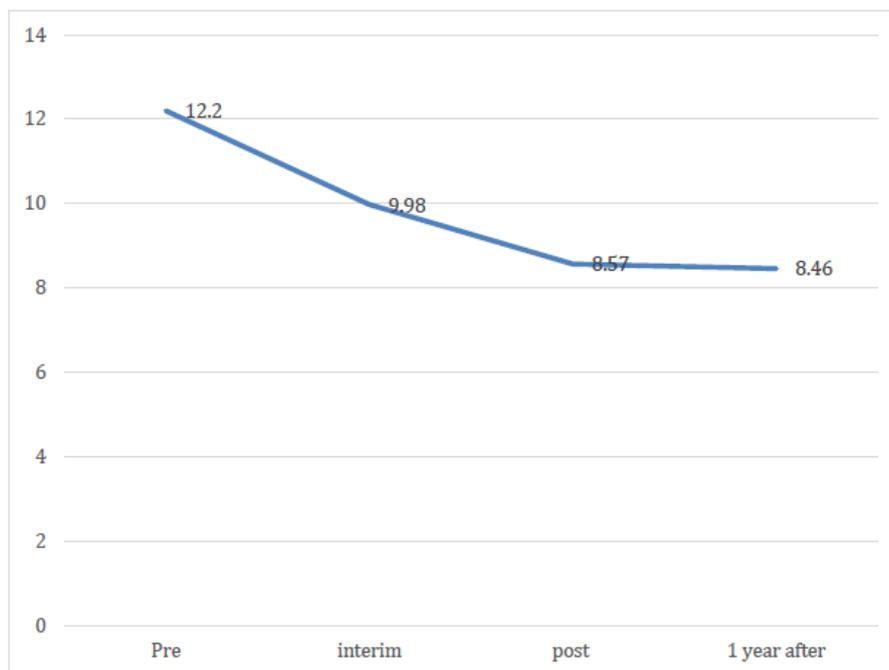


Figure 1 Timed Up and Go results (seconds).

As Table 1 and Figure 1 show, the average time of the TUG tests went from 12.20 ± 1.17 seconds in the pre-test to 8.46 ± 2.67 seconds one year after the intervention, indicating that the 15 patients who continued practicing Qigong exercises after the intervention continued to show a significant improvement ($P < 0.01$).

3.2 Effect of Qigong Exercises on Progressive Balance after One Year

The one-legged blind balance test was used to evaluate the progressive balance of the patients with PD. Each patient's right and left sides were assessed, and current data were compared with that from the 5th and 10th weeks of the previous intervention. The results of the one-legged blind balance test for the follow-up group are shown in Table 2 and Figure 2 and Figure 3.

Table 2 One-legged blind balance test for the right and left side of each patient (seconds).

Time	Follow-up Group (N = 15)			
	Pre/test	5 th week	10 th week	1 year later
Left	6.93 ± 4.70	8.11 ± 3.83	$10.60 \pm 4.89^*$	$14.34 \pm 4.43^*$
Right	6.60 ± 4.02	7.49 ± 3.67	$9.60 \pm 3.97^*$	$17.11 \pm 4.04^*$

Note: * $p < 0.05$; ** $p < 0.01$.

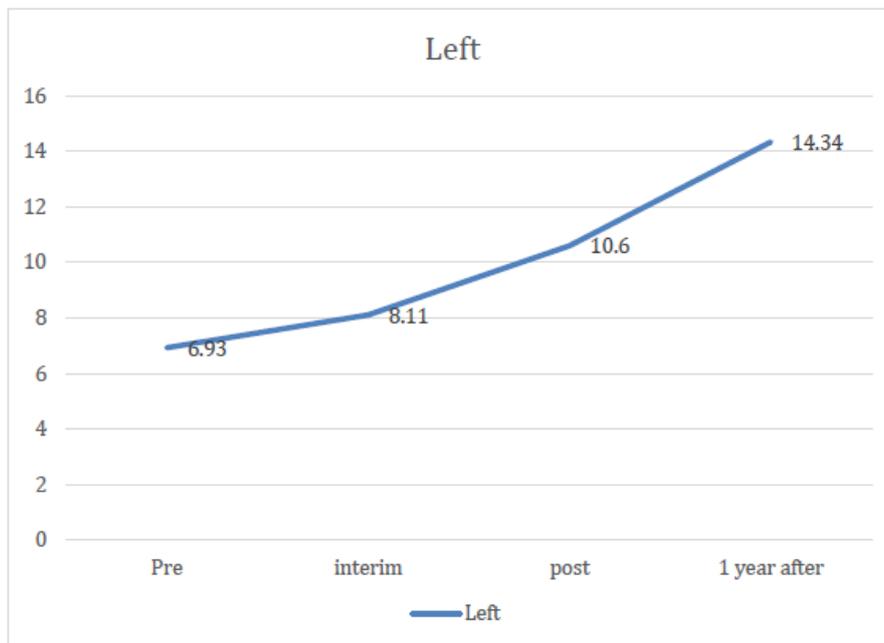


Figure 2 One-legged blind balance test: left side (seconds).

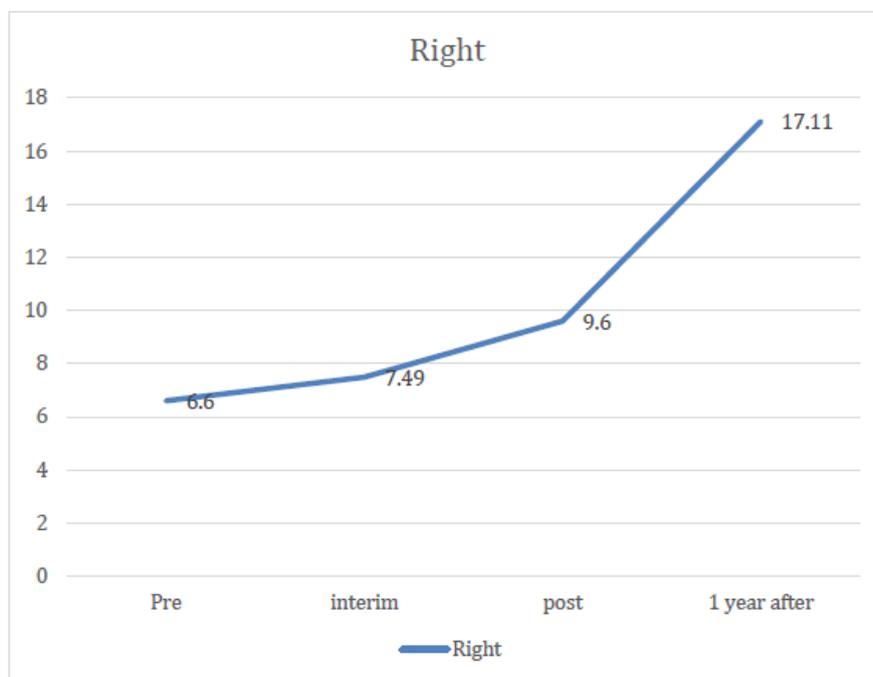


Figure 3 One-legged blind balance test: right side (seconds).

As Table 2 and Figure 2 and Figure 3 indicate, the one-legged blind balance test for the follow-up group showed a significant improvement on the left and right sides. On the left side, the average increased from 6.93 ± 4.70 seconds before the experiment to 14.34 ± 4.43 seconds in one year after the intervention. On the right side, the average time increased from 6.60 ± 4.42 seconds before the experiment to 17.11 ± 4.04 seconds in the one year after the intervention. These data indicate that the balance abilities of the experimental group were maintained and continued to improve significantly one year after the intervention.

4. Discussion

Researchers and clinicians have widely used the TUG test to evaluate patients with movement disorders and elderly people's dynamic balance and mobility. Recent research studies have also used the TUG test to evaluate movement quality and mobility [35, 36]. A good dynamic balance is essential to our ability to respond to sudden changes in balance [37]. We used the TUG test to evaluate functional ability in walking because gait disorders are typically found in PD patients. Gait disorders can affect stride and walking balance, seriously impacting the daily life of PD patients [38]. Therefore, it is crucial to assess gait to demonstrate the effects of Qigong exercises on the movement abilities of patients with PD.

Our results showed that it was again proof of the Qigong's effectiveness and significant improvement in the TUG test on PD patients who continued to practice Qigong exercises for one year, compared with the performance one year prior. These patients, who had been practicing Qigong exercises regularly after the intervention, had a significantly decreased TUG testing time, showing that physical coordination, gait, strides, and walking abilities were improved. As such, Qigong exercise may provide an alternative treatment with long-term benefits in improving functional coordination, gait, and walking abilities, thus contributing to improving the quality of life of patients with PD.

Qigong exercises can improve the functional movement ability of PD patients and reduce their risk of falls because of traditional exercises' inherent nature and structure [39]. This is particularly crucial for people with PD. The slang said, "Legs become old before people do," which refers to the fact that the first part of aging is seen in one's lower limbs. With increasing aging and the prevalence of walking disorders, people are trying to avoid going out for exercise comes automatically when people are afraid of falling. Gradually, people become isolated and disconnected with the outside world. Unfortunately, the interaction of these behaviors worsens accelerated aging. The movements of the Qigong exercise routine, such as making a fist, watching angrily, and holding the breath, can strengthen core muscles, increase joint stress, and improve input to the trunk and lower-limb joint proprioception. All of these contribute to better movement performance in the TUG test.

As a basic indicator, balance has always been an essential aspect of physical testing. The one-legged blind balance test is a simple and sensitive test instrument for balance, especially since it is easy and convenient for older people and people with PD to complete [40]. It measures a patient's ability to achieve static balance by measuring the time taken to maintain the body's center of gravity on a single support surface without a visual reference. It relies solely on sensory organs, such as the vestibular system and the coordination of muscles. The one-legged blind balance skill is vital for doing activities such as squatting or standing on one leg.

The results of the one-legged blind balance test indicated that all patients demonstrated a significant and progressive improvement compared with one year prior. The balance of the PD patients gradually improved from the previous 10-week RCT. However, this may be due to the short duration of the intervention (10 weeks). In this follow-up, one year later, the same patients showed a significant increase in time to maintain their balance in the one-legged blind balance test, showing that their balance capabilities have been maintained and progressively improved even after one year. These data showed that the Qigong exercise routine is an alternative treatment, with long-term effects, for improving the balance abilities of patients with PD.

Qigong exercises, consisting of soft, slow, smooth, moderate, calm, and steady motions, are easy to learn and can produce promising effects in movement control [41]. The movements in Qigong exercises require that practitioners constantly adjust their center of gravity and the posture of their body and maintain balance. During practice, patients flex and extend, open and close their limbs and torso, adjust their breathing with movements, and try to maintain balance when moving and changing directions as they progress through the movement routine. This effective anti-gravity dynamic can improve the controllability of the body in focusing on a supporting surface and enhance postural stability. As a result, the tendons and muscles of the entire body are coordinately stretched and moved. The main and collateral muscles and body parts (upper and lower body) are coordinated, contributing to better posture control. Therefore, the Qigong exercise routine is an ideal alternative treatment for improving the balance abilities of people with PD.

5. Conclusions

5.1 Qigong Exercises Are Suitable for Patients with Parkinson's Disease

Our previous Qigong program was implemented through a 10-week RCT and showed beneficial effects in improving physical functions related to the symptoms of patients with PD. The results supported the modified Health Qigong program's effectiveness and suitability for patients with PD.

5.2 Positive Long-term Effects of Qigong Exercises for Patients with Parkinson's Disease

It was previously suggested that the beneficial effects of the Qigong program in reducing the symptoms of PD would be more significant if patients undertook the exercises over a longer period. This follow-up study confirmed that all patients who continued to practice Qigong exercises not only demonstrated an improvement from the previous intervention, but also showed progressive improvement about the physical coordination of walking abilities in the TUG test, and balance abilities in the one-legged blind balance test. These results also proved that the Qigong exercise is a viable alternative treatment with long-term benefits in improving physical coordination and balance abilities, thus contributing to the quality of life of patients with PD. The results of this follow-up study encourage us to continue exploring Qigong exercises as an alternative treatment for improving, mitigating, and treating the symptoms of patients with PD. Due to the limited follow-up time, the present study cannot examine if there is a plateau effect in terms of beneficial effects. The limitations are the small sample size and unavailability of the latest test instruments (e.g., 3D gait analysis). Larger-scale experiments with more PD patients, more measurements, and better practice environments are recommended for future research.

Author Contributions

All authors made substantial contributions to conception and design. Conceptualization, Xiaolei Liu, Yanjie Zhang, Yongzhi Ma, Yongtai Wang and Shihui Chen; methodology, Xiaolei Liu, Yanjie Zhang and Shihui Chen; software, Xiaolei Liu, Yanjie Zhang, Xiru Du, Ruike Jiang, Yongtai Wang and Shihui Chen; validation, Xiaolei Liu, Yanjie Zhang and Shihui Chen; formal analysis, Xiaolei Liu, Yanjie Zhang, Xiru Du and Ruike Jiang; investigation, Xiaolei Liu, Yanjie Zhang, Xiru Du, Yongzhi Ma, Ruike Jiang, Shihui Chen and Yongtai Wang; resources, Xiaolei Liu, Yanjie Zhang, Yongzhi Ma and Shihui Chen; data curation, Xiaolei Liu and Ruike Jiang; writing—original draft preparation, Xiaolei Liu,

Yanjie Zhang, Xiru Du, Ruike Jiang and Shihui Chen; writing—review and editing, Xiaolei Liu, Yanjie Zhang, Shihui Chen and Yongtai Wang; supervision, Xiaolei Liu, Yanjie Zhang, and Shihui Chen; project administration, Xiaolei Liu; funding acquisition, Xiaolei Liu. All authors have read and agreed to the published version of the manuscript.

Funding

This research was funded by the International Cooperative Scientific Research Project of Beijing Sport University (No. 2018GJ016).

Competing Interests

The authors have declared that no competing interests exist.

References

1. World Health Organization. The World Health Report: 2006: Working together for health [Internet]. Geneva: World Health Organization; 2006. Available from: <https://www.who.int/publications/i/item/the-world-health-report---2006---working-together-for-health>.
2. Jankovic J. Parkinson's disease: Clinical features and diagnosis. *J Neurol Neurosurg Psychiatry*. 2008; 79: 368-376.
3. Liu HH, Yeh NC, Wu YF, Yang YR, Wang RY, Cheng FY. Effects of Tai Chi exercise on reducing falls and improving balance performance in Parkinson's disease: A meta-analysis. *Parkinsons Dis*. 2019; 2019: 9626934.
4. Parkinson's News Today. Gait and balance problems [Internet]. Pensacola: Parkinson's News Today; 2020. Available from: <https://parkinsonsnewstoday.com/gait-and-balance-problems/>.
5. Earhart GM, Williams AJ. Treadmill training for individuals with Parkinson disease. *Phys Ther*. 2012; 92: 893-897.
6. Filippin NT, Lobo da Costa PH, Mattioli R. Effects of treadmill-walking training with additional body load on quality of life in subjects with Parkinson's disease. *Braz J Phys Ther*. 2010; 14: 344-350.
7. Cerasa A, Quattrone A. The effectiveness of cognitive treatment in patients with Parkinson's disease: A new phase for the neuropsychological rehabilitation. *Parkinsonism Relat Disord*. 2015; 21: 165.
8. Allert N, Cheeran B, Deuschl G, Barbe MT, Csoti I, Ebke M, et al. Postoperative rehabilitation after deep brain stimulation surgery for movement disorders. *Clin Neurophysiol*. 2018; 129: 592-601.
9. Bonavita S. Exercise and Parkinson's disease. In: *Advances in experimental medicine and biology*. New York: Springer Nature; 2020. pp. 289-301.
10. Borrione P, Tranchita E, Sansone P, Parisi A. Effects of physical activity in Parkinson's disease: A new tool for rehabilitation. *World J Methodol*. 2014; 4: 133-143.
11. Liu JF. Movement therapy improves Parkinson's disease dyskinesia effectiveness analysis. *Chin J Trauma Disabil Med*. 2013; 11: 317-318.

12. Liu XL, Chen S, Wang Y. Effects of health Qigong exercises on relieving symptoms of Parkinson's disease. *Evid Based Complementary Altern Med*. 2016; 2016: 5935782.
13. Goodwin VA, Richards SH, Taylor RS, Taylor AH, Campbell JL. The effectiveness of exercise interventions for people with Parkinson's disease: A systematic review and meta-analysis. *Mov Disord*. 2008; 23: 631-640.
14. Chen S, Zhang Y, Wang YT, Liu XL. Traditional Chinese mind and body exercises for promoting balance ability of old adults: A systematic review and meta-analysis. *Evid Based Complement Altern Med*. 2016; 2016: 7137362.
15. Liu X, Miller YD, Burton NW, Brown WJ. A preliminary study of the effects of Tai Chi and Qigong medical exercise on indicators of metabolic syndrome, glycaemic control, health-related quality of life, and psychological health in adults with elevated blood glucose. *Br J Sports Med*. 2010; 44: 704-709.
16. Jin P. Efficacy of Tai Chi, brisk walking, meditation, and reading in reducing mental and emotional stress. *J Psychosom Res*. 1992; 36: 361-370.
17. Chen S, Zhang Y, Wang YT, Liu X, Song W, Du X. The effect of Qigong-based therapy on patients with Parkinson's disease: A systematic review and meta-analysis. *Clin Rehabil*. 2020; 34: 1436-1448.
18. Tsang HW, Cheung L, Lak DC. Qigong as a psychosocial intervention for depressed elderly with chronic physical illnesses. *Int J Geriatr Psychiatry*. 2002; 17: 1146-1154.
19. Wang CW, Ng SM, Ho RT, Ziea ET, Wong VC, Chan CL. The effect of Qigong exercise on immunity and infections: A systematic review of controlled trials. *Am J Chinese Med*. 2012; 40: 1143-1156.
20. Wang C, Collet JP, Lau J. The effect of Tai Chi on health outcomes in patients with chronic conditions: A systematic review. *Arch Intern Med*. 2004; 164: 493-501.
21. Zhen K, Zhang S, Tao X, Li G, Lv Y, Yu L. A systematic review and meta-analysis on effects of aerobic exercise in people with Parkinson's disease. *NPJ Parkinsons Dis*. 2022; 8: 146.
22. Pang MY, Mak MK. Muscle strength is significantly associated with hip bone mineral density in women with Parkinson's disease: A cross-sectional study. *J Rehabil Med*. 2009; 41: 223-230.
23. Pothakos K, Kurz MJ, Lau YS. Restorative effect of endurance exercise on behavioral deficits in the chronic mouse model of Parkinson's disease with severe neurodegeneration. *BMC Neurosci*. 2009; 10: 6.
24. Rodrigues de Paula F, Teixeira-Salmela LF, Coelho de Moraes Faria CD, Rocha de Brito P, Cardoso F. Impact of an exercise program on physical, emotional, and social aspects of quality of life of individuals with Parkinson's disease. *Mov Disord*. 2006; 21: 1073-1077.
25. Schenkman M, Cutson TM, Kuchibhatla M, Chandler J, Pieper CF, Ray L, et al. Exercise to improve spinal flexibility and function for people with Parkinson's disease: A randomized, controlled trial. *J Am Geriatr Soc*. 1998; 46: 1207-1216.
26. Zong WB, Lu YZ, Chen XS. Observed changes of the event-related potential P300 of mid-term Parkinson's patients before and after Qigong adjuvant therapy. *Chin J Clin Rehabil*. 2003; 7: 3090-3091.
27. Song R, Grabowska W, Park M, Osypiuk K, Vergara-Diaz GP, Bonato P, et al. The impact of Tai Chi and Qigong mind-body exercises on motor and non-motor function and quality of life in Parkinson's disease: A systematic review and meta-analysis. *Parkinsonism Relat Disord*. 2017; 41: 3-13.

28. Lima LO, Scianni A, Rodrigues-de-Paula F. Progressive resistance exercise improves strength and physical performance in people with mild to moderate Parkinson's disease: A systematic review. *J Physiother*. 2013; 59: 7-13.
29. Boonstra TA, van der Kooij H, Munneke M, Bloem BR. Gait disorders and balance disturbances in Parkinson's disease: Clinical update and pathophysiology. *Curr Opin Neurol*. 2008; 21: 461-471.
30. Mayer M. Qigong and hypertension: A critique of research. *J Altern Complement Med*. 1999; 5: 371-382.
31. McNeely ME, Duncan RP, Earhart GM. Medication improves balance and complex gait performance in Parkinson disease. *Gait Posture*. 2012; 36: 144-148.
32. Muhlack S, Welnic J, Voitalla D, Müller T. Exercise improves efficacy of levodopa in patients with Parkinson's disease. *Mov Disord*. 2007; 22: 427-430.
33. Physiopedia. Timed Up and Go Test (TUG) [Internet]. London: Physiopedia Website; [cited date 2020 July]. Available from: [https://www.physio-pedia.com/Timed_Up_and_Go_Test_\(TUG\)](https://www.physio-pedia.com/Timed_Up_and_Go_Test_(TUG)).
34. Gobbi LT, Oliveira-Ferreira MD, Caetano MJ, Lirani-Silva E, Barbieri FA, Stella F, et al. Exercise programs improve mobility and balance in people with Parkinson's disease. *Parkinsonism Relat Disord*. 2009; 15: S49-S52.
35. Vance RC, Healy DG, Galvin R, French HP. Dual tasking with the timed "up & go" test improves detection of risk of falls in people with Parkinson disease. *Phys Ther*. 2015; 95: 95-102.
36. Shumway-Cook A, Brauer S, Woollacott M. Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go Test. *Phys Ther*. 2000; 80: 896-903.
37. Ashburn A, Pickering R, McIntosh E, Hulbert S, Rochester L, Roberts HC, et al. Exercise-and strategy-based physiotherapy-delivered intervention for preventing repeat falls in people with Parkinson's: The PDSAFE RCT. *Health Technol Assess*. 2019; 23: 1-150.
38. Dorsey ER, Bloem BR. The parkinson pandemic-A call to action. *JAMA Neurol*. 2018; 75: 9-10.
39. Deuel LM, Seeberger LC. Complementary therapies in Parkinson disease: A review of acupuncture, Tai Chi, Qi Gong, yoga, and cannabis. *Neurotherapeutics*. 2020; 17: 1434-1455.
40. Tiedemann A, O'Rourke S, Sesto R, Sherrington C. A 12-week Iyengar yoga program improved balance and mobility in older community-dwelling people: A pilot randomized controlled trial. *J Gerontol A Biol Sci Med Sci*. 2013; 68: 1068-1075.
41. Pölönen P, Lappi O, Tervaniemi M. Effect of meditative movement on affect and flow in Qigong practitioners. *Front Psychol*. 2019; 10: 2375.