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Original Article

Baduanjin Exercise Training for Elderly Chronic Obstructive Pulmonary Disease Patients with Mild Cognitive Impairment: A Feasibility Clinical Trial

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SUMMARY

Objective: To examine the effectiveness of Baduanjin exercise in community-based rehabilitation for patients with chronic obstructive pulmonary disease (COPD) and mild cognitive impairment (MCI).
Methods: Forty-five COPD patients with MCI were assigned to either a control group (n = 25) or an intervention group (n = 20). Both groups received standard care, while the intervention group received additional on-site Baduanjin exercise instruction. The instruction lasted for 2 weeks, followed by 10 weeks of home-based practice and follow-up. After 12 weeks, the two groups were compared based on pulmonary function tests and Montreal Cognitive Assessment (MoCA) scores. COPD Assessment Test (CAT) scores and exercise adherence rates were also assessed. Adverse events were monitored for both groups.
Results: After the intervention, the intervention group exhibited greater improvements in FVC (p = 0.020, 95% CI (-0.37, -0.03)) and FEV1 (p = 0.027, 95% CI (-0.83, -0.05)) compared to the control group. The intervention group showed improvements from baseline in FVC (p = 0.002), FEV1 (p < 0.001), FEV1/FVC (p = 0.037), and CAT scores (p = 0.027). The intervention group also demonstrated greater improvement in language (p = 0.002, 95% CI (-1.29, -0.33)), orientation (p = 0.020, 95% CI (-0.65, -0.06)), and total MoCA score (p = 0.001, 95% CI (-3.42, -1.02)) compared to the control group. Adherence to the exercise regimen was reported by 71.43% of participants in the intervention group during the home-based period. No adverse events were observed in the intervention group throughout the study.
Conclusion: A 12-week Baduanjin exercise program effectively improves both cognitive and pulmonary function in COPD patients with MCI.

1. Introduction

Chronic obstructive pulmonary disease (COPD) is a prevalent, progressive respiratory condition. In 2019, the global prevalence of COPD in individuals aged 30 to 79 years was 10.3% (95% CI: 8.2–12.8), affecting about 391.9 million people (95% CI: 312.6–487.9).[1] COPD results in about 3 million deaths annually, presenting major challenges for public health and healthcare systems.[2]

Cognitive impairment (CI) is a common comorbidity among elderly individuals with COPD, with prevalence estimates ranging from 12% to 88%.[3] The development of CI in these patients is influenced by multiple factors, particularly aging, chronic hypoxemia, and persistent inflammatory responses. Hypoxemia and hypercapnia can lead to insufficient oxygen delivery to the brain, which interferes with acetylcholine and neurotransmitter production, promotes the formation of free radicals, causes neuronal damage, and triggers axonal degeneration.[4,5] Chronic inflammation in COPD, marked by elevated interleukin-6 and C-reactive protein, contributes to endothelial injury, which exacerbates cognitive and executive function decline.[6–8] Other factors, including poor nutrition, sedentary behavior, aging, long-term smoking, educational background, and disease severity and duration, may also play a role in structural and functional brain abnormalities.[9] Comorbid conditions such as cerebrovascular disease, anxiety, depression, sleep disturbances, and metabolic syndrome further impact cognitive function.[10]

As CI progresses, elderly COPD patients tend to have difficulty with symptom self-monitoring, adherence to medication and inhaler use,[11] and maintaining a healthy lifestyle. These individuals are also at a higher risk of discontinuing pulmonary rehabilitation programs[12] and experiencing increased exacerbations, hospitalizations, and mortality.[13] Cognitive function is critical for proper medication management and adherence to pulmonary rehabilitation. Thus, it is important to screen for cognitive decline, especially mild cognitive impairment (MCI), in COPD patients, as early intervention may provide an opportunity for improvement during the early stages.

Exercise has been shown to enhance lung function and reduce dyspnea in COPD patients.[14] Combining respiratory muscle stretching with 30 minutes of aerobic running effectively strengthens abdominal muscles and reduces breathlessness in moderate to severe COPD cases.[15] Regular aerobic exercise has also been found to improve cognitive function.[15] A study by Dan Song[16] found that elderly MCI patients showed improvements in cognitive function and health-related quality of life after 16 weeks of moderate-intensity aero-

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bic walking combined with lower limb joint stretching exercises.

However, prior research has often focused on single types of exercise (such as walking, cycling, or swimming), which can present certain risks and may require specific facilities or equipment. COPD patients with MCI, due to their cognitive and executive function limitations, tend to have higher dropout rates in rehabilitation programs.[17] Therefore, it is crucial to explore appropriate exercise regimens for COPD patients with MCI to improve adherence and health outcomes. Baduanjin, a moderate to low-intensity exercise rooted in traditional Chinese martial arts, is recommended in COPD rehabilitation guidelines.[18,19] It combines muscular movement with respiratory control, which helps improve lung function, alleviate airway obstruction, and reduce dyspnea.[20] A six-month pulmonary rehabilitation program incorporating Baduanjin has been shown to improve lung function, exercise tolerance, and pulmonary adaptability in stable COPD patients, while also reducing clinical symptoms and enhancing quality of life.[21] The practice of Baduanjin also involves cognitive tasks such as visual-spatial processing, recalling movements, and switching between tasks, which facilitates the integration of motor and cognitive-linguistic systems, serving as both aerobic exercise and cognitive training.[22]

Previous studies have generally examined COPD or MCI individually, overlooking the combined benefits of Baduanjin for pulmonary and cognitive functions in COPD patients with MCI.[23] This study aims to conduct a 3-month feasibility clinical trial to preliminarily evaluate the effects of Baduanjin on improving pulmonary function and cognitive abilities in COPD patients with MCI. The research will employ a 'community-based rehabilitation + home-based practice' model to determine whether patients can independently complete the exercise regimen during an extended home period. Adherence to the exercise program will be assessed to evaluate the feasibility of this model.

2. Materials and methods

2.1. Objective

To examine the effects of a 12-week Baduanjin exercise program on pulmonary function, cognitive abilities, and quality of life in elderly COPD patients with MCI.

2.2. Trial design and study site

This study is a single-center, randomized controlled trial with a 1:1 random allocation to either the intervention or control group, conducted at the Weifang Community Service Center in Shanghai.

2.3. Participant eligibility

2.3.1. Inclusion criteria

Participants must meet all of the following conditions: (a) Diagnosed with COPD as per the 2023 GOLD guidelines, classified as GOLD stages 1–3; (b) MoCA score < 26; (c) Global Deterioration Scale (GDS) stage 2 or 3; (d) Aged between 60 and 75 years; (e) Manual muscle testing grades 4 or 5; (f) Willing to provide informed consent and participate in the study.

2.3.2. Exclusion criteria

Participants will be excluded if they meet any of the following conditions: (a) History of myocardial infarction, severe heart failure, severe hypertension, musculoskeletal disorders, or other contraindications to exercise; (b) Cognitive impairment resulting from depression, medication, or intoxication; (c) History of severe mental illness, alcohol or drug abuse; (d) Active tuberculosis, malignancy, or hematological conditions; (e) Participation in other clinical trials that may interfere with the outcomes of this study.

2.3.3. Dropout and termination criteria

Participants will be excluded from the final analysis if they meet any of the following criteria: (a) severe illness or hospitalization during the study; (b) death or relocation of the participant; (c) incomplete data collection; (d) early study withdrawal; (e) inability to contact the participant.

2.4. Interventions

2.4.1. Control group

The control group received standard medical treatment, oxygen therapy, breathing exercise guidance, and health education.

(a) Medical Treatment: Participants continued using their prescribed inhalers/oral medications, with guidance on proper inhaler technique. (b) Oxygen Therapy: Oxygen flow rates and duration were adjusted according to medical recommendations, with regular monitoring of oxygen saturation. (c) Breathing Exercises: Participants practiced pursed-lip breathing techniques daily (5–10 min, twice a day, 5 days a week). (d) Health Education: Participants were provided with advice on smoking cessation, infection prevention, pollution avoidance, nutrition, weight management, and reducing the risk of exacerbations.

2.4.2. Intervention group

The intervention group received the same standard interventions as the control group, with the addition of Baduanjin exercises in both centralized sessions and home-based practice.

(a) Centralized Teaching: Four centralized classes were conducted twice weekly at the Weifang Community Health Service Center, led by professional qigong instructors, with support from respiratory physicians, nurses, and research staff. Participants were evaluated, and those capable of performing Baduanjin independently progressed to home-based practice. To ensure consistency in training, movements and requirements were standardized, and instructional videos were recorded. For safety purposes, participants were not required to master the fifth movement, focusing instead on the first four movements.

(b) Home-based Practice and Supervision: Participants performed Baduanjin three times a week, twice a day, for 15 minutes per session.[19,24] Instructional videos were provided through a WeChat group, and a customized Borg Scale was used to monitor intensity (score 4–6).[25] Adherence was supported through weekly reminders and bi-monthly sessions. Any queries were addressed via WeChat or phone calls.

2.5. Termination and exclusion criteria

Termination Criteria: (a) Occurrence of serious adverse events that make the participant unfit for continued participation. (b) Death or significant worsening of the participant's condition requiring hospitalization.

Exclusion Criteria: (a) Inability to pass the Baduanjin proficiency assessment or failure to cooperate. (b) Engagement in Baduanjin for less than 30% of the required time due to various factors. (c) Voluntary withdrawal by the participant.

2.6. Ethical principles

The study was approved by the IRB of Shanghai University of

Traditional Chinese Medicine (2023-01-13-02). All procedures are in accordance with the Declaration of Helsinki and relevant ethical guidelines. Participants were provided with comprehensive information regarding the study's purpose, risks, and benefits. Written informed consent was obtained on a voluntary basis. The confidentiality of the data is guaranteed, with data being used solely for statistical purposes and stored securely in a database accessible only to the research team. The results will be published anonymously. After the study, the control group will receive Baduanjin training and instructional videos.

2.7. Outcome measures

All outcome measures will be evaluated for each participant at baseline and 12 weeks after the intervention.

2.7.1. Primary outcome measures

Pulmonary Function Tests (PFTs): Participants will undergo PFTs at the community health center to measure FVC, FEV1, and the FEV1/FVC ratio, performed by trained professionals using the same equipment to ensure consistency.

The Montreal Cognitive Assessment (MoCA): The Chinese version of MoCA[26] will be used to assess cognitive abilities across seven domains, with scores ranging from 0 to 30, where lower scores suggest reduced cognitive function. Cronbach's α = 0.810, and test-retest reliability is high (r = 0.898, p < 0.05).[27]

2.7.2. Secondary outcome measures

COPD Assessment Test (CAT): This 8-item questionnaire, scored from 0 to 5, measures the impact of COPD on quality of life.[28] Higher scores indicate poorer health. Scores 0–10 represent 'mild', 11–20 represent 'moderate', and 31–40 represent 'severe' impact. Cronbach's α = 0.805 among Chinese COPD patients demonstrates good validity and reliability.[29]

Exercise adherence rate: Exercise will be monitored by participants using diaries, and photos will be submitted on a monthly basis. Participants in the intervention group were instructed to perform at least three exercise sessions weekly at home. An exercise frequency exceeding 24 sessions (80%) was categorized as good adherence, 18 to 24 sessions (60%–80%) as moderate adherence, and fewer than 18 sessions (< 60%) as poor adherence.[30]

Adverse event: Adverse events occurring during the study will be documented, including their causes. The occurrence rate will be calculated as follows: (number of adverse events in the group / total number of participants in the group) × 100%.

2.8. Sample size calculation

MoCA scale scores were utilized as the outcome measure, and the sample size was determined using methods for comparing means of two independent samples with differences. PASS 15 software was applied with α = 0.05 and 1-β = 0.8. Based on the relevant literature,[31] the intervention group scored 21.65 ± 1.72, while the control group scored 20.10 ± 1.37. After considering a 20% dropout rate, the final sample size was adjusted to N1 = N2 = 21, with a total N = 42.

2.9. Recruitment and randomization

Participants will be recruited through convenience sampling by placing advertisements at the Weifang Community Service Center in Pudong New Area, Shanghai. SPSS 24.0 software will generate random numbers to randomly assign eligible participants, in a 1:1 ratio, to either the intervention group or the control group.

2.10. Blinding

This study is non-blinded. Due to the requirement for on-site instruction of Baduanjin in the intervention group and the presence of researchers and community nurses to ensure participant safety, blinding cannot be applied to participants, researchers, community nurses, Qigong instructors, or traditional Chinese medicine practitioners. The evaluator will be qualified community doctors and nurses who will not engage in the teaching of Baduanjin or the WeChat management and will remain unaware of the participant group assignments.

2.11. Data management and statistical analysis

Each participant will be assigned a unique ID and Case Report Form (CRF) for data recording. Data will be collected 12 weeks after the intervention and compared to baseline measurements. All researchers will complete standardized training before the study begins. Raw data will be accurately recorded on CRF forms and entered into an electronic database by two data managers to ensure accuracy. Dropouts will be identified due to significant data loss. A Per-Protocol analysis will be conducted in this study. Normally distributed continuous data will be described using mean ± SD and analyzed with independent t-tests. Categorical data will be analyzed using chi-square tests (α = 0.05, 1-β = 0.08).

2.12. Harms

Participants will be informed of potential adverse events, including difficulty breathing, chest tightness, dizziness, palpitations, falls, and fractures. Exercise will be stopped if any symptoms occur, and a qualified physician will determine whether continuation is safe. Incidents will be reported to hospital authorities and the ethics committee. Financial compensation will be provided for adverse events caused by Baduanjin exercises.

3. Result

3.1. Patient demographics

Between May 12, 2023, and March 29, 2024, a total of 56 eligible participants, with an average age of 68.84 ± 4.43 years, were recruited through pull-up banners and advertisements at the Weifang Community Health Service Center. SPSS 24.0 software was used to randomly assign participants to either an intervention group (28 participants) or a control group (28 participants). A total of 45 participants completed the study. The patient recruitment process and trial design are depicted in Figure 1. No significant differences were observed between the two groups in terms of age, BMI, gender, or other factors (p > 0.05). Further details are provided in Table 1.

3.2. Exercise adherence rate and adverse events

The average attendance rate for Baduanjin instruction in the intervention group was 91.75%, with individual attendance ranging from 75% to 100%. During the home exercise period, 71.43% of participants completed more than 24 exercise sessions, reflecting good adherence. No adverse events were recorded during the intervention in the experimental group, demonstrating the study's safety and feasibility.

3.3. Pulmonary function tests and quality of life assessment

Following 12 weeks of intervention, the intervention group exhibited significantly higher FVC ($d = 0.03 \pm 0.55$, $p = 0.020$) and FEV1 ($d = 0.28 \pm 0.59$, $p = 0.027$) values compared to the control group. The intervention group also showed improvements in FVC, FEV1, and FEV1/FVC ratio after the intervention ($p < 0.05$), whereas no significant changes were observed in pulmonary function in the control group before and after the intervention. No significant difference in CAT scores was noted between the two groups ($p = 0.240$). Detailed results are available in Tables 2 and 3.

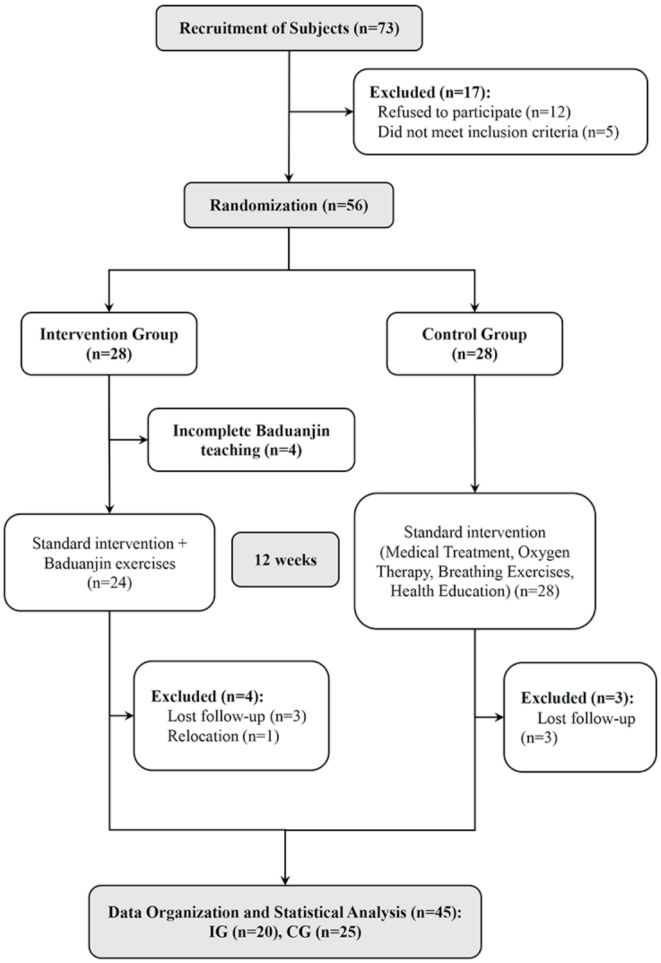

Figure 1. The trial design roadmap.

3.4. Cognitive abilities

Statistical differences were found between the two groups in language ($d = 0.95 \pm 0.94$, $p = 0.002$, 95% CI (-1.29, -0.33)), orientation ($d = 0.20 \pm 0.83$, $p = 0.020$, 95% CI (-0.65, -0.06)), and total MoCA score ($d = 3.40 \pm 4.04$, $p = 0.001$, 95% CI (-3.42, -1.02)). Within the intervention group, significant changes were observed in language and MoCA total scores before and after the intervention ($p < 0.05$). No significant changes in cognitive abilities or total scores were noted in the control group before and after the intervention ($p > 0.05$). Detailed information is available in Tables 4 and 5.

4. Discussion

At present, no medication is available to fully reverse the decline in lung function in COPD patients, and there is limited evidence suggesting that any drug can improve CI.[32,33] Consequently, exercise interventions are currently considered a more cost-effective and practical approach, which is generally accepted by elderly COPD patients with concurrent MCI.

This study found a statistically significant difference in the improvement of FVC and FEV1 between the intervention and control groups. While the CAT scores showed statistical significance, the difference was minimal. These results are consistent with those of Li Meng,[34] who demonstrated that 3 months of Baduanjin exercise during the stable phase of COPD can improve subjective scales such as ADL, SGRQ, and activities of daily living, although no significant differences were observed in physiological indicators like FEV1/FVC

Table 1
Baseline demographic and clinical characteristics.

Variable	CG (n = 25)	IG (n = 20)	*p*
Age (y), mean (SD)	68.56 ± 4.83	69.20 ± 3.97	0.636
BMI (kg/m^2), mean (SD)	22.61 ± 2.87	23.13 ± 2.94	0.555
Male, n (%)	15 (60)	7 (35)	0.095
Duration of illness (y), median (IQR)	3 [2, 5]	2 [2,4]	0.056
Number of comorbidities, median (IQR)	1 [0.5,1]	1 [1,2]	0.061
Education, n (%)			0.352
Primary school	1 (4)	2 (10)	
Junior high school	11 (44)	5 (25)	
Senior high school and above	13 (52)	13 (65)	
Smoker, n (%)	15 (60)	8 (40)	0.182
Drinker, n (%)	5 (20)	2 (10)	0.613
MoCA, mean (SD)	20.72 ± 2.246	21.95 ± 2.743	0.105
FVC (L), mean (SD)	2.39 ± 0.38	2.22 ± 0.42	0.169
FEV1 (L), mean (SD)	1.67 ± 0.43	1.58 ± 0.50	0.433
FEV1/FVC (%), mean (SD)	59.93 ± 5.49	61.06 ± 5.51	0.500
mMRC, n (%)			0.602
Stage 0	8 (32)	5 (25)	
Stage 1	10 (40)	11 (55)	
Stage 2	7 (28)	4 (20)	
CAT score, mean (SD)	19.28 ± 3.46	18.10 ± 3.24	0.249

Notes: [a] Student's*t*-test; [b] Chi-square test; [c] Mann-Whitney *U*-test.
Abbreviations: BMI, body mass index; CAT, the COPD Assessment Test questionnaires; FEV1, forced expiratory volume in 1 s; FEV1/FVC, forced expiratory volume in 1 s/forced vital capacity; FVC, forced vital capacity; IQR, interquartile range; mMRC, the modified Medical Research Council dyspnea scale; MoCA, montreal cognitive assessment; SD, standard deviation.

Table 2
Comparison of pulmonary function within the groups.

Variable, mean (SD)	CG (n = 25)		*d*1	*p*1	IG (n = 20)		*d*2	*p*2
	Pre-invention	Post-invention			Pre-invention	Post-invention		
FVC (L)	2.39 ± 0.38	2.29 ± 0.38	-0.10 ± 0.39	0.226	2.22 ± 0.42	2.33 ± 0.49	0.10 ± 0.14	**0.002***
FEV1 (L)	1.67 ± 0.43	1.84 ± 0.42	0.16 ± 0.56	**0.037***	1.58 ± 0.50	2.17 ± 0.49	0.69 ± 0.74	< **0.001***
FEV1/FVC (%)	59.93 ± 5.49	59.33 ± 7.02	-0.61 ± 3.90	0.446	61.06 ± 5.51	62.62 ± 5.92	1.56 ± 3.12	**0.037***
CAT score	19.28 ± 3.46	18.96 ± 3.18	-0.32 ± 1.57	0.319	18.10 ± 3.24	17.20 ± 2.28	-0.90 ± 1.68	**0.027***

Notes: *P*1: Comparison within CG before and after intervention; *P*2: Comparison within IG before and after intervention; *d*: Difference before and after intervention.
* Compared to pre- and post-intervention within the same group, $p < 0.05$.
Abbreviations: CAT, the COPD Assessment Test questionnaires; FEV1, forced expiratory volume in 1 s; FEV1/FVC, forced expiratory volume in 1 s/forced vital capacity; FVC, forced vital capacity; SD, standard deviation.

Table 3
Comparison of pulmonary function between 2 groups after intervention.

Variable, mean (SD)	CG (n = 25)	IG (n = 20)	*d*	*p*	95% CI
FVC (L)	2.29 ± 0.38	2.33 ± 0.49	0.03 ± 0.55	**0.020***	(-0.37, -0.03)
FEV1 (L)	1.84 ± 0.42	2.17 ± 0.49	0.28 ± 0.59	**0.027***	(-0.83, -0.05)
FEV1/FVC (%)	59.33 ± 7.02	62.62 ± 5.92	4.37 ± 6.45	0.050	(-4.33, 0.00)
CAT score	18.96 ± 3.18	17.20 ± 2.28	-2.20 ± 3.91	0.240	(-0.40, 1.56)

Notes: *d*: Difference before and after intervention; *p*: Comparison between CG and IG after intervention. * $p < 0.05$.
Abbreviations: CAT, the COPD Assessment Test questionnaires; FEV1, forced expiratory volume in 1 s; FEV1/FVC, forced expiratory volume in 1 s/forced vital capacity; FVC, forced vital capacity; SD, standard deviation.

Table 4
Comparison of cognitive function within the groups.

Variable, mean (SD)	CG (n = 25)		*d*1	*p*1	IG (n = 20)		*d*2	*p*2
	Pre-invention	Post-invention			Pre-invention	Post-invention		
Visuospatial	2.96 ± 0.676	2.96 ± 0.790	0.00 ± 0.81	1.000	3.45 ± 0.999	3.80 ± 0.951	0.35 ± 0.81	0.069
Naming	2.16 ± 0.688	2.24 ± 0.663	0.08 ± 0.57	0.491	2.35 ± 0.745	2.55 ± 0.605	0.20 ± 0.52	0.104
Attention	4.68 ± 1.108	4.48 ± 0.963	-0.20 ± 1.00	0.327	4.85 ± 1.089	4.95 ± 0.759	0.10 ± 1.07	0.681
Language	1.44 ± 0.768	1.48 ± 0.823	0.04 ± 0.84	0.814	1.45 ± 0.826	2.30 ± 0.470	0.85 ± 0.75	< **0.001***
Abstraction	0.64 ± 0.826	0.76 ± 0.597	0.12 ± 0.73	0.417	0.95 ± 0.638	1.10 ± 0.553	0.15 ± 0.67	0.330
Memory	2.60 ± 1.080	2.80 ± 1.080	0.20 ± 1.00	0.327	2.90 ± 1.483	3.45 ± 0.945	0.55 ± 1.19	0.053
Orientation	5.76 ± 0.436	5.60 ± 0.500	-0.16 ± 0.47	0.103	5.60 ± 0.503	5.80 ± 0.523	0.20 ± 0.52	0.104
Total	20.72 ± 2.246	20.80 ± 2.345	0.08 ± 2.34	0.866	21.95 ± 2.743	24.25 ± 2.124	2.30 ± 1.38	< **0.001***

Notes: *d*: Difference before and after intervention; *p*1: Comparison within CG before and after intervention; *p*2: Comparison within IG before and after intervention; * Compared to pre- and post-intervention within the same group, $p < 0.05$.

Table 5
Comparison of cognitive function between 2 groups after intervention.

Variable, mean (SD)	CG (n = 25)	IG (n = 20)	*d*	*p*	95% CI
Visuospatial	2.96 ± 0.790	3.80 ± 0.951	0.75 ± 1.33	0.159	(-0.82, 0.14)
Naming	2.24 ± 0.663	2.55 ± 0.605	0.20 ± 0.89	0.472	(-0.45, 0.21)
Attention	4.48 ± 0.963	4.95 ± 0.759	0.55 ± 1.39	0.338	(-0.92, 0.32)
Language	1.48 ± 0.823	2.30 ± 0.470	0.95 ± 0.94	**0.002***	(-1.29, -0.33)
Abstraction	0.76 ± 0.597	1.10 ± 0.553	0.30 ± 0.80	0.887	(-0.45, 0.39)
Memory	2.80 ± 1.080	3.45 ± 0.945	0.60 ± 1.70	0.290	(-1.01, 0.31)
Orientation	5.60 ± 0.500	5.80 ± 0.523	0.20 ± 0.83	**0.020***	(-0.65, -0.06)
Total	20.80 ± 2.345	24.25 ± 2.124	3.40 ± 4.04	**0.001***	(-3.42, -1.02)

Notes: *d*: Difference before and after intervention; *p*: Comparison between CG and IG after intervention; * $p < 0.05$.

between the two groups. When the intervention period is extended to 6 months, significant differences in pulmonary function indicators emerge, indicating that at least 3 months of Baduanjin exercise may be required for objective improvement in lung function. Similarly, Liu Haijuan[21] found that a 6-month pulmonary rehabilitation program combined with Baduanjin exercise improves FVC, FEV1, and 6MWD, reduces clinical symptoms, and enhances pulmonary adaptability. Therefore, further research with long-term follow-up is needed to better understand the effects of these interventions and provide more specific guidance for clinical application. Compared to the control group, the intervention group exhibited improvements in language, orientation, and MoCA scores, which may promote better social interaction. Xia[35] also confirmed that Baduanjin enhances cognitive function, with greater benefits as exercise duration increases.

Baduanjin is a safe, simple, and cost-effective form of exercise that does not require much space and is easy to learn. The techniques of Baduanjin, including 'Two Hands Hold up the Heavens to Regulate the Triple Burner', 'Drawing the Bow to Shoot the Hawk', and 'Separate Heaven and Earth', involve movements such as raising the upper limbs and expanding the chest, which help increase the contraction of respiratory muscles, diaphragm, and abdominal muscles. These exercises enhance the endurance of both upper limb muscles and respiratory muscles in patients.[36] Moreover, each mo-

vement in Baduanjin requires synchronized and controlled breathing, which can relieve hypoxemia, enhance cerebral blood circulation, and improve oxygen supply to the brain, thereby boosting cognitive function.[35] Participants with lower baseline MoCA scores tend to experience more significant cognitive improvements following the intervention. However, due to the small sample size, it is currently difficult to fully validate this hypothesis.

This study has some limitations. Due to limitations in human and material resources, recruitment and interventions were carried out at a community health service center in Shanghai, which may have introduced some bias, limiting the representativeness of the sample. Future studies could consider increasing the sample size or conducting multicenter studies to confirm causal relationships and improve the generalizability and strength of the results. Furthermore, as the participants were elderly, some had difficulties using mobile phones, which made it challenging for them to follow video instructions or upload photos. Additionally, the study focused only on elderly COPD patients with MCI, with inclusion criteria of MoCA scores < 26 and GDS levels 2–3. Patients with moderate to severe cognitive impairment (GDS level 4 and above) were excluded and referred to tertiary hospitals for further evaluation and treatment. Consequently, the study did not explore whether these patients could effectively participate in Baduanjin exercises.

5. Conclusion

In summary, this study seeks to preliminarily evaluate the effects of Baduanjin exercise on pulmonary function, cognitive abilities, and quality of life in elderly COPD patients with comorbid MCI. The intention is to offer a basis for future high-quality research and encourage the wider implementation of this intervention.

Consent for publication

Written informed consent was obtained from the participants.

Availability of data and materials

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Conflict of interests

All authors declare that they have no conflict of interests.

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Authors' contributions

(1) Jiechao Yang and Xiaoqin Liao conceiving and designing the study; (2) Jiechao Yang, Xiaoqin Liao, Jie Li, Chi Chen, Yi Zhang and Dandan Geng collecting the data; (3) Jiechao Yang, Xiaoqin Liao, Jie Li, Chi Chen, Yi Zhang and Dandan Geng analyzing and interpreting the data; (4) Jiechao Yang writing the manuscript; (5) Jiechao Yang, Xiaoqin Liao, Jie Li, Chi Chen, Yi Zhang and Dandan Geng providing critical revisions that are important for the intellectual content; (6) All authors approving the final version of the manuscript.

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