Research Square

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Impact of Various Qigong and Tai Chi Exercises on Motor Function, Depression, and Quality of Life in Parkinson's Disease Patients: A Network Meta-Analysis

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Abstract

Fitness Qigong and Tai Chi, as forms of exercise therapy, are suitable for Parkinson's disease (PD) patients who are mainly middle-aged and elderly, and their effectiveness has been proven by an increasing number of studies. However, there is a serious issue in some previous studies, which is the misconception of considering Fitness Qigong and Tai Chi as a specific form of exercise. In fact, Fitness Qigong and Tai Chi are not single forms of exercise, but rather a general term for a category of exercises. Since the fitness effects of different types of Fitness Qigong and Tai Chi are not exactly the same, it is necessary to conduct a more specific classification of Fitness Qigong and Tai Chi and then perform a network Meta-analysis to explore the effects of different types of Fitness Qigong and Tai Chi on treating different symptoms of PD. By comprehensively collecting and organizing literature from English and Chinese databases such as Pubmed, Embase, Cochrane Library, Web of Science, CNKI, and Wan Fang, with the literature search cut-off date being November 22, 2024, and extracting data from the finally included randomized controlled trials. According to the Cochrane Risk of Bias Assessment Tool in the Cochrane Handbook, the methodological quality and bias risk of the included literature were evaluated using RevMan 5.4 software, and finally, Stata 18.0 software was used for network Meta-analysis. During the analysis, subgroup analyses were conducted based on different intervention types, intervention periods, Hoehn-Yahr stages, and patient disease courses to explore the sources of heterogeneity. The 35 studies included in this article involved 4 types of Fitness Qigong exercises and 4 types of Tai Chi exercises, with a total of 1,763 patients with mild to moderate Parkinson's disease. The results of the network Meta-analysis showed that compared with the conventional treatment of Parkinson's disease, 24-Form Tai Chi Qigong (24-FTJQ) was the best treatment plan for improving UPDRS Ⅲ scores and Berg Balance Scale (BBS) scores; 42-Form Tai Chi Qigong (ATJQ) was the best treatment plan for improving Gait Velocity; Wu Qin Xi (WQX) was the best treatment plan for improving Timed Up and Go Test (TUGT) scores; Ba Duan Jin (BDJ) was the best treatment plan for improving Depression scores; and Yi Jin Jing (YJJ) was the best treatment plan for improving PDQ-39 scores. Therefore, in clinical practice, more suitable exercise plans can be formulated according to the main symptoms of patients, reducing the treatment period.

Introduction

Parkinson's disease (PD) is the second most common neurodegenerative disorder, primarily caused by the death of dopaminergic neurons in the substantia nigra[1]. It predominantly affects adults aged 60 or older, with a higher incidence rate in males than females, impacting at least 6 million people worldwide[2]. In severe cases, PD leads to motor symptoms such as dystonia, bradykinesia, and tremors, as well as non-motor symptoms like insomnia, constipation, and depression[3]. Although there are various treatments that can effectively alleviate PD symptoms, it remains an incurable disease[4]. Levodopa is the "gold standard" for PD treatment and can significantly alleviate PD symptoms, but it also has side effects in the late stages of PD, which are detrimental to the body[5]. Since there is no cure for PD and drug treatments can cause adverse reactions that severely reduce the quality of life, exercise therapy, as one of the most important components of physical therapy, has seen significant development in the rehabilitation management of PD[6]. Qigong and Tai Chi are traditional Chinese sports that inherit the advantages of ancient projects and combine the exercise characteristics of modern people. They integrate body movement, breathing, and mental focus, combining sports with traditional Chinese medicine health concepts to achieve the purpose of strengthening the body and regulating the mind and body[7]. The intensity of practice is suitable for the group of PD patients, mainly middle-aged and elderly people. Current studies have demonstrated that Qigong and Tai Chi can improve both motor and non-motor symptoms in PD patients, such as balance, gait, and sleep[8,9]. Additionally, some scholars have conducted systematic reviews focusing on the therapeutic effects of Qigong and Tai Chi on PD patients[10].However, in some previous studies, there has been a serious misunderstanding, which is the misconception of considering Fitness Qigong and Tai Chi as a specific form of exercise. In fact, Fitness Qigong and Tai Chi are not single forms of exercise, but rather a general term for a category of exercises. For example, Fitness Qigong includes Baduanjin, Wuqinxi, Yijinjing, etc., and Tai Chi includes Yang-style Tai Chi, Chen-style Tai Chi, etc. Since the fitness effects of different types of Qigong and Tai Chi are not entirely the same, their therapeutic effects on PD patients cannot be generalized and should be analyzed separately. To explore the effects of different types of Qigong and Tai Chi on motor symptoms, depression, and quality of life in PD, and to identify the best treatment measures for improving various symptoms of PD, a network meta-analysis was conducted after classifying Qigong and Tai Chi more specifically. This study aims to investigate the effects of Qigong and Tai Chi on different symptoms of PD and compare the therapeutic effects of different types of Qigong and Tai Chi, hoping to provide reliable references for clinical decision-makers and help PD patients shorten the treatment period.

Methods

Study Registration

This study has been registered on the PROSPERO platform with the registration number CRD42024627650.

Literature Search Strategy

The literature search was conducted independently by two researchers according to the predetermined research protocol. Comprehensive collection and organization of literature were performed by searching English and Chinese databases, including Pubmed, Embase, Cochrane Library, Web of Science, CNKI, and Wan Fang. The search was completed by November 22, 2024. Chinese search terms primarily included Qigong, Baduanjin, Wuqinxi, Liuzijue, Yijinjing, Aerobic Exercise, Chinese Traditional Sports, Tai Chi, and Parkinson's Disease. English search terms included Qigong, Chi Kung, Baduanjin, Wuqinxi, Yijinjing, Liuzijue, Aerobics, Traditional Chinese Sports, Tai Ji, Tai Chi, Tai Chi Chuan, Taijiquan, Parkinson Disease, Idiopathic Parkinson's Disease, Lewy Body Parkinson's Disease, Paralysis Agitans, and Primary Parkinsonism. Additionally, relevant references were extracted from other Meta-analyses and review articles related to the topic to ensure the comprehensiveness of the included literature. The search strategy is exemplified using the PubMed database, as shown in Fig. 1.

Inclusion Criteria

The study type is randomized controlled trials investigating the effects of Qigong and Tai Chi on motor function, non-motor function, and quality of life in Parkinson's disease.

Participants must meet the clinical diagnostic criteria for Parkinson's disease established by the Movement Disorder Society (MDS)[11]or other diagnostic criteria, with no restrictions on gender, age, or ethnicity.

The intervention measures for the experimental group include Qigong promoted by the General Administration of Sport of China, Qigong specifically developed for Parkinson's disease, and various styles of Tai Chi. The intervention measures for the control group are only the routine treatments for Parkinson's disease.

Outcome measures include the third part of the Unified Parkinson's Disease Rating Scale (UPDRS III), where lower scores indicate better motor function. Gait velocity, where faster speeds indicate better walking ability, is also measured. Berg Balance Scale (BBS) scores, where lower scores indicate better balance ability, are assessed. The Timed Up and Go Test (TUGT), where shorter completion times indicate better coordination ability, is included. The Hamilton Depression Scale (HAMD), Profile of Mood States (POMS), Symptom Checklist-90 (SCL-90), and Hamilton Rating Scale for Depression (HDRS) are used, where lower scores indicate milder depressive symptoms. Finally, the Parkinson's Disease Questionnaire-39 (PDQ-39) is utilized, where lower scores indicate higher quality of life.

Exclusion Criteria

Studies will be excluded if the full text is not accessible, if there is duplicated or missing data, if the intervention group does not clearly specify the type of Qigong and Tai Chi or combines these with other therapeutic methods, if they are literature reviews, conference articles, or similar types of publications, or if there is a high rate of participant dropout.

Data Extraction

The retrieved studies will be imported into the EndNote X9 reference management software. The software's duplicate detection function will be used in conjunction with manual comparison to remove duplicate studies. By browsing the titles and abstracts of the de-duplicated studies, those unrelated to the theme of this paper will be excluded. Finally, based on the inclusion and exclusion criteria, the full texts of the studies will be read to determine the included articles, and data extraction will be conducted for these articles. The extracted data will include basic information about the articles (such as authors, titles, publication years, etc.) and information about the experiments (such as total sample size, gender ratio, intervention measures, Hoehn-Yahr staging, intervention frequency, outcome measures, etc.). This process will always be independently completed by two researchers, and their screening results will be compared. If there are inconsistencies in the results, a third researcher will be consulted to analyze the reasons for the differences.

Literature Quality Assessment

The methodological quality and risk of bias of the included studies will be assessed using the Cochrane Risk of Bias tool from the Cochrane Handbook, with the aid of RevMan 5.4 software. The assessment will cover seven items: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, completeness of outcome data, selective reporting, and other sources of bias. Each item will be judged as "low risk," "high risk," or "unclear" to determine the quality of the studies[12].

Statistical Analysis

The outcome measures in this article are all continuous variables. If the included numerical units or scales are consistent, the mean difference (MD) and its 95% confidence interval (CI) will be used as the effect size. If the included numerical units or scales are inconsistent, the standardized mean difference (SMD) and its 95% CI will be used as the effect size. The RevMan 5.4 software will be used for bias assessment of the literature and traditional meta-analysis, and the I^2 statistic will be used to analyze the magnitude of heterogeneity. When $I^2 < 50\%$, it is considered that there is no significant heterogeneity among the included studies, and a fixed-effects model will be used for analysis. When $I^2 > 50\%$, it indicates significant heterogeneity among the included studies. Sensitivity analysis or subgroup analysis will be conducted to explore the sources of heterogeneity. If the heterogeneity cannot be reduced, a random-effects model will be used, and the results will be analyzed descriptively. The Stata 18.0 software will be used for network meta-analysis. First, a network evidence diagram will be drawn. If there are closed loops in the diagram, global and local inconsistency tests will be conducted. A P value greater than 0.05 indicates good consistency between direct and indirect comparisons. The consistency of each outcome measure in the closed loops will be evaluated through loop inconsistency tests. When the 95% CI of the loop inconsistency factor includes 0, it indicates good consistency between direct and indirect evidence. A consistency model will be used for analysis, and a network meta-analysis results table and cumulative probability plot will be drawn to determine the best treatment option. Funnel plots will be used to assess publication bias in the literature.

Research Results

Literature Screening Results

A total of 1595 articles were retrieved from various databases. Specifically, there were 163 articles from the PubMed database, 287 from the Web of Science database, 138 from the Cochrane Library database, 274 from the Embase database, 605 from the CNKI database, and 128 from the Wanfang Data database. Additionally, 23 articles were obtained from the reference lists of other articles. After removing duplicate articles and those that did not meet the inclusion and exclusion criteria, 35 eligible articles were finally included. The detailed screening process is shown in Fig. 2.

Characteristics of Included Studies

A total of 35 studies were included, encompassing four types of Qigong exercises: Qigong techniques, Baduanjin, Wuqinxi, and Yijinjing, as well as four types of Tai Chi exercises: 24-Form Tai Chi, Tai Chi Wu Gong Liu Fa, adapted Tai Chi, and Chen-style Tai Chi. These studies involved a total of 1763 patients with mild to moderate Parkinson's disease, with Hoehn-Yahr stages ranging from 1 to 4. More detailed information about the included studies can be found in Table 1.

Table 1
Basic information of included studies

Study author, year	Sample size		Age, years		Gender(M:F)		Course,years		Hoehn-Yahr	Interventions		Frequency	Ou me
	T	C	T	C	T	C	T	C		T	C		
Zong, W. J.[13] 2021	19	18	—		16:21		—		1 ~ 3	FQM	CT	12weeks,5times/week, 60min/session	
Zhi, X.[14] 2020	15	15	56.2 ± 9.90	58.0 ± 4.98	16:14		3.00 ± 2.05	3.25 ± 1.65	1 ~ 2	BDJ	CT	12weeks,6times/week, 60min/session	
Yang, H.[15] 2023	48	47	65.13 ± 3.41	64.89 ± 3.08	33:15	35:12	3.02 ± 0.91	3.51 ± 0.48	1 ~ 3	WQX	CT	16weeks,5times/week, 30 ~ 50min/session	
Yang, D.[16] 2019	50	50	62.08 ± 4.13	61.74 ± 3.93	30:20	31:19	5.15 ± 1.02	5.03 ± 1.13	—	BDJ	CT	8weeks	
Xiao, H. L.[17] 2021	20	20	72.78 ± 2.63	72.58 ± 2.62	9:11	8:12	1.07 ± 0.17	1.08 ± 0.16	1 ~ 2.5	24-FTJQ	CT	24weeks,4times/week, 60min/session	
Wang, M. H.[18] 2023	15	15	69.80 ± 6.90	67.13 ± 8.33	6:9	8:7	5.87 ± 2.72	4.80 ± 3.05	1 ~ 4	24-FTJQ	CT	24weeks,3times/week, 60min/session	
Wang, J. Z.[19] 2016	40	40	67.60 ± 8.40	68.00 ± 8.50	19:21	20:20	—		1 ~ 2	24-FTJQ	CT	16weeks,2times/day, 50 ~ 60min/session	
Lv, C. F.[20] 2021	15	16	65.87 ± 6.13	63.25 ± 6.70	5:10	6:10	5.60 ± 1.72	6.13 ± 1.96	1 ~ 3	FQM	CT	12weeks,5times/week, 60min/session	
Lu, F. L.[21] 2017	8	8	67.75 ± 6.84	68.20 ± 7.32	5:3	5:3	2.41 ± 0.48	2.02 ± 0.52	1 ~ 2	24-FTJQ	CT	8weeks,5times/week, 40 ~ 60min/session	
Lu, C. F.[22] 2016	34	34	67.10 ± 1.50	65.20 ± 1.30	18:16	19:15	1.50 ± 0.30	1.20 ± 0.50	1 ~ 2.5	FESM TJQ	CT	12weeks,5times/week, 60 ~ 65min/session	
Liu, X. L.[23] 2017	23	18	57.20 ± 8.00	57.10 ± 5.70	9:14	6:12	3.90 ± 1.10	4.30 ± 0.90	1 ~ 3	FQM	CT	10weeks,5times/week, 60min/session	
Li, L.[24] 2017	42	38	65.25 ± 6.37	67.78 ± 5.36	24:18	—	3.73 ± 1.08	3.45 ± 0.88	1 ~ 3	ATJQ	CT	16weeks,3times/week, 60min/session	
Li, C. J.[25] 2019	33	33	52.88 ± 7.50	62.42 ± 9.37	20:13	19:14	—		1 ~ 3	BDJ	CT	4weeks,7times/week, 30min/session	
Li, B.[26] 2017	30	30	—		—		—		—	24-FTJQ	CT	12weeks,4times/week, 60min/session	
Li, F.[27] 2021	19	18	66.95 ± 7.44	66.11 ± 8.02	10:9	10:8	7.84 ± 2.60	8.06 ± 3.26	1 ~ 3	FQM	CT	16weeks,5times/week, 60min/session	
Jiang, J. H.[28] 2023	20	20	60.60 ± 6.75	59.45 ± 5.45	8:12	13:7	4.30 ± 1.38	3.85 ± 1.35	1 ~ 3	YJJ	CT	8weeks,5times/week, 30min/session	

Study author, year	Sample size		Age, years		Gender(M:F)		Course,years		Hoehn-Yahr	Interventions		Frequency	Ou me
	T	C	T	C	T	C	T	C		T	C		
Ji, S. Q.[29] 2016	16	16	56.06 ± 11.16	59.13 ± 11.22	9:7	8:8	2.09 ± 1.07	2.28 ± 1.18	1 ~ 3	CSTJQ	CT	12weeks, 60min/session	
Guan, X. H.[30] 2018	40	40	69.46± 5.45	68.61± 6.22	23:17	21:19	1.52 ± 0.25	1.50 ± 0.32	—	24-FTJQ	CT	24weeks,4times/week, 60min/session	
Guan, X. H.[31] 2017	40	40	—		—		—		1 ~ 2.5	24-FTJQ	CT	24weeks,5times/week, 60min/session	
Guan, X. H.[32] 2016	31	31	70.23 ± 4.24	69.71 ± 4.13	16:15	17:14	4.43 ± 3.71	4.28 ± 3.25	1 ~ 3	24-FTJQ	CT	12weeks,4times/week, 60min/session	
Gao, S.[33] 2022	21	21	64.00 ± 5.00	63.00 ± 6.00	10:11	6:15	—		1 ~ 3	ATJQ	CT	16weeks,3times/week, 60min/session	
Fan, J.[34] 2017	18	16	64.06 ± 8.56		—		—		3 ~ 4	FQM	CT	8weeks,5times/week, 60min/session	
Dong, S. S.[35] 2022	27	30	65.37±7.47	63.07±12.78	13:14	16:14	6.63 ± 2.27	6.67±2.24	1 ~ 3	BDJ	CT	3weeks,7times/week, 30min/session	
Ding, L.[36] 2023	42	42	69.34± 4.02	69.12± 4.06	24:18	26:16	4.12 ± 0.38	4.25± 0.42	2 ~ 3	24-FTJQ	CT	12weeks,4times/week, 60min/session	
Cao, H. H.[37] 2021	31	31	62.45±2.87	62.97±3.27	20:11	21:10	6.10±0.87	5.71 ± 1.10	3	WQX	CT	8weeks,5times/week, 30min/session	
Wan, Z. R.[38] 2021	20	20	64.95 ± 7.83	67.03 ± 7.47	8:12	11:9	3.63 ± 1.52	3.25 ± 1.73	1 ~ 4	FQM	CT	12weeks,4times/week, 60min/session	
Nocera, J. R.[39] 2013	15	6	66.00 ± 11.00	65.00 ± 7.00	7:8	4:2	8.08 ± 5.42	6.83 ± 3.50	—	ATJQ	CT	16weeks,3times/week, 60min/session	
Li, X. Y.[40] 2022	18	18	66.33 ± 10.89	69.17 ± 6.48	7:11	8:10	3.27 ± 1.28	3.75 ± 2.27	1 ~ 3	FQM	CT	12weeks,5times/week, 60min/session	
Li, K. F.[41] 2024	27	27	65.59 ± 9.16	60.48 ± 11.52	13:14	10:17	4.59 ± 3.70	7.56 ± 7.95	1 ~ 4	BDJ	CT	4weeks,5times/week, 40min/session	
Gao, Q.[42] 2014	37	39	69.54 ± 7.32	68.28 ± 8.53	23:14	27:12	9.15 ± 8.58	8.37 ± 8.24	1 ~ 3	24-FTJQ	CT	12weeks,3times/week, 60min/session	
Choi, H. J.[43] 2016	11	9	60.81 ± 7.60	65.54 ± 6.80	—		5.20 ± 2.70	5.20 ± 2.70	1 ~ 2	ATJQ	CT	12weeks,3times/week, 60min/session	
Chang, C. L.[44]	16	13	64.43 ± 7.37	63.15 ± 7.95	7:9	6:7	6.75 ± 5.49	6.77 ± 6.84	1 ~ 2	24-FTJQ	CT	12weeks,2times/week, 60min/session	

Study author, year	Sample size		Age, years		Gender(M:F)		Course,years		Hoehn-Yahr	Interventions		Frequency	Ou me
	T	C	T	C	T	C	T	C		T	C		
2024													
Amano, S.[45] 2013	15	9	66.00 ± 11.00	66.00 ± 7.00	7:8	7:2	8.00 ± 5.00	5.00 ± 3.00	1 ~ 3	ATJQ	CT	16weeks,3times/week, 60min/session	□ □
Wu, T. T.[46] 2018	28	24	62.42 ± 5.37	64.66 ± 5.47	20:8	17:7	4.75 ± 2.01	4.25 ± 1.69	1 ~ 3	ATJQ	CT	16weeks,4times/week, 40min/session	□
Vergara-Diaz, G.[47]2018	12	15	65.70 ± 3.86	62.00 ± 7.77	—		2.90 ± 2.38	2.90 ± 2.20	1 ~ 2.5	ATJQ	CT	24weeks,3times/week	□ □

Table Notes: T represents the experimental group, and C represents the control group. FQM refers to Qigong specifically developed for Parkinson's disease; BDJ refers to Baduanjin Qigong; WQX refers to Wuqinxi Qigong; YJJ refers to Yijinjing Qigong; 24-FTJQ refers to 24-Form Simplified Tai Chi; FESMTJQ refers to Tai Chi Wu Gong Liu Fa; ATJQ refers to adapted Tai Chi based on Yang-style Tai Chi; CSTJQ refers to Chen-style Tai Chi; CT refers to routine treatment for Parkinson's disease. □UPDRS III; □ Gait velocity; □ BBS; □ TUGT; □ HAMD; □ POMS; □ SCL-90; □ HDRS; □ PDQ-39. A dash "—" indicates that the study did not provide relevant information.

Quality Assessment Results of Included Studies

The final inclusion of 35 studies all mentioned random allocation. Among them, 18 studies did not specify the randomization method [13,14,16,21,22,23,25,26,27,29,32,34,39,40,43,44,45,46]. 14 studies used a random number table for allocation[17,18,19,24,28,30,31,33,35,36,37,38,41,42]. 3 studies used different methods for randomization: one used a ball-drawing method[15], one used a lottery method[20], and one used permuted block randomization[47]. 2 studies performed allocation concealment[33,38]. 14 studies blinded the outcome assessors[18,25,28,33,37,38,39,40,41,42,43,44,45,47]. 4 studies did not report the reasons for participant dropout[16,22,24,43]. 2 studies had a risk of selective reporting bias[13,14]. 1 study had other sources of bias[24]. Detailed evaluations can be found in Figs. 3 and 4.

Traditional Meta-Analysis Results

UPDRS III Score Analysis Results

A total of 18 studies were involved, including eight treatment plans: FQM, BDJ, WQX, YJJ, 24-FTJQ, FESMTJQ, ATJQ, and CSTJQ. The overall heterogeneity test showed $I^2 = 72\%$, $P < 0.00001$, indicating significant heterogeneity among the studies. Therefore, a random-effects model was used for analysis, as shown in Fig. 5. Subgroup analyses were conducted based on intervention measures, treatment duration, Hoehn-Yahr staging, and disease duration. In the disease duration subgroup, three studies that did not provide information on the PD patients' disease duration were excluded. The subgroup analysis results are presented in Table 2. The overall study results indicate that compared to routine PD treatment, FQM, BDJ, WQX, YJJ, 24-FTJQ, FESMTJQ, ATJQ, and CSTJQ can effectively reduce UPDRS III scores. The heterogeneity in studies with different disease durations was significantly reduced, with $I^2 < 50\%$, suggesting that disease duration may be a factor influencing heterogeneity.

Table 2
Subgroup Analysis Results of UPDRS Ⅲ

Subgroup		Number of References	Heterogeneity Test		Results of Meta-analysis	
			P	I^2	SMD(95%CI)	P
Interventions	FQM vs. CT	4	0.06	59%	−1.11 [−1.67,−0.55]	0.0001
	BDJ vs. CT	2	0.03	78%	−0.58 [−1.59, 0.42]	0.25
	WQX vs. CT	1	-	-	−1.01 [−1.44,−0.58]	<0.00001
	TJJ vs. CT	1	-	-	−1.39 [−2.09.−0.69]	<0.0001
	24-FTJQ vs. CT	5	<0.0001	86%	−1.06 [−1.86,−0.27]	0.009
	FESMTJQ vs. CT	1	-	-	−0.52 [−1.01,−0.04]	0.03
	ATJQ vs. CT	3	0.02	75%	−0.61 [−1.35,0.12]	0.10
	CSTJQ vs. CT	1	-	-	−0.27 [−0.96,0.43]	0.45
	Tatol	18	<0.00001	72%	−0.88 [−1.16,−0.60]	<0.00001
Treatment cycles	4weeks	1	-	-	−0.11 [−0.64,0.42]	0.68
	8weeks	2	0.69	0%	−1.31 [−1.90,−0.73]	<0.0001
	10weeks	1	-	-	−1.99 [−2.75,−1.22]	<0.00001
	12weeks	7	0.27	21%	−0.70 [−0.97,−0.43]	<0.00001
	16weeks	6	<0.0001	81%	−0.96 [−1.51,−0.41]	0.0006
	24weeks	1	-	-	−0.28 [−1.00,0.44]	0.44
	Tatol	18	<0.00001	72%	−0.88 [−1.16,−0.60]	<0.00001
Hoehn-Yahr	1 ~ 2	4	0.08	56%	−1.52 [−2.10,−0.93]	<0.00001
	1 ~ 2.5	1	-	-	−0.52 [−1.01,−0.04]	0.03
	1 ~ 3	11	0.004	62%	−0.85 [−1.15,−0.55]	<0.00001
	1 ~ 4	2	0.70	0%	−0.17 [−0.60.0.26]	0.43
	Tatol	18	<0.00001	72%	−0.88 [−1.16,−0.60]	<0.00001
Course	<3years	3	0.42	0%	0.52 [−0.89,−0.15]	0.006
	3−4years	3	0.93	0%	−1.07 [−1.37,−0.78]	<0.00001
	4−5years	2	0.26	22%	−1.66 [−2.18,−1.15]	<0.00001
	>5years	7	0.11	42%	0.44 [−0.68,−0.20]	0.0003
	Tatol	15	0.0005	63%	−0.75 [−0.91,−0.60]	<0.00001

Gait Velocity Analysis Results

A total of 12 studies involved gait velocity as an outcome measure, encompassing five treatment plans: FQM, BDJ, 24-FTJQ, ATJQ, and CSTJQ. The overall heterogeneity test showed I^2 = 83%, P < 0.00001, indicating significant heterogeneity among the studies. Therefore, a random-effects model was used for analysis, as shown in Fig. 6. Subgroup analyses were conducted based on intervention measures, treatment duration, Hoehn-Yahr staging, and disease duration. In the Hoehn-Yahr subgroup, one study that did not provide relevant information was excluded, and in the disease duration subgroup, two studies that did not provide relevant information were excluded. The subgroup analysis results are presented in Table 3. The overall study results indicate that compared to routine PD treatment, FQM, BDJ, 24-FTJQ, ATJQ, and CSTJQ can effectively improve gait velocity in PD patients. The heterogeneity in studies with different disease durations was significantly reduced, with I^2 < 50%, suggesting that disease duration may be a factor influencing heterogeneity.

Table 3
Results of Subgroup Analysis of Gait Speed

Subgroup		Number of References	Heterogeneity Test		Results of Meta-analysis	
			P	I^2	SMD(95%CI)	P
Interventions	FQM vs. CT	3	0.28	21%	0.91 [0.46, 1.36]	<0.0001
	BDJ vs. CT	2	0.0006	92%	0.18 [−1.42,1.79]	0.22
	24-FTJQ vs. CT	3	0.02	73%	1.06 [0.51. 1.60]	0.0001
	ATJQ vs. CT	3	0.0003	87%	0.92 [−0.16, 2.01]	0.10
	CSTJQ vs. CT	1	-	-	−0.08 [−0.77, 0.62]	0.83
	Tatol	12	<0.00001	82%	0.76 [0.33,1.18]	0.0006
Treatment cycles	3weeks	1	-	-	−0.48 [−1.00,0.05]	0.08
	12weeks	7	0.01	64%	0.92 [0.52, 1.32]	<0.00001
	16weeks	3	0.0003	87%	0.92 [−0.16,2.01]	0.10
	24weeks	1	-	-	0.61 [0.16, 1.06]	0.008
	Tatol	12	<0.00001	82%	0.77 [0.35, 1.18]	0.0003
Hoehn-Yahr	1 ~ 2	1	-	-	1.03 [0.26, 1.80]	0.09
	1 ~ 3	8	<0.00001	86%	0.65 [0.04, 1.25]	0.04
	1 ~ 4	1	-	-	0.79 [0.15, 1.44]	0.02
	2 ~ 3	1	-	-	1.64 [1.14, 2.14]	<0.00001
	Tatol	11	<0.0001	84%	0.79 [0.32, 1.27]	0.001
Course	1–2years	1	-	-	0.61 [0.16, 1.06]	0.008
	2–3years	1	-	-	−0.08 [−0.77, 0.62]	0.83
	3–4years	3	0.19	39%	1.20 [0.85, 1.55]	<0.00001
	4–5years	2	0.19	43%	1.31 [0.95, 1.67]	<0.00001
	5–6years	1	-	-	0.58 [−0.14, 1.31]	0.11
	6–7years	2	0.84	0%	−0.45 [−0.89,−0.00]	0.05
	Tatol	10	<0.00001	83%	0.72 [0.54, 0.91]	<0.00001

BBS Score Analysis Results

A total of 15 studies involved the BBS outcome measure, including six treatment plans: BDJ, WQX, 24-FTJQ, FESMTJQ, ATJQ, and CSTJQ. The overall heterogeneity test showed $I^2 = 70\%$, $P < 0.0001$, indicating significant heterogeneity among the studies. Therefore, a random-effects model was used for analysis, as shown in Fig. 7. Subgroup analyses were conducted based on intervention measures, treatment duration, Hoehn-Yahr staging, and disease duration. In the Hoehn-Yahr subgroup, three studies that did not provide relevant information were excluded, and in the disease duration subgroup, four studies that did not provide relevant information were excluded. The subgroup analysis results are presented in Table 4. The overall study results indicate that compared to routine PD treatment, BDJ, WQX, 24-FTJQ, FESMTJQ, ATJQ, and CSTJQ can effectively improve BBS scores in PD patients. The heterogeneity in studies with different intervention measures was significantly reduced, with $I^2 = 0\%$, suggesting that intervention measures may be a factor influencing heterogeneity. The heterogeneity in studies with different disease durations was also significantly reduced, with $I^2 < 50\%$, indicating that disease duration may be a factor influencing heterogeneity.

Table 4
Subgroup Analysis Results of BBS Scores

Subgroup		Number of References	Heterogeneity Test		Results of Meta-analysis	
			P	I^2	MD(95%CI)	P
Interventions	BDJ vs. CT	1	-	-	4.12 [3.42, 4.82]	<0.00001
	WQX vs. CT	1	-	-	3.00 [2.12, 3.88]	<0.00001
	24-FTJQ vs. CT	10	0.57	0%	3.95 [3.29, 4.60]	<0.00001
	FESMTJQ vs. CT	1	-	-	2.30 [−0.24, 4.84]	0.08
	ATJQ vs. CT	1	-	-	3.00 [0.70, 5.30]	0.01
	CSTJQ vs. CT	1	-	-	1.25 [0.52, 1.98]	0.0008
	Tatol	15	<0.0001	70%	3.14 [2.79, 3.50]	<0.00001
Treatment cycles	8weeks	3	0.12	54%	3.52 [2.55, 4.49]	<0.00001
	12weeks	6	0.006	69%	2.99 [1.60, 4.39]	<0.0001
	16weeks	2	0.33	0%	3.94 [2.62, 5.25]	<0.00001
	24weeks	4	0.09	54%	3.54 [1.84, 5.24]	<0.0001
	Tatol	15	<0.0001	70%	3.32 [2.54, 4.10]	<0.0001
Hoehn-Yahr	1 ~ 2	2	0.32	0%	4.08 [2.60, 5.56]	<0.00001
	1 ~ 2..5	3	0.03	72%	3.34 [1.35, 5.34]	0.001
	1 ~ 3	4	0.08	56%	2.52 [0.98, 4.07]	0.001
	1 ~ 4	1	-	-	1.96 [−2.13, 6.05]	0.35
	2 ~ 3	1	-	-	4.08 [2.49, 5.67]	<0.00001
	3	1	-	-	3.00 [2.12, 3.88]	<0.00001
	Tatol	12	0.0002	69%	3.14 [2.24, 4.05]	<0.00001
Course	1–2years	3	0.18	42%	4.36 [3.26, 5.46]	<0.00001
	2–3years	2	0.62	0%	1.28 [0.57, 2.00]	0.0004
	3–4years	2	0.84	0%	3.99 [2.67, 5.31]	<0.00001
	>5years	4	0.21	33%	3.66 [3.12, 4.20]	<0.00001
	Tatol	11	<0.00001	77%	3.09 [2.71, 3.48]	<0.00001

TUGT Analysis Results

A total of 12 studies involved the TUGT outcome measure, including five treatment plans: FQM, BDJ, WQX, 24-FTJQ, and ATJQ. The overall heterogeneity test showed I^2 = 35%, P = 0.11, indicating minimal heterogeneity among the studies. Therefore, a fixed-effects model was used for analysis, as shown in Fig. 8. The study results indicate that compared to routine PD treatment, FQM, BDJ, WQX, 24-FTJQ, and ATJQ can effectively improve TUGT scores in PD patients.

Depression Score Analysis Results

A total of six studies were involved, including three treatment plans: FQM, BDJ, and 24-FTJQ. The overall heterogeneity test showed I^2 = 87%, P < 0.00001, indicating significant heterogeneity among the studies. Therefore, a random-effects model was used for analysis, as shown in Fig. 9. Subgroup analyses were conducted based on intervention measures, treatment duration, Hoehn-Yahr staging, and the scales used. The subgroup analysis results are presented in Table 5. The overall study results indicate that compared to routine PD treatment, FQM, BDJ, and 24-FTJQ can effectively reduce depression scores in PD patients. The heterogeneity in studies with different Hoehn-Yahr stages was significantly reduced, with I^2 < 50%, suggesting that Hoehn-Yahr staging may be a factor influencing heterogeneity.

Table 5
Subgroup Analysis Results of Depression Scores

Subgroup		Number of References	Heterogeneity Test		Results of Meta-analysis	
			P	I^2	MD(95%CI)	P
Interventions	FQM vs. CT	2	0.45	0%	−1.59 [−2.14,−1.05]	<0.00001
	BDJ vs. CT	1	-	-	−2.34 [−2.98,−1.71]	<0.00001
	24-FTJQ vs. CT	3	<0.00001	94%	−2.28 [−3.88,−0.67]	0.006
	Tatol	6	<0.00001	87%	−2.07 [−2.87,−1.27]	<0.00001
Treatment cycles	4weeks	1	-	-	−2.34 [−2.98,−1.71]	<0.00001
	8weeks	1	-	-	−1.39 [−2.15,−0.63]	0.0003
	12weeks	2	0.09	66%	−2.28 [−3.13,−1.44]	<0.00001
	16weeks	1	-	-	−3.54 [−4.25,−2.83]	<0.00001
	24weeks	1	-	-	−0.60 [−1.33, 0.13]	0.11
	Tatol	6	<0.00001	87%	−2.07 [−2.87,−1.27]	<0.00001
Hoehn-Yahr	1 ~ 2	1	-	-	−3.54 [−4.25,−2.83]	<0.00001
	1 ~ 3	3	0.23	32%	−2.35 [−2.73,−1.97]	<0.00001
	1 ~ 4	1	-	-	−0.60 [−1.33, 0.13]	0.11
	3 ~ 4	1	-	-	−1.39 [−2.15,−0.63]	0.0003
	Tatol	6	<0.0001	87%	−2.15 [−2.43,−1.86]	<0.00001
Measurement	HAMD	3	<0.00001	94%	−2.16 [−3.76,−0.56]	0.008
	POMS	1	-	-	−1.39 [−2.15,−0.63]	0.0003
	SCL−90	1	-	-	−2.67 [−3.27,−2.08]	<0.00001
	HDRS	1	-	-	−1.81 [−2.60,−1.02]	<0.00001
	Tatol	6	<0.0001	87%	−2.07 [−2.87,−1.27]	<0.00001

Quality of Life Score Analysis Results

A total of seven studies were involved, including four treatment plans: BDJ, WQX, YJJ, and ATJQ. The overall heterogeneity test showed I^2 = 90%, P < 0.00001, indicating significant heterogeneity among the studies. After excluding studies with high heterogeneity[28], the overall consistency test showed I^2 = 0%, P = 0.62, as shown in Fig. 11. The study results indicate that compared to the control group, BDJ, WQX, YJJ, and ATJQ can effectively reduce the quality of life scores in PD patients.

Network Meta-Analysis Results

Network Evidence Diagram

The network evidence diagrams for each outcome measure are shown in Fig. 12. Each circle represents a different intervention, with the size of the circle indicating the number of participants involved. The lines connecting the circles represent the number of direct comparison studies between two interventions, with thicker lines indicating a greater number of direct comparison studies.

Inconsistency Test Results

Among the six outcome measures, direct comparisons between interventions do not exist, and the network evidence diagrams for each outcome measure do not form closed loops. Therefore, inconsistency tests are not conducted.

Cumulative Probability Ranking Comparison Results of Included Studies

UPDRS III Score

This includes 18 studies with a total of 842 PD patients, involving eight types of Qigong and Tai Chi exercise programs. Compared to routine PD treatment, Qigong and Tai Chi exercises show superior effects in improving UPDRS III scores, with significant differences observed. Among the different Qigong and Tai Chi programs, 24-FTJQ is superior to other programs, with significant differences, as shown in Fig. 13. The best probability ranking for each Qigong and Tai Chi program is 24-FTJQ > WQX > YJJ > BDJ > FQM > CSTJQ > FESMTJQ > CSTJQ > CT. The cumulative probability comparison is shown in Fig. 14.

Gait Velocity

This includes 12 studies with a total of 599 PD patients, involving five types of Qigong and Tai Chi exercise programs. Compared to routine PD treatment, Qigong and Tai Chi exercises show superior effects in improving gait velocity, with significant differences observed. Among the different Qigong and Tai Chi programs, ATJQ is superior to other programs, with significant differences, as shown in Fig. 15. The best probability ranking for each Qigong and Tai Chi program is ATJQ > 24-FTJQ > FQM > BDJ > CSTJQ > CT. The cumulative probability comparison is shown in Fig. 16.

BBS Score

This includes 15 studies with a total of 912 PD patients, involving six types of Qigong and Tai Chi exercise programs. Compared to routine PD treatment, Qigong and Tai Chi exercises show superior effects in improving BBS scores, with significant differences observed. Among the different Qigong and Tai Chi programs, 24-FTJQ is superior to other programs, with significant differences, as shown in Fig. 17. The best probability ranking for each Qigong and Tai Chi program is 24-FTJQ > BDJ > WQX > ATJQ > FESMTJQ > CSTJQ > CT. The cumulative probability comparison is shown in Fig. 18.

TUGT Score

This includes 12 studies with a total of 540 PD patients, involving five types of Qigong and Tai Chi exercise programs. Compared to routine PD treatment, Qigong and Tai Chi exercises show superior effects in improving TUGT scores, with significant differences observed. Among the different Qigong and Tai Chi programs, WQX is superior to other programs, with significant differences, as shown in Fig. 19. The best probability ranking for each Qigong and Tai Chi program is WQX > FQM > 24-FTJQ > BDJ > ATJQ > CT. The cumulative probability comparison is shown in Fig. 20.

Depression Score

This includes six studies with a total of 330 PD patients, involving three types of Qigong and Tai Chi exercise programs. Compared to routine PD treatment, Qigong and Tai Chi exercises show superior effects in improving depression scores, with significant differences observed. Among the different Qigong and Tai Chi programs, BDJ is superior to other programs, with significant differences, as shown in Fig. 21. The best probability ranking for each Qigong and Tai Chi program is BDJ > 24-FTJQ > FQM > CT. The cumulative probability comparison is shown in Fig. 22.

PDQ-39 Score

This includes seven studies with a total of 298 PD patients, involving four types of Qigong and Tai Chi exercise programs. Compared to routine PD treatment, Qigong and Tai Chi exercises show superior effects in improving PDQ-39 scores, with significant differences observed. Among the different Qigong and Tai Chi programs, YJJ is superior to other programs, with significant differences, as shown in Fig. 23. The best probability ranking for each Qigong and Tai Chi program is YJJ > WQX > BDJ > ATJQ > CT. The cumulative probability comparison is shown in Fig. 24.

Adverse Reaction Analysis

Among the 35 included studies, no adverse reactions were reported. Specifically, two articles explicitly stated that no adverse reactions occurred in PD patients practicing ATJQ[24,47]. One article clearly indicated that no adverse reactions were observed in the FQM group throughout the entire experimental process[38]. Another article explicitly stated that no adverse reactions were produced during BDJ practice[14]. Additionally, one article clearly indicated that no adverse reactions occurred during the complete intervention period of 24-FTJQ[44]. This suggests that Qigong and Tai Chi exercises have a high level of safety.

Publication Bias Analysis

Funnel plots were created using Stata 18.0 software for the included studies, as shown in Fig. 25. The results indicate that in the funnel plots for UPDRS III scores, gait velocity, and TUGT scores, the dots are roughly symmetrical on both sides of the dashed line, suggesting a low likelihood of publication bias. In the funnel plots for depression scores and PDQ-39 scores, the distribution of dots also shows good symmetry, but the evaluation of publication bias is limited due to the small number of included studies. In the funnel plot for BBS scores, most dots are distributed on the left side of the dashed line, with lower symmetry, and some dots are distributed at the bottom, indicating that small sample size studies may have caused some publication bias. Therefore, the study results should be interpreted with caution.

Discussion

Evidence Summary

Parkinson's disease (PD) is a neurodegenerative disorder characterized by the significant death of dopaminergic neurons in the substantia nigra pars compacta. This deficiency of dopamine leads to motor disorders within the basal ganglia, manifesting as typical Parkinsonian motor symptoms[48]. In addition to these motor symptoms, non-motor symptoms such as rapid eye movement sleep behavior disorder, loss of smell, constipation, and depression appear in the prodromal stage and progress along with cognitive impairment and autonomic dysfunction, often dominating in the late stages of the disease[49]. Current treatments for PD include pharmacological and surgical interventions. However, even with optimal medication or surgery, PD patients' autonomy gradually deteriorates, disability increases, and side effects or adverse reactions may occur [50,51,52]. Qigong and Tai Chi are two increasingly popular mind-body interventions. Both combine balance, flexibility, and neuromuscular coordination training with cognitive components, potentially addressing a range of PD-related motor and non-motor symptoms[53]. However, different types of Qigong and Tai Chi have varying specific fitness effects and should not be conflated. Currently, no studies have systematically evaluated the effects of different types of Qigong and Tai Chi on PD patients. Therefore, this article includes randomized controlled trials using Qigong or Tai Chi as interventions, categorizes the two exercise programs, and conducts a network meta-analysis to compare the efficacy differences among different types of Qigong and Tai Chi.

Traditional meta-analysis results show that compared to routine PD treatment, Qigong and Tai Chi exercises can effectively reduce UPDRS III scores, TUGT scores, depression scores, and PDQ-39 scores, and can effectively improve gait velocity and BBS scores. Network meta-analysis results indicate that for UPDRS III scores, the best treatment ranking is 24-FTJQ > WQX > YJJ > BDJ > FQM > CSTJQ > FESMTJQ > CSTJQ > CT; for gait velocity, the best treatment ranking is ATJQ > 24-FTJQ > FQM > BDJ > CSTJQ > CT; for BBS scores, the best treatment ranking is 24-FTJQ > BDJ > WQX > ATJQ > FESMTJQ > CSTJQ > CT; for TUGT scores, the best treatment ranking is WQX > FQM > 24-FTJQ > BDJ > ATJQ > CT; for depression scores, the best treatment ranking is BDJ > 24-FTJQ > FQM > CT; and for PDQ-39 scores, the best treatment ranking is YJJ > WQX > BDJ > ATJQ > CT.

24-FTJQ may be the best exercise program for reducing UPDRS III scores and improving BBS scores. Developed in 1956 by the Chinese National Sports Commission based on traditional Yang-style Tai Chi, 24-FTJQ is a simplified form of exercise designed to enhance physical fitness. The knee joint is a primary support for body weight and balance. Studies have shown that 24-FTJQ can improve the stability of the body's center of gravity in anterior-posterior and lateral directions, enhance proprioception and force sensation in lower limb joints, and increase the peak torque of extensor and flexor muscle groups in the lower limbs[55], making it highly effective in improving human motor abilities, especially balance. ATJQ may be the best exercise program for improving PD patients' gait velocity. Reduced gait speed is one of the typical motor symptoms of PD, related not only to the decline of the central nervous system but also to decreased muscle strength and joint flexibility. The movements of ATJQ are gentle and smooth, involving the use of muscles throughout the body, which helps to improve joint flexibility and range of motion, enhance muscle strength, and increase walking speed. WQX may be the best exercise program for reducing PD patients' TUGT scores. TUGT is a test that evaluates an individual's coordination ability, requiring the individual to understand multiple instructions and perform multiple tasks during the test. Studies have shown that six months of Wuqinxi exercise can enhance the flexibility, strength, balance, and neural response abilities of middle-aged and elderly practitioners[56], thereby improving PD patients' coordination abilities. BDJ may be the best treatment for improving depression scores. Parkinson's disease is considered a tremor disease in traditional Chinese medicine, while depressive states fall under the category of "yu syndrome," characterized by stagnation of qi, with the liver being the primary affected organ[57]. Chinese medicine believes that liver qi flows smoothly when it is in a state of growth and discharge. The "left and right bow shooting" movement in BDJ can stimulate the Governing Vessel, Hand Taiyin Meridian, and Hand Jueyin Meridian, allowing qi and blood to flow normally, thereby improving liver function and regulating depression[58]. YJJ may be the best treatment for reducing PDQ-39 scores. YJJ emphasizes stretching and pulling the body's muscles and fascia, enhancing the body's mobility. In particular, the "claw and wing display" movement has the effect of eliminating distracting thoughts and depression through the unity of form and spirit[59], effectively improving the quality of life for PD patients.

Limitations of the Study

(1) For the treatment of PD patients, Qigong and Tai Chi are emerging exercise interventions, and therefore, there are relatively few high-quality randomized controlled trials included, which may increase the likelihood of bias in the study results. (2) In the process of exploring sources of heterogeneity, some studies did not provide relevant information, which may affect the results of subgroup analyses. (3) There are fewer studies involving Qigong exercises such as BDJ, WQX, and YJJ, which may lead to an overestimation of the therapeutic effects of these interventions.

Clinical Application and Implications for Future Research

The network meta-analysis has identified potential optimal interventions for improving motor function, depression, and quality of life in PD patients, providing a reference for clinicians and rehabilitation therapists when developing treatment plans for different symptoms of PD patients. However, due to the limited number of included studies, the results may have some bias, and more high-quality research is needed to demonstrate the role of Qigong and Tai Chi in the rehabilitation of PD patients. Future research should focus on providing more comprehensive information, categorizing Qigong and Tai Chi more specifically, conducting experimental studies with a wider variety of Qigong and Tai Chi exercises, and performing more research on the effects of Qigong and Tai Chi on non-motor symptoms in PD patients.

Research Conclusions and Recommendations

Compared to routine treatments for PD, Qigong and Tai Chi can effectively improve patients' motor function, depression, and quality of life. Specifically, 24-FTJQ shows superior effects in improving motor function and balance ability, ATJQ is more effective in enhancing gait velocity, WQX is better at improving coordination ability, BDJ is more effective in reducing depression, and YJJ is superior in improving quality of life.

In clinical practice, when developing exercise programs, it is important to tailor the interventions to the patient's primary symptoms. For instance, 24-FTJQ can be chosen to improve motor function and balance ability, ATJQ for enhancing gait velocity, WQX for strengthening coordination ability, BDJ for reducing depression, and YJJ for improving quality of life. However, these conclusions need to be further validated and updated through more high-quality research.

Declarations

Author Contribution

A: Conceptualization, methodology, formal analysis, investigation, writing - original draft.B: Conceptualization, supervision, project administration, writing - review & editing, correspondence. C: Data curation, investigation, writing - review & editing. D: Data curation, investigation,writing - review & editing. E: Resources, investigation, writing - review & editing. F: investigation, writing - review & editing.G: Validation, investigation, writing - review & editing.

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Figures

#1 Qigong [Mesh]
#2 Chi Kung [Title/Abstract]
#3 Baduanjin [Title/Abstract]
#4 Wuqinxi [Title/Abstract]
#5 Yijinjing [Title/Abstract]
#6 Liuzijue [Title/Abstract]
#7 Aerobics [Title/Abstract]
#8 Traditional Chinese sports [Title/Abstract]
#9 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8
#10 Tai Ji [Mesh]
#11 Tai Chi [Title/Abstract]
#12 Tai Chi Chuan [Title/Abstract]
#13 Taijiquan [Title/Abstract]
#14 #10 OR #11 OR #12 OR #13
#15 #9 OR #14
#16 Parkinson Disease [Mesh]
#17 Parkinson [Title/Abstract]
#18 Idiopathic Parkinson's Disease [Title/Abstract]
#19 Lewy Body Parkinson's Disease [Title/Abstract]
#20 Paralysis Agitans [Title/Abstract]
#21 Primary Parkinsonism [Title/Abstract]
#22 #16 OR #17 OR #18 OR #19 OR #20
#23 #15 AND #21

Figure 1

PubMed Literature Search Strategy

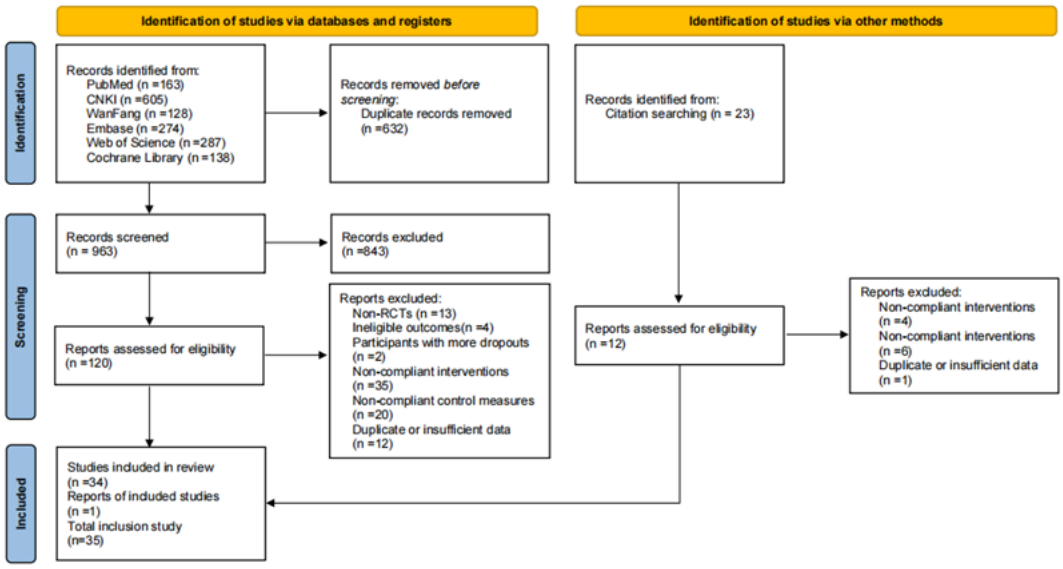


Figure 2

Literature search strategy

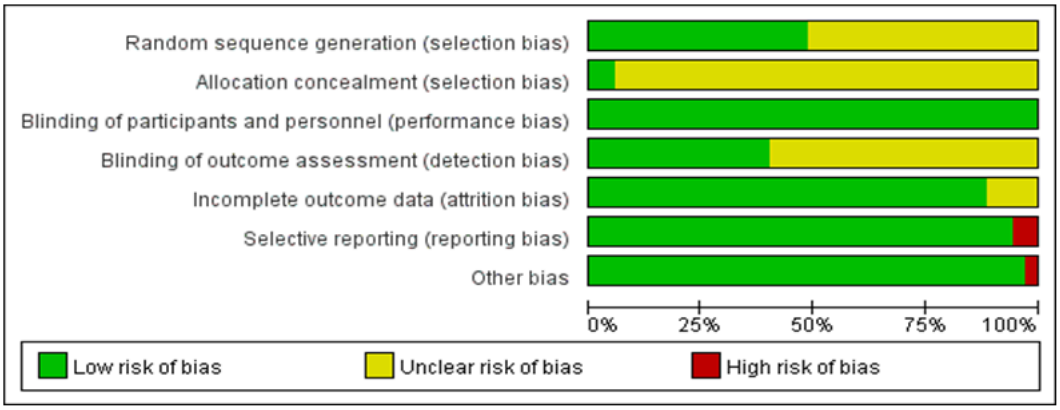


Figure 3

Risk of bias assessment graph of included study

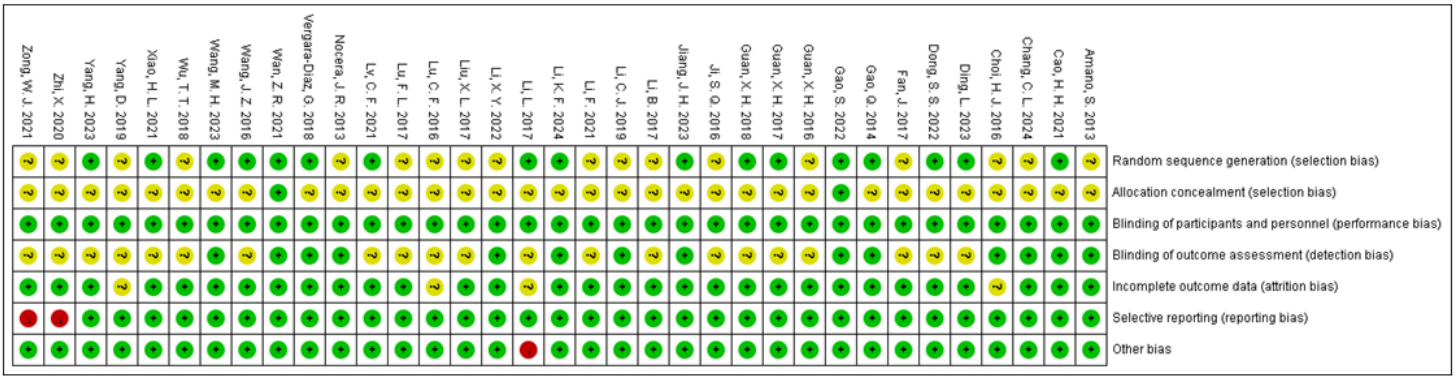


Figure 4

Summary of risk of bias in included studies

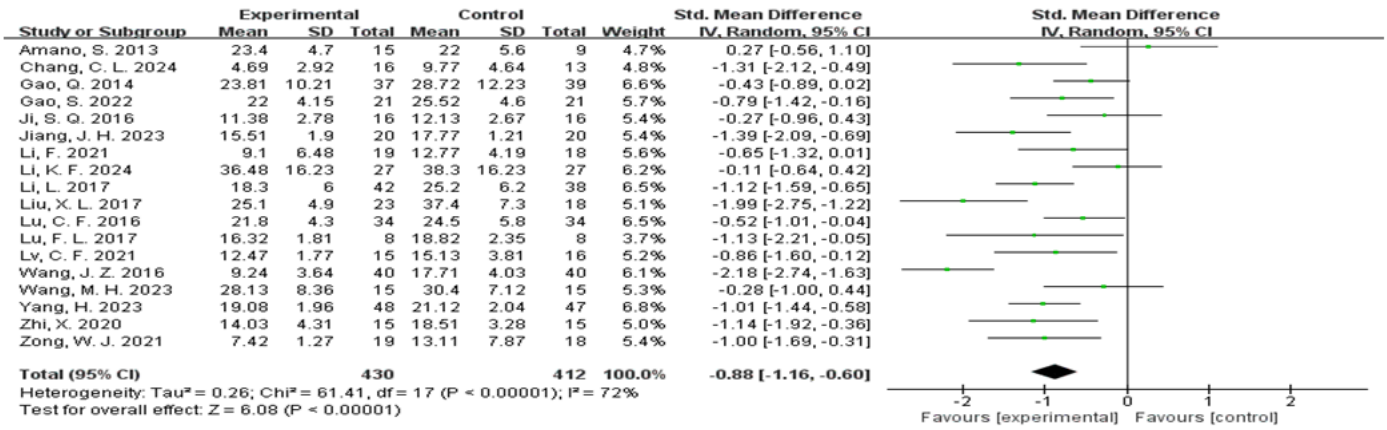


Figure 5

Results of traditional Meta-analysis of UPDRS Ⅲ

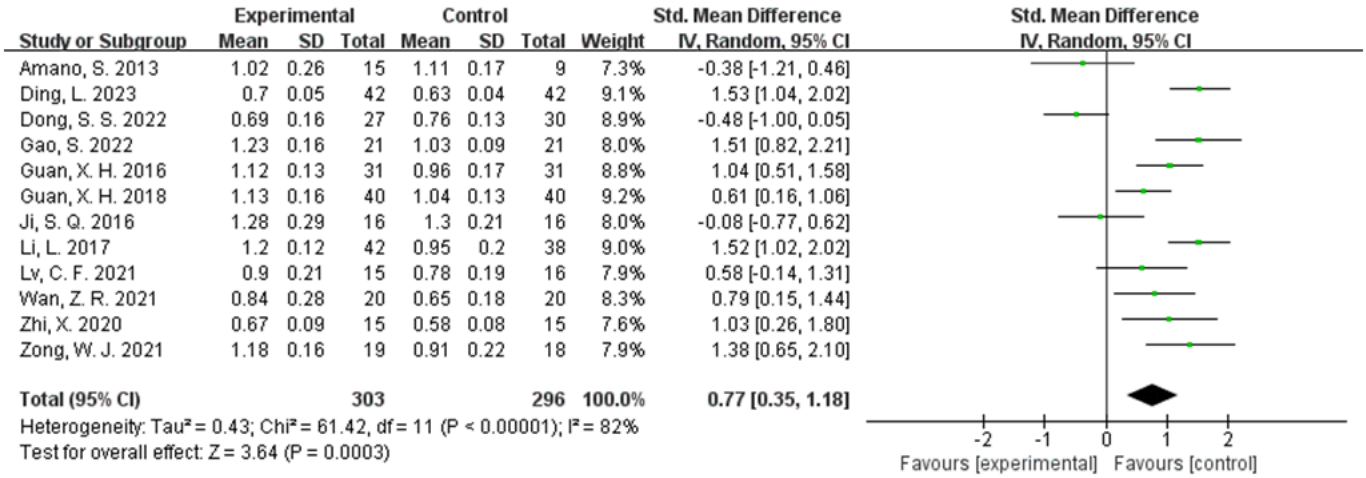


Figure 6

Results of Traditional Meta-analysis of Gait Speed

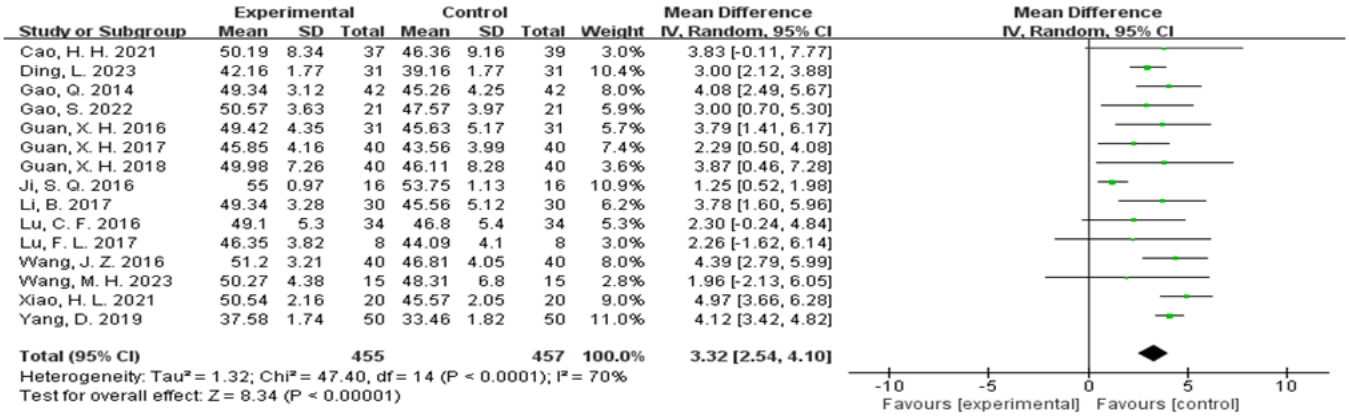


Figure 7

Results of Traditional Meta-analysis of BBS Scores

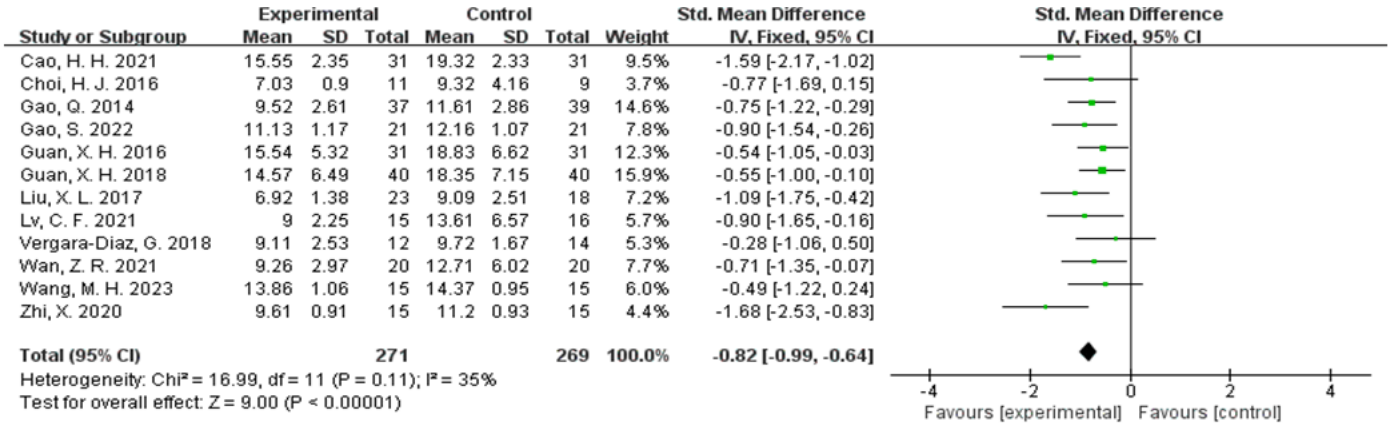


Figure 8

Results of Traditional Meta-analysis of TUGT

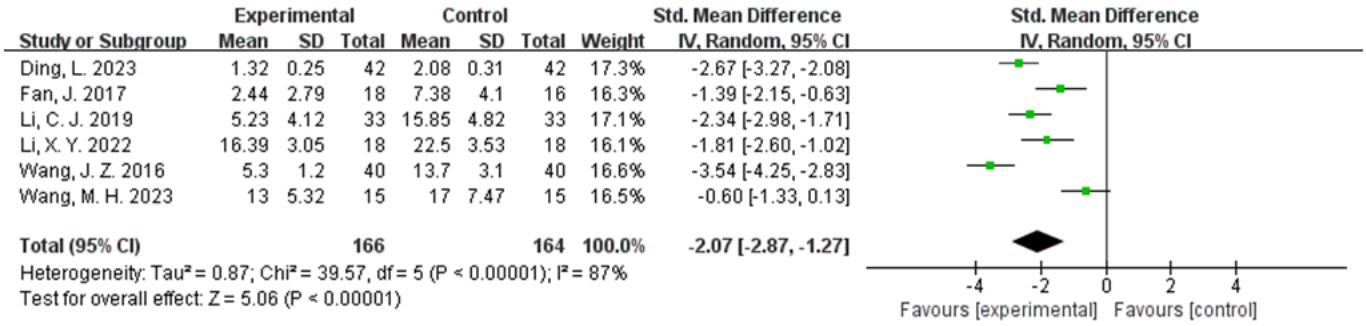


Figure 9

Results of Traditional Meta-analysis of Depression Scores

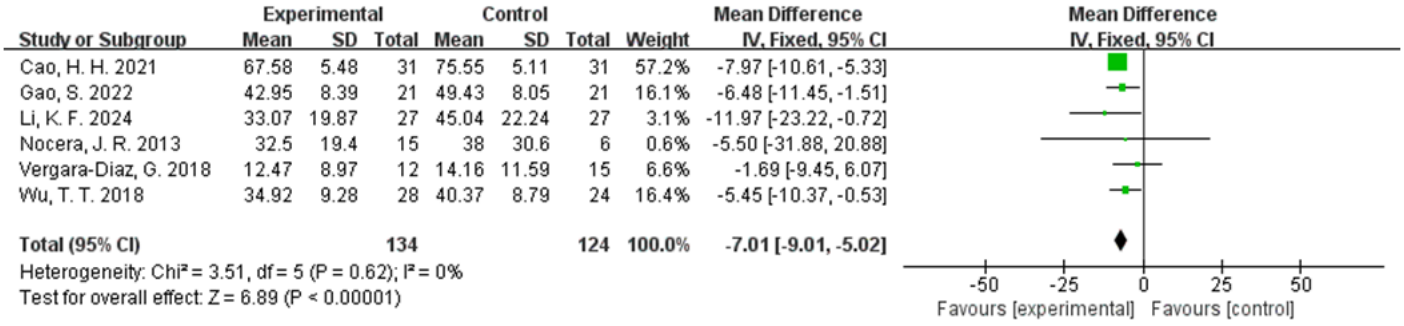


Figure 10

Figure 11 Results of Traditional Meta-analysis of Quality of Life Scores After Excluding High Heterogeneity Studies

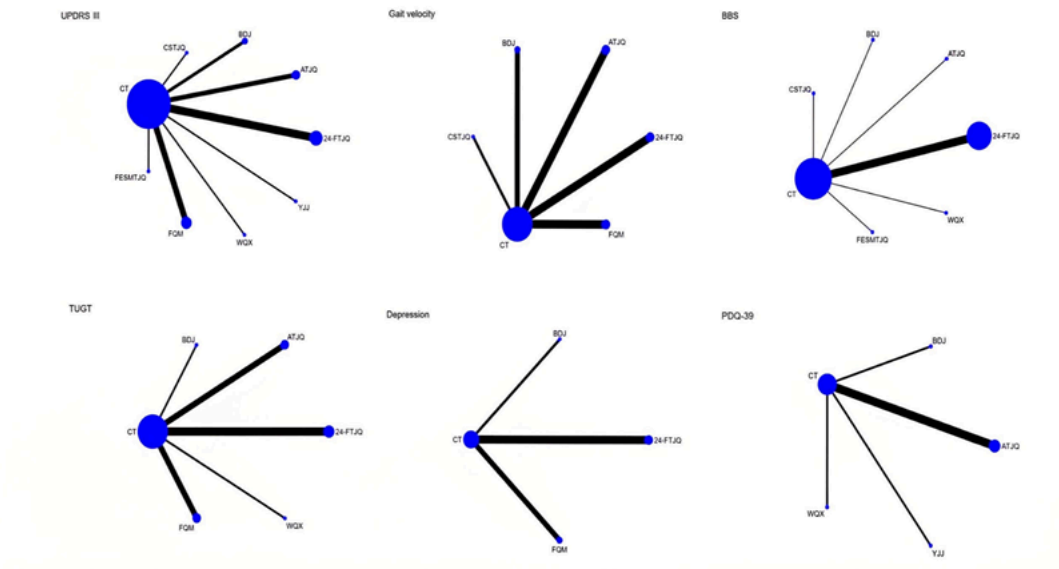


Figure 11

Figure 12 Network Evidence Map

24-FTJQ								
0.07 (-1.40, 1.53)	WQX							
0.06 (-1.49, 1.61)	-0.01 (-1.94, 1.93)	YJJ						
-0.09 (-1.29, 1.11)	-0.16 (-1.82, 1.51)	-0.15 (-1.89, 1.59)	BDJ					
-0.20 (-1.16, 0.76)	-0.27 (-1.76, 1.23)	-0.26 (-1.84, 1.32)	-0.11 (-1.35, 1.13)	FQM				
-0.64 (-2.21, 0.92)	-0.71 (-2.65, 1.23)	-0.71 (-2.71, 1.30)	-0.55 (-2.31, 1.20)	-0.44 (-2.04, 1.15)	CSTJQ			
-0.68 (-2.16, 0.81)	-0.74 (-2.62, 1.13)	-0.74 (-2.68, 1.21)	-0.59 (-2.26, 1.09)	-0.48 (-1.99, 1.04)	-0.03 (-1.99, 1.92)	FESMTJQ		
-0.63 (-1.66, 0.41)	-0.69 (-2.24, 0.85)	-0.69 (-2.32, 0.94)	-0.54 (-1.84, 0.76)	-0.43 (-1.50, 0.65)	0.02 (-1.62, 1.66)	0.05 (-1.51, 1.61)	ATJQ	
-1.03 (-1.67, -0.38)	-1.09 (-2.41, 0.22)	-1.09 (-2.50, 0.32)	-0.94 (-1.95, 0.08)	-0.83 (-1.54, -0.12)	-0.38 (-1.81, 1.05)	-0.35 (-1.69, 0.98)	-0.40 (-1.21, 0.41)	CT

Figure 12

Figure 13 Results of Network Meta-analysis of the Impact of Different Interventions on UPDRS III Scores

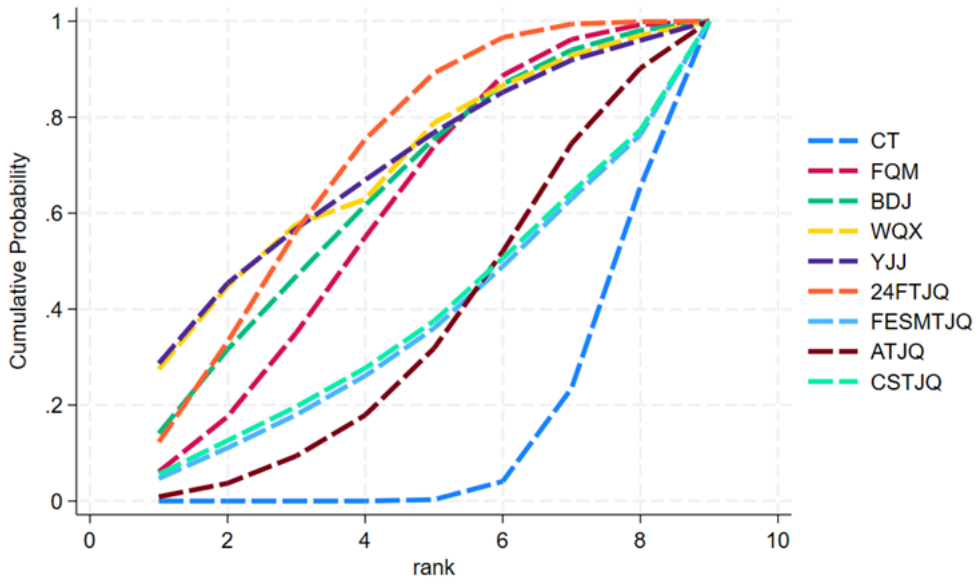


Figure 13

Figure 14 Cumulative Probability Ranking of Different Interventions on UPDRS III Scores

ATJQ					
0.05 (-0.89, 0.98)	24-TJQ				
0.35 (-0.63, 1.32)	0.30 (-0.64, 1.24)	FQM			
0.55 (-0.53, 1.63)	0.50 (-0.54, 1.54)	0.20 (-0.87, 1.28)	BDJ		
1.02 (-0.36, 2.40)	0.97 (-0.38, 2.33)	0.67 (-0.71, 2.06)	0.47 (-0.99, 1.93)	CSTJQ	
1.05 (0.36, 1.74)	1.00 (0.37, 1.63)	0.70 (0.01, 1.39)	0.50 (-0.32, 1.33)	0.03 (-1.17, 1.23)	CT

Figure 14

Figure 15 Results of Network Meta-analysis of the Impact of Different Interventions on Gait Velocity

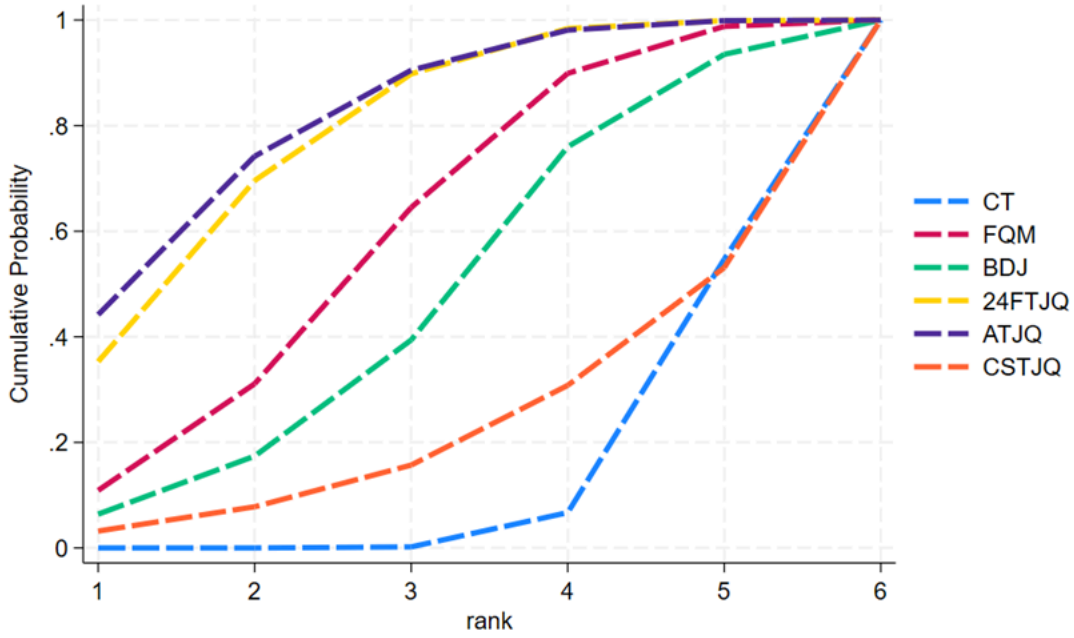


Figure 15

Figure 16 Cumulative Probability Ranking of Different Interventions on Gait Velocity

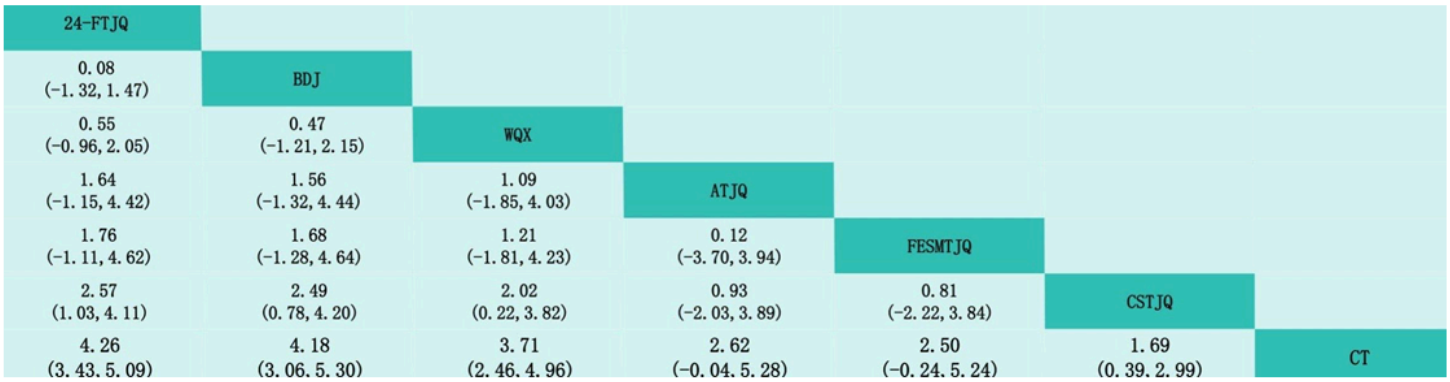


Figure 16

Figure 17 Results of Network Meta-analysis of the Impact of Different Interventions on BBS Scores

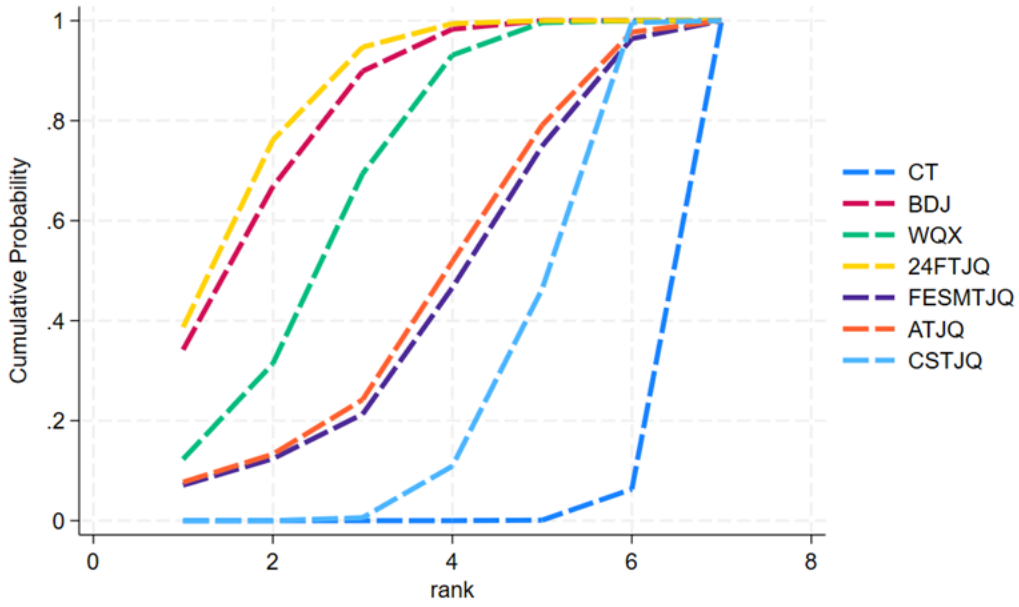


Figure 17

Figure 18 Cumulative Probability Ranking of Different Interventions on BBS Scores

WQX					
−3. 07 (−4. 04, −2. 09)	FQM				
−3. 12 (−4. 05, −2. 19)	−0. 06 (−0. 56, 0. 45)	24-FTJQ			
−3. 25 (−4. 43, −2. 08)	−0. 19 (−1. 06, 0. 69)	−0. 13 (−0. 95, 0. 69)	BDJ		
−3. 39 (−4. 38, −2. 40)	−0. 32 (−0. 93, 0. 29)	−0. 27 (−0. 80, 0. 27)	−0. 14 (−1. 02, 0. 75)	ATJQ	
−3. 83 (−4. 71, −2. 94)	−0. 76 (−1. 17, −0. 35)	−0. 70 (−0. 99, −0. 41)	−0. 57 (−1. 34, 0. 20)	−0. 44 (−0. 88, 0. 01)	CT

Figure 18

Figure 19 Results of Network Meta-analysis of the Impact of Different Interventions on TUGT Scores

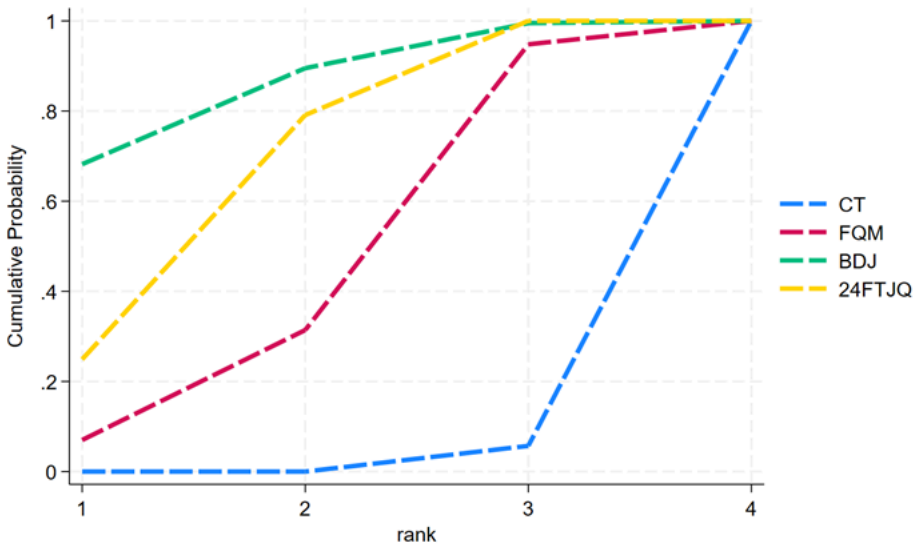


Figure 19

图20 不同干预措施对TUGT的累积概率排序图

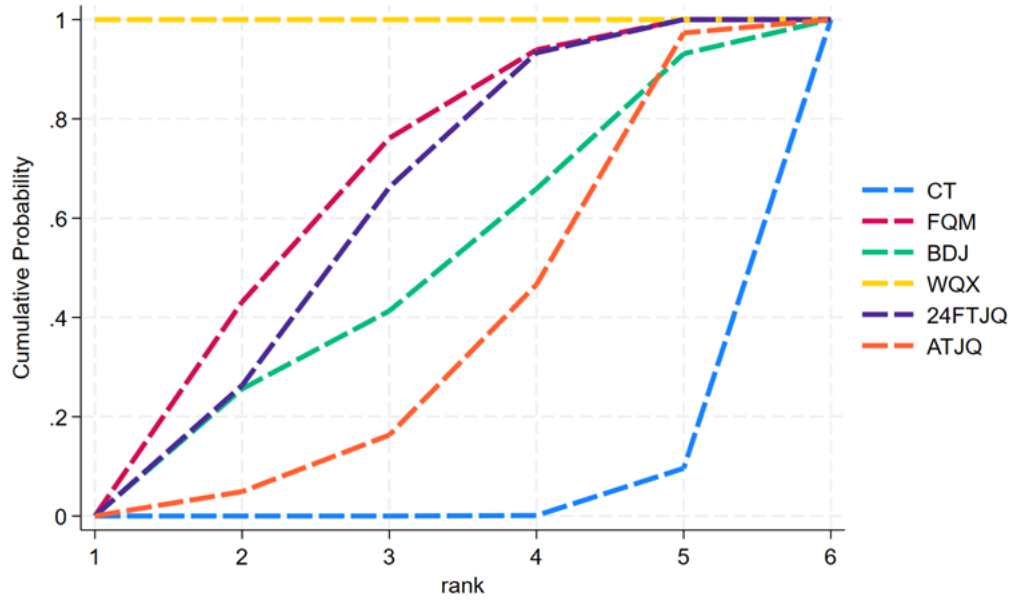


Figure 20

图21 不同干预措施对Depression的网状结构Meta分析图

BDJ			
−0.63 (−2.79, 1.53)	24-FTJQ		
−1.24 (−3.54, 1.06)	−0.61 (−2.33, 1.12)	FQM	
−2.38 (−4.25, −0.51)	−1.74 (−2.82, −0.67)	−1.14 (−2.48, 0.20)	CT

Figure 21

Figure 20 Cumulative Probability Ranking of Different Interventions on TUGT Scores

YJJ				
-7.72 (-11.13, -4.31)	WQX			
-13.38 (-24.91, -1.85)	-5.66 (-17.28, 5.96)	BDJ		
-14.17 (-18.15, -10.19)	-6.45 (-10.68, -2.22)	-0.79 (-12.59, 11.01)	ATJQ	
-17.49 (-19.68, -15.30)	-9.77 (-12.38, -7.16)	-4.11 (-15.43, 7.21)	-3.32 (-6.65, 0.01)	CT

Figure 22

Figure 23 Results of Network Meta-analysis of the Impact of Different Interventions on PDQ-39 Scores

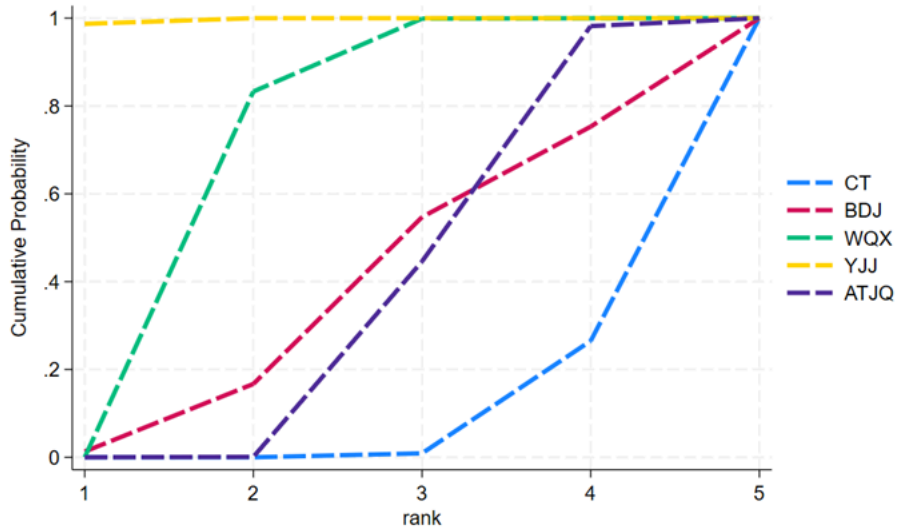


Figure 23

Figure 24 Cumulative Probability Ranking of Different Interventions on PDQ-39 Scores

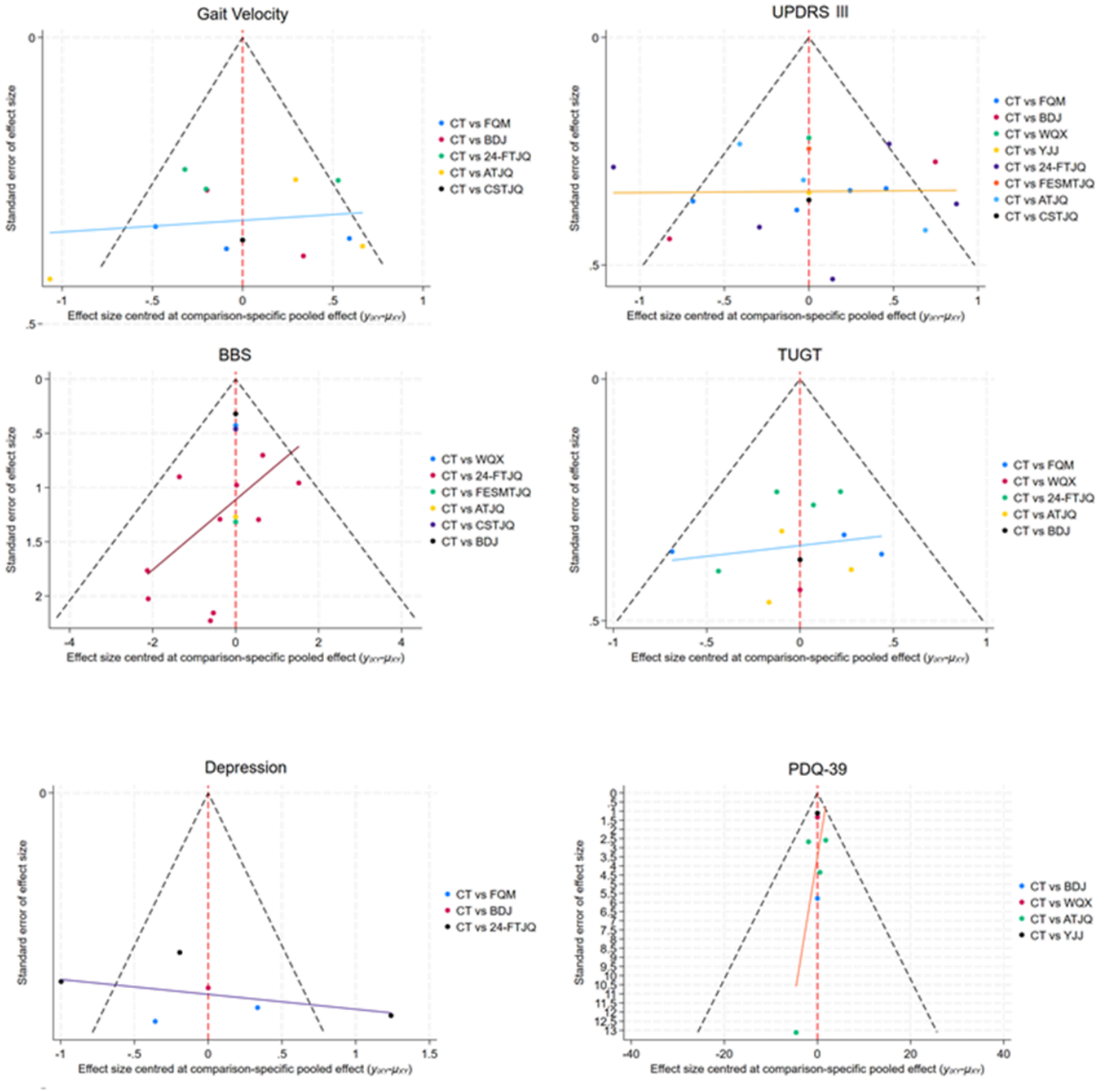


Figure 24

Figure 25 Publication Bias Analysis Graph