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Non-pharmacological Integrated Intervention for Mild Cognitive Impairment in Older Adults: A Single-Case Study Postprint

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Abstract

Background Cognitive impairment can lead to declines in cognitive function, depression, loneliness, as well as decreased self-efficacy and quality of life in older adults.

Objective To explore the intervention effects of non-pharmacological integrated interventions on cognitive function, depression, loneliness, self-efficacy, and quality of life in elderly patients with mild cognitive impairment.

Methods Based on risk factors for cognitive impairment, this study developed a non-pharmacological integrated intervention program comprising five dimensions: cognitive function training, physical exercise, emotion management, social connection, and healthy lifestyle habits. Using an A-B-A single-subject experimental design, from June to December 2021, three older adults diagnosed with mild cognitive impairment received interventions for three months, once per week, 60 minutes per session. At baseline, after the 3-month intervention, and three months after intervention completion, the Montreal Cognitive Assessment (MoCA), General Self-Efficacy Scale (GSES), Geriatric Depression Scale-15 (GDS-15), 12-item Short Form Health Survey (SF-12), and Chinese version of the De Jong Gierveld Loneliness Scale (DJGLS) were used to evaluate the three older adults across five dimensions—cognitive function, self-efficacy, quality of life, depressive mood, and loneliness—and analyze changes in their scores. Additionally, semi-structured interviews were conducted three months after the intervention ended to evaluate intervention effects across the dimensions of cognitive function, quality of life, depressive mood, self-efficacy, and loneliness.

Results The three older adults included in the study were aged 70–74 years, all married and living with their spouses and grandchildren. The three older adults' MoCA baseline scores were 21, 22, and 24; after the 3-month intervention

they were 28, 26, and 27; and three months after intervention completion they were 25, 19, and 23. GSES baseline scores were 25, 30, and 27; after the 3-month intervention they were 29, 29, and 30; and three months after intervention completion they were 28, 31, and 28. SF-12 baseline scores were 69, 32, and 51; after the 3-month intervention they were 81, 81, and 83; and three months after intervention completion they were 78, 38, and 59. GDS-15 baseline scores were 4, 8, and 2; after the 3-month intervention they were 2, 6, and 1; and three months after intervention completion they were 1, 8, and 4. DJGLS baseline scores were 8, 7, and 8; after the 3-month intervention they were 5, 5, and 4; and three months after intervention completion they were 5, 5, and 7. Semi-structured interview data indicated that participants showed improvements across all five dimensions: cognition, quality of life, depression, loneliness, and self-efficacy.

Conclusion For elderly subjects with mild cognitive impairment, implementing non-pharmacological integrated interventions across cognitive function training, physical exercise, emotion regulation, social connection, and healthy lifestyle habits is meaningful. Elderly individuals with mild cognitive impairment showed improved scores on MoCA, SF-12, GDS-15, and DJGLS after the 3-month intervention, while GSES scores showed unsatisfactory effects post-intervention, and scores across all dimensions showed a declining trend three months after intervention completion.

Full Text

Non-pharmacological Integrated Interventions in Older Adults with Mild Cognitive Impairment: A Single Case Pilot Study

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Abstract

Background: Cognitive impairment can lead to declines in cognitive function, depression, and loneliness, as well as decreased self-efficacy and quality of life in older adults. **Objective:** To investigate the effects of non-pharmacological integrated interventions on cognitive function, depression, loneliness, self-efficacy, and quality of life in older adults with mild cognitive impairment.

Methods: Based on risk factors for cognitive impairment, we developed a non-pharmacological integrated intervention program comprising five dimensions: cognitive training, physical exercise, emotional management, social connection, and healthy lifestyle habits. Using a single-subject A-B-A experimental design, we conducted a 3-month intervention from June to December 2021 in three elderly individuals with mild cognitive impairment. The intervention was administered once weekly for 60 minutes per session. We assessed the three participants at baseline, after 3 months of intervention, and 3 months post-intervention using the Montreal Cognitive Assessment (MoCA), General Self-Efficacy Scale (GSES), Geriatric Depression Scale-15 (GDS-15), 12-item Short Form Health Survey (SF-12), and Chinese version of the De Jong Gierveld Loneliness Scale (DJGLS) across five dimensions: cognitive function, self-efficacy, quality of life, depression, and loneliness. Score changes were analyzed. A semi-structured interview was conducted 3 months post-intervention to evaluate intervention effects across these dimensions.

Results: The three participants were aged 70–74 years, all married and living with their spouses and grandchildren. Baseline MoCA scores were 21, 22, and 24; after 3 months of intervention, scores were 28, 26, and 27; and 3 months post-intervention, scores were 25, 19, and 23. GSES scores were 25, 30, and 27 at baseline; 29, 29, and 30 after intervention; and 28, 31, and 28 at follow-up. SF-12 scores were 69, 32, and 51 at baseline; 81, 81, and 83 after intervention; and 78, 38, and 59 at follow-up. GDS-15 scores were 4, 8, and 2 at baseline; 2, 6, and 1 after intervention; and 1, 8, and 4 at follow-up. DJGLS scores were 8, 7, and 8 at baseline; 5, 5, and 4 after intervention; and 5, 5, and 7 at follow-up. Semi-structured interview data indicated improvements across all five dimensions.

Conclusion: For older adults with mild cognitive impairment, implementing a non-pharmacological integrated intervention across cognitive training, physical exercise, emotional management, social connection, and healthy lifestyle habits is meaningful. Scores on the MoCA, SF-12, GDS-15, and DJGLS improved after 3 months of intervention, while GSES scores showed less ideal effects. All dimension scores demonstrated a declining trend 3 months after intervention completion.

Keywords: Non-pharmacological integrated intervention; Aged; Cognitive dysfunction; Quality of life; Depression; Loneliness

Introduction

As global population aging accelerates, cognitive impairment is becoming one of the most common degenerative diseases among older adults [1], with a worldwide prevalence of 3%–20% [2]. In China, the incidence of mild cognitive impairment (MCI) among older adults is currently 15.4% [3]. Moreover, MCI serves as a transitional stage to dementia and Alzheimer's disease [4], with 10%–15%

of MCI patients progressing to dementia annually [5] and 5%–17% developing Alzheimer's disease [6].

Clinical manifestations of MCI initially present as cognitive decline, followed by negative emotional tendencies or symptoms such as depression and loneliness [7-9], low self-efficacy [10], and rapid deterioration in quality of life [11].

Current interventions are primarily divided into pharmacological and non-pharmacological approaches. Research evidence indicates that pharmacological interventions show insignificant or uncertain effects and may cause adverse reactions such as nausea, vomiting, and palpitations [12]. Non-pharmacological interventions mainly fall into three categories: dietary supplementation [13], cognitive training, and integrated interventions. Studies on dietary supplementation have not found strong supporting evidence [13-14]. While cognitive training interventions have received support from some randomized controlled trials [15], conclusions remain inconsistent [16-17].

Existing integrated interventions represent a combination of two or more non-pharmacological measures. For example, Yang et al. [18] combined cognitive training, music therapy, touch therapy, and life narrative; Yin et al. [19] combined music and game-based interventions; Chobe et al. [20] and Lee et al. [21] integrated yoga and Ayurveda, combining physical, cognitive, and emotional activities; Khoo et al. [22] combined traditional physical exercise with Tai Chi, yoga, meditation, Qigong, dance movements, and mindfulness; and Lee et al. [21] combined physical exercise with emotional regulation. However, integrated interventions face several limitations. First, intervention outcomes are inconsistent. Some studies suggest that non-pharmacological integrated interventions can improve cognitive abilities, daily living skills, learning, attention, processing speed, working memory, and participants' mental health to some extent [18,20,24-25], while others indicate that interventions may only be tentatively effective [22] and require further validation [26]. Second, existing integrated interventions merely stack two or more intervention measures without explaining the rationale for combination, other than assuming each individual component may benefit cognitive impairment improvement [19-20], lacking holistic systematic and structural considerations. Although some studies note that integrated interventions consider risk factors for cognitive impairment, such as healthy lifestyle habits and physical exercise maintaining good physical and mental states [24], and incorporate these into cognitive training [27], no comprehensive, systematic, and structured integrated intervention studies targeting cognitive impairment risk factors have been identified.

Research conclusions regarding risk factors for cognitive impairment are relatively clear, including demographic characteristics (e.g., gender, age, education level), occupation, medical history (e.g., stroke, hypertension, hyperlipidemia, head injury, cardiovascular and cerebrovascular diseases), psychological and positive emotional factors, healthy lifestyle habits (e.g., smoking, alcohol consumption, sleep, physical exercise), and social connection [28-29]. While demographic characteristics and medical history are difficult or impossible to

intervene, maintaining physical health, positive emotions, social connection, and healthy lifestyle habits represent important modifiable dimensions.

Based on this foundation, we developed a structured integrated intervention program centered on cognitive training and comprising five dimensions: physical exercise, emotional management, social connection, and healthy lifestyle habits. We conducted a 3-month single-case pilot study to analyze the feasibility and effectiveness of this intervention protocol.

Methods

Study Design

This study employed an A-B-A single-subject research design [30], collecting data at baseline (A), after 3 months of intervention (B), and 3 months post-intervention (A) to analyze the effects of integrated intervention on mild cognitive impairment. The study was approved by the Institutional Ethics Review Committee of Lanzhou University (approval number: HDS202208-02), and informed consent was obtained from all participants.

Participant Selection

The study was conducted from June to December 2021. Recruitment and baseline measurements occurred in June 2021, followed by 3 months of continuous intervention (July–September 2021) and a 3-month follow-up period (October–December 2021).

Participants were recruited from L Community in LZ City, GS Province. Researchers posted flyers in the community and disseminated study information through WeChat groups for retired employees. Inclusion criteria were: (1) age $\geq$ 60 years; (2) diagnosis of mild cognitive impairment using the Mini-Mental State Examination (MMSE) [31] and Montreal Cognitive Assessment (MoCA) [32]; (3) ability to communicate normally and read; (4) understanding of intervention content and voluntary participation. Exclusion criteria included severe intellectual problems or major illness that might affect participation. A total of 15 older adults were recruited; 3 met inclusion criteria while 12 were excluded (4 due to age $<$ 60, 2 non-MCI, 2 with heart disease or severe hearing impairment, 2 unable to communicate in Mandarin, and 2 unable to commit to weekly sessions).

Outcome Measures

Primary outcome: Cognitive function was assessed using the Montreal Cognitive Assessment (MoCA), which has demonstrated excellent reliability and validity and has been validated in Chinese populations [37].

Secondary outcomes: (1) Depression was assessed using the Geriatric Depression Scale-15 (GDS-15) [36]. (2) Quality of life was assessed using the 12-item

Short Form Health Survey (SF-12) [34]. (3) Self-efficacy was assessed using the General Self-Efficacy Scale (GSES), which shows good reliability and validity [45]. (4) Loneliness was assessed using the Chinese version of the De Jong Gierveld Loneliness Scale (DJGLS), which demonstrates good reliability and validity [36].

Baseline data included general information (gender, age, education level, occupation, living arrangement, marital status, medical history, economic status). The three participants were assessed at baseline, after 3 months of intervention, and 3 months post-intervention using MoCA, GSES, SF-12, GDS-15, and DJGLS across five dimensions.

Intervention Protocol

The intervention was based on the hypothesis that improvements in cognitive training, physical exercise, emotional regulation, social connection, and healthy lifestyle habits would ameliorate symptoms of mild cognitive impairment in older adults [Figure 1: see original paper]. The cognitive training component targeted visuospatial execution, attention, language expression, abstraction, delayed recall, and orientation. Physical exercise included light activities such as finger exercises and oral exercises. Emotional regulation involved training in emotional management knowledge and positive emotion meditation techniques. Social connection encompassed group interactions, life reminiscence, and narrative activities. Healthy lifestyle habits covered nutrition knowledge, disease prevention, and relaxation techniques for sleep improvement. The intervention lasted 3 months, with one 60-minute session per week.

Intervention Fidelity

Five MSW graduate students served as interventionists. Before implementation, they received 10 hours of training using the service manual and participated in five role-playing exercises. The first author supervised these role-playing sessions and recruited one older adult volunteer to test and refine the service manual. Throughout the intervention, the first author provided continuous supervision to ensure adherence to the manual. Additionally, weekly meetings were held for discussion, feedback, and guidance between the first author and implementers.

Interview Procedures

Participant observation was conducted during each intervention session. Semi-structured interviews were performed 3 months post-intervention to evaluate intervention effects across cognitive function, quality of life, depression, self-efficacy, and loneliness dimensions.

Data Collection and Analysis

To avoid test-retest effects from frequent measurement, we used single-timepoint data collection at post-intervention and follow-up phases. Data collectors were not blinded. All assessments were conducted in the same environment (the activity room of L Community in LZ City). Baseline, post-intervention, and follow-up scores on MoCA, SF-12, GDS-15, DJGLS, and GSES were collected for difference analysis.

Interview data were recorded verbatim by two graduate students unfamiliar with the study and analyzed using directed content analysis as described by Hsieh and Shannon [37] through NVivo 12.1.0. Content analysis was organized separately for participants and interventionists, with each category further divided into positive and negative feedback.

Results

Participant Characteristics

The three participants were aged 70–74 years, all married and living with their spouses and grandchildren . Baseline MMSE scores were 25, 23, and 25; MoCA scores were 21, 22, and 24, confirming mild cognitive impairment diagnosis.

Changes in Scale Scores

After 3 months of intervention, MoCA scores were 28, 26, and 27; at 3-month follow-up, scores were 25, 19, and 23. GSES baseline scores were 25, 30, and 27; post-intervention scores were 29, 29, and 30; follow-up scores were 28, 31, and 28. SF-12 baseline scores were 69, 32, and 51; post-intervention scores were 81, 81, and 83; follow-up scores were 78, 38, and 59. GDS-15 baseline scores were 4, 8, and 2; post-intervention scores were 2, 6, and 1; follow-up scores were 1, 8, and 4. DJGLS baseline scores were 8, 7, and 8; post-intervention scores were 5, 5, and 4; follow-up scores were 5, 5, and 7 .

Interview Findings

Interview data yielded 17 themes: 13 related to participants and 4 related to interventionists. Participant themes included 10 positive evaluations: improved memory, better sleep, clearer thinking, physical exercise engagement, positive emotions, healthy lifestyle formation, increased social connection, reduced loneliness, willingness to actively train, and improved self-efficacy. Three negative themes emerged: anxiety and worry about personal health, cognitive impairment stigma, and low acceptance of aging and concerns about becoming a burden to caregivers, children, and family. The four interventionist themes included: observed lack of security among participants, non-acceptance of aging and illness, need for more refined measurement scales, and potential influence of intervention duration and frequency on effectiveness .

Discussion

This study demonstrates that non-pharmacological integrated intervention is effective for older adults with mild cognitive impairment. After intervention, all three participants showed improvements in cognitive function, depression, loneliness, and quality of life, though effects declined at 3-month follow-up. Self-efficacy improvements were less pronounced. These findings align with previous research showing that non-pharmacological interventions can alleviate mild cognitive impairment in older adults to some extent [18-22,24-26]. The five-dimensional non-pharmacological integrated intervention is relatively low-cost, free from pharmacological side effects, and clinically feasible. Future interventions for mild cognitive impairment in older adults should consider implementing integrated approaches across cognitive stimulation, physiological, psychological, social connection, and daily lifestyle dimensions.

Notably, some existing integrated intervention studies did not measure or observe long-term effects 3 months post-intervention [19-20,22,26]. This study found that intervention effects across all five dimensions showed a declining trend 3 months after intervention completion, which is inconsistent with some literature [18,21,24-25]. Possible reasons may relate to intervention duration and frequency. Existing studies show considerable variation in integrated intervention frequency [18-22,24,26], with some implementing interventions 5–6 times weekly [19-20]. Our intervention involved older adults, lasted 3 months, and occurred once weekly. Future research should conduct quasi-experimental and randomized controlled trials to validate these effects.

Study limitations include the lack of local validation for measurement scales. Although scales have been validated in Chinese older adult populations [35], two issues emerged during measurement: (1) The self-efficacy scale lacked clear distinction between response options, causing participant hesitation. For example, GSES item 3 ("For me, sticking to my ideals and achieving goals is easy") created confusion about whether "easy" had objective criteria, making it difficult to distinguish between "somewhat incorrect" and "somewhat correct." Future research should clarify measurement standards and validate scale reliability and validity. (2) Participants may experience fatigue from frequent and lengthy assessments. Future studies should consider using brief scales to reduce participant burden and improve accuracy, or gamify measurements to create a more engaging experience.

This study aimed to develop a systematic, safe, simple, low-cost, and effective intervention targeting multiple risk factors for cognitive impairment. To minimize potential risks, we employed a single-case experimental design, which limits external validity due to non-random selection. We emphasize that this is a single-case, non-double-blind, non-randomized study that cannot establish causal relationships between the intervention and dependent variables.

In summary, implementing non-pharmacological integrated interventions targeting cognitive training, physical exercise, emotional management, social con-

nection, and healthy lifestyle habits represents a potentially safe and effective approach for improving cognitive function, depression, loneliness, and quality of life in older adults with mild cognitive impairment. However, effects on self-efficacy and long-term sustainability require further investigation. Future randomized controlled trials are recommended to validate this intervention protocol's effectiveness and examine its long-term outcomes.

Author Contributions: WANG Ying and YANG Kehu designed the study through multiple discussions on research methodology. WANG Ying wrote the introduction and discussion sections, while DONG Zhixiao wrote the methods and results sections. All authors provided critical revisions to the manuscript.

Conflict of Interest: None declared.

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