Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Development and feasibility of a theory-driven multidomain intervention for community-dwelling older adults with mild cognitive impairment: a quasi-experimental pilot study based on the Multi-Theory Model

Rui Ren
Nanjing University of Chinese Medicine
Xiaoxiao Wei
Nanjing University of Chinese Medicine
Yuxin Han
Nanjing University of Chinese Medicine
Qing Wang
ruoyiwangqing@163.com

Nanjing Drum Tower Hospital Clinical College of Nanjing University of Chinese Medicine
Shaoting Sheng
Nanjing Drum Tower Hospital
Ke Liu
Nanjing Drum Tower Hospital
Lijun Wei
Maigaoqiao Community Health Service Center
Ling Sha
Nanjing Drum Tower Hospital
Xiaomin Zhang
Nanjing Drum Tower Hospital

Research Article

Keywords: Mild cognitive impairment, multidomain intervention, Multi-Theory Model, adherence

Posted Date: September 10th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10443778/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background Mild cognitive impairment (MCI) is a critical stage for dementia prevention, and multidomain interventions are recommended to delay cognitive decline. However, implementing these interventions in community settings remains challenging because of difficulties in initiating health behaviours and maintaining long-term adherence. Theory-based interventions can facilitate the initiation of behaviors and sustained engagement. This study aimed to develop a multidomain intervention guided by the Multi-Theory Model (MTM) for community-dwelling older adults with MCI and to evaluate its feasibility and preliminary effectiveness.

Methods This study comprised two sequential phases: intervention development and feasibility evaluation. The intervention was developed through evidence synthesis, semi-structured interviews with older adults with MCI guided by the Multi-Theory Model (MTM), and multidisciplinary expert consultation. A 12-week quasi-experimental pilot study with a historical non-equivalent control group was subsequently conducted. Participants in the control group (n = 20) received a conventional multidomain intervention, whereas those in the intervention group (n = 22) received the MTM-guided multidomain intervention. Feasibility outcomes included recruitment and adherence. The primary outcome was feasibility, assessed by recruitment and adherence. Secondary outcomes included cognitive function, physical performance, frailty, depressive symptoms, instrumental activities of daily living, and social participation.

Results Forty participants completed the study (intervention, n = 21; control, n = 19). Recruitment was significantly higher in the intervention group than in the control group (73.3% vs. 40.0%, P = 0.024), and overall adherence was also significantly better (P = 0.007). Compared with the control group, participants receiving the MTM-guided intervention demonstrated significantly greater improvements in global cognitive function, physical performance, instrumental activities of daily living, and social participation (all P < 0.05), together with greater reductions in frailty and depressive symptoms (both P < 0.001).

Conclusions The MTM-guided multidomain intervention was feasible and acceptable for community-dwelling older adults with MCI, with higher recruitment and adherence than a conventional programme. These findings suggest that integrating behaviour change strategies that explicitly target behaviour initiation and maintenance may facilitate the implementation of multidomain interventions in community settings. Larger multicentre randomised controlled trials with longer follow-up are warranted to confirm the intervention's effectiveness and scalability.

Trial registration This study was registered with the Chinese Clinical Trial Registry (ChiCTR2500112119; registered on 10 November 2025. https://www.chictr.org.cn/showproj.html?proj=289572).

Background

The global prevalence of mild cognitive impairment (MCI) among older populations is 23.7% [1], while in China, the prevalence among adults aged 65 years and older reached 28.4%[2], MCI is a critical transitional stage between normal aging and dementia; compared with cognitively normal older adults, approximately 10%–15% of patients with MCI progress to dementia each year[3]. Dementia has become one of the greatest challenges facing health and social care systems in the 21st century. MCI represents a critical window for intervention to prevent dementia and delay disease progression; as some patients with MCI may experience cognitive recovery or a reversal of the disease course[4], it is crucial to implement measures at this stage to slow the decline of cognitive function. The World Health Organization (WHO) and the Lancet Commission on dementia prevention strongly recommend multidomain interventions, encompassing cognitive training, physical activity, dietary optimisation, and vascular risk management, as a priority strategy for delaying cognitive decline[5, 6]. Landmark trials represented by the Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER)[7–11], have demonstrated that multidomain interventions can improve or maintain cognitive function in older adults, and such approaches have become an important strategy in the current international approach to cognitive impairment prevention. Despite the established efficacy of multidomain interventions, theory-driven, locally adapted multidomain intervention protocols for community-dwelling older adults with MCI in China remain relatively limited[12, 13].

In recent years, China has introduced a series of policies to support cognitive health management. The National Action Plan for Responding to Senile Dementia (2024–2030)[14] proposes the establishment of a comprehensive prevention and control system covering prevention, screening, diagnosis, treatment, rehabilitation, and care, and encourages the establishment of memory clinics and multidisciplinary teams, thereby creating favourable conditions for the implementation of multidomain interventions for cognitive impairment. Despite increasing policy support, the clinical translation of multidomain interventions for patients with MCI in real-world community-dwelling older adults faces persistent practical challenges, including low screening coverage, difficulties in initiating interventions[15], poor adherence, and challenges in sustaining intervention effects[16], which limit the effectiveness of their community-based implementation and application. Improving patient participation in and adherence to multidomain interventions has thus become a critical challenge in current research and practice.

Applying behavior change theory is crucial for developing effective multidomain interventions for MCI. The Multi-Theory Model (MTM)[17] divides the process of behavior change into two stages, behavior initiation and behavior maintenance, and explains the mechanisms of behavior change through dimensions such as individual cognition, behavioral regulation, and social-environmental support. Elderly patients with mild cognitive impairment (MCI) experience declines in memory, executive function, and self-management abilities, making them more prone to difficulties in initiating and sustaining behaviors when engaging in multi-domain, health-related activities[18]. The core constructs emphasised by MTM, participatory dialogue, behavioural confidence, changes in the physical environment, emotional transformation, and changes in the social environment[19], effectively address the key obstacles encountered by patients with MCI during the process of behavioral change. Therefore, MTM may provide a new theoretical basis for enhancing the motivation and long-term adherence of patients with mild cognitive impairment (MCI) regarding participation in multidomain interventions.

In summary, to address the practical challenges of initiation difficulties and poor adherence faced by patients with MCI in participating in multidomain interventions, this study aimed to: (1) develop a multidomain intervention protocol for patients with MCI based on the MTM; and (2) conduct a preliminary

implementation evaluation of the protocol to assess its feasibility and preliminary effectiveness, thereby providing a basis for future large-sample randomised controlled trials and for facilitating the translation of multidomain interventions for MCI into clinical and community practice.

Method

This study comprised two components: (1) development of a multidomain intervention protocol for patients with MCI based on the MTM theoretical framework; and (2) a three-month study conducted in community-dwelling older adults to evaluate the feasibility and effectiveness of the intervention protocol.

Part I: Development of the intervention protocol

The intervention was developed by a multidisciplinary working group comprising geriatric neurologists, cognitive specialist nurses, rehabilitation physicians, nursing graduate students, and community healthcare providers. The protocol development process consisted of three steps(Figure 1).

Step 1: Evidence synthesis and extraction of intervention elements

An evidence synthesis was first conducted to identify the essential components of multidomain interventions reported in the current literature. Research questions were structured using the PIPOST framework. A systematic literature search was conducted in PubMed, Web of Science, Cochrane Library, Embase, CINAHL, CNKI, and Wanfang Data in accordance with the PRISMA guidelines[20]. The search strategy combined terms for cognitive impairment ("cognitive dysfunction," "mild cognitive impairment," "cognitive decline," "cognitive impairment") with terms for intervention type ("multidomain intervention," "multicomponent intervention," "multimodal intervention"). Following screening, 18 publications met the inclusion criteria, including clinical guidelines[21-24], expert consensus statements[25-27], systematic reviews[28-31], randomized controlled trials[7, 32-36] and quasi-experimental study[37]. The literature screening process and characteristics of the included studies are presented in the Supplementary Materials(Supplementary Table S1, Table S2). Information related to intervention characteristics was extracted, including intervention components, delivery mode, intervention intensity and duration, multidisciplinary involvement, and implementation procedures.

Step 2：Theoretical Mapping and Construction of Intervention Strategies

Based on the preliminary intervention framework formed by evidence-based research, the Multi-Theory Model (MTM) was further used to guide the development of intervention programs. Findings from a previous qualitative study conducted by the research team were used to identify the behavioral determinants that affect the participation of community-dwelling elderly people with mild cognitive impairment in the initiation and maintenance of multi-domain interventions[18]. The two researchers independently mapped the above behavioral determinants according to the six core constructs of the MTM. Discrepancies were resolved through discussion until consensus was reached. Each behavioural determinant was mapped to corresponding intervention measures, and develop implementation strategies to promote the initiation of interventions and long-term adherence. The complete mapping relationship between behavioral determinants and MTM constructs is shown in Table 1.

Table 1 Mapping matrix of MTM theoretical constructs and intervention strategies

MTM phase	Core construct	Recognition impairment	Intervention Strategies	Delivery Example
Behavioral initiation phase	Participatory dialogue	Cognitive biases regarding illness and anosognosia; Perception of illness-threat triggers healthcare-seeking behavior.	Use visual educational tools; Correct illness misconceptions; Emphasize threat perception of MCI.	Multidisciplinary team meetings; Illustrated handbooks
	Behavioral confidence	Low self-efficacy regarding expected outcomes of cognitive rehabilitation.	Set incremental goals; Share peer success stories; Adaptive task design	Goal-setting sheets; Group sharing sessions
	Physical environment Modification	Barriers to accessing and utilizing intervention resources; Weighing economic costs against value.	Provide standardized home-based toolkits; Assist with home environment setup for training	Cognitive training mats/boards; Home visit guidance
Behavior maintenance stage	Emotional Transformation	Lack of positive emotional experiences during the intervention.	Reinforce positive experiences; Provide personalized feedback; Review interim goals	Weekly feedback via WeChat/phone; Success story reviews
	Behavior Change Practice	Poor self-regulation; Time preferences regarding intervention; Impact of frailty and comorbidities.	Teach self-monitoring (diaries); Contextual coping strategies; Dynamic goal adjustment	Cognitive diaries; Monthly plan adjustments
	Social Environment Support	Insufficient or diverse forms of external support.	Empower family caregivers; Organize peer support groups; Multi-party communication mechanism	Caregiver training sessions; Online peer groups

Step 3: Expert meeting and protocol refinement

The preliminary multidomain intervention programme was reviewed by an expert panel including specialists in geriatric nursing, neurology, rehabilitation medicine, nutrition, psychology, and community health services. All panel members had more than 10 years of clinical or research experience in cognitive

impairment. Prior to the review, experts received the preliminary intervention programme, the intervention handbook, and supporting materials describing the evidence synthesis, qualitative findings, and MTM-based mapping process. Experts independently evaluated the programme using a structured evaluation form with respect to its scientific validity, clinical relevance, feasibility, and applicability. Recommendations considered both evidence-based and feasible for community implementation were incorporated into the revised intervention programme. Any disagreements were resolved through consensus discussion between the expert panel and the research team, after which the intervention programme was finalised for feasibility evaluation. A detailed intervention manual, including the content of each intervention session, patient education materials, and guidance for family caregivers, was developed to support standardised programme delivery. A summary of the intervention implementation plan is provided in the Supplementary Materials(Supplementary Table S3).

Part II: Pilot implementation and feasibility evaluation of the MTM-guided multidomain intervention

Following completion of intervention development, the MTM-guided multidomain intervention protocol was pilot-tested using a 3-month quasi-experimental study to evaluate its feasibility and preliminary effectiveness. This 3-month quasi-experimental feasibility study was conducted between June 2025 and January 2026 at the Cognitive Training Nursing Outpatient Clinic and Cognitive Center of a Grade-A tertiary hospital in Nanjing, as well as community screening sites. A historical non-equivalent control group design was used: participants recruited between June and August 2025 were assigned to the control group, and those recruited between October 2025 and January 2026 were assigned to the intervention group. Feasibility was comprehensively evaluated using indicators including recruitment rate and adherence.

Participants

As this was a pilot feasibility study, no formal sample size calculation was performed. Based on recommendations for pilot and feasibility studies[38], a target sample size of 20 participants per group was considered sufficient. Recruitment was conducted as follows：

Between June 2025 and January 2026, the research team recruited participants from among patients with MCI attending the Cognitive Center and Cognitive Training Nursing Outpatient Clinic of a tertiary hospital, as well as through community screening programmes. Potential participants were invited through face-to-face communication. Those who agreed to participate and provided written informed consent underwent a more comprehensive pre-intervention assessment. Inclusion criteria were as follows: (1) diagnosis of MCI according to the criteria of the International Working Group on MCI [39] and the Chinese expert consensus on neuropsychological assessment for mild cognitive impairment (2025 edition) [40]; (2) age ≥ 60 years and < 80 years; and (3) provision of written informed consent. Exclusion criteria were as follows: (1) diagnosis of dementia or mental disorder; (2) severe comorbidities such as heart failure or malignancy; and (3) language or communication barriers. For participants who withdrew or were lost to follow-up, the research team documented the reasons for withdrawal (illness, family circumstances, personal choice). Participants who withdrew were excluded from the final analysis.

Interventions

The control group received a standard 12-week multidomain intervention delivered by a designated nurse in the Neurology Department. The intervention included: (1) distribution of educational brochures on cognitive impairment during outpatient visits or community screening, together with verbal instructions on MCI, dementia risk factors and healthy lifestyle principles; (2) instruction for patients and family members in two or three simple memory exercises to practise at home, such as picture recall, word association and recounting daily events, 3-4 times per week for 20-30 minutes per session, with family assistance to support adherence; and (3) a monthly follow-up call of approximately 10 minutes to assess cognitive status, monitor adherence, answer questions and remind participants about scheduled follow-up examinations. No additional systematic multidisciplinary protocol, toolkit or structured behavioural support was provided.

In addition to the standard intervention, the intervention group received a 12-week MTM-guided multidomain intervention delivered by a multidisciplinary team comprising:

(1) Neurologists, who assessed clinical condition and monitored vascular risk factors;

(2) Cognitive specialist nurses, who conducted motivational interviews, guided cognitive training and reviewed cognitive diaries;

(3) Rehabilitation physicians, who developed and adjusted the exercise programme;

(4) Neuropsychologists or cognitive assessors, who performed cognitive assessments and provided feedback on cognitive training progress; and

(5) Dietitians, who delivered dietary education and personalized meal planning guidance.

The intervention was structured around the six core MTM constructs and focused on five domains, and monitoring of vascular and metabolic risk factors. Delivery methods included face-to-face guidance, group sessions, online consultation, and home-based training. The research team made dynamic adaptations based on participant feedback. For participants who had difficulty using digital devices, family members were trained to assist with device operation. For participants with a high time preference, the frequency of nurse-patient communication was increased from at least once weekly to at least twice weekly. Details of the intervention content, timing, and format are presented in Figure 2. Intervention fidelity was supported by the use of standardised manuals, staff training prior to the intervention, and monthly multidisciplinary case review meetings. Due to the behavioural nature of the intervention, blinding of participants and interventionists was not feasible. However, outcome assessors were blinded to group allocation.

Outcome measures

At study enrolment, researchers collected participants' demographic characteristics and clinical data, including age, sex, educational level, marital status, monthly household income, family history of dementia, and medical payment method. Outcome measures were divided into primary feasibility outcome and secondary efficacy outcome, both assessed at baseline (T0) and 12 weeks after intervention (T1).

Primary outcomes (feasibility)

Recruitment rate was calculated as the proportion of eligible individuals who agreed to participate. Recruitment feasibility was assessed against a pre-specified criterion of ≥ 50%, consistent with thresholds used in similar feasibility studies[41, 42]. Adherence referred to the extent to which participants completed the multidomain intervention, including five dimensions: (1) cognitive training, assessed by reviewing the cognitive training platform to calculate completed sessions as a proportion of scheduled sessions; (2) physical exercise, assessed from cognitive activity diary records; (3) dietary management, assessed using questionnaires during monthly dietary education sessions and calculated as the proportion of weeks with adherence on ≥ 4 days per week; (4) social activities, assessed from the cognitive lifestyle diary as actual participation relative to planned frequency; and (5) vascular and metabolic risk factor monitoring, recorded as whether at least one follow-up monitoring session occurred during the intervention period. Following adherence criteria from the GOIZ ZAINDU study [43], overall adherence was graded as:

(1) High adherence: completion rate ≥ 50% across all five dimensions;

(2) Partial adherence: completion rate ≥ 30% across all five dimensions, with not all dimensions reaching the 50% threshold;

(3) Low adherence: completion rate < 30% in any single dimension; participants with adherence < 30% in two or more dimensions were considered dropouts.

Secondary outcomes (preliminary effectiveness)

(1) Overall cognitive function was assessed using the MoCA [40] as the primary measure. The Mini-Mental State Examination (MMSE) [44] was also administered as a secondary descriptive measure. The MoCA assesses attention, executive function, memory, language, visuospatial and constructional skills, abstract thinking, calculation and orientation. Total scores range from 0 to 30, with higher scores indicating better cognitive function. The Cronbach's α coefficient of the MoCA is 0.818.

(2) Physical function was assessed using the Short Physical Performance Battery (SPPB) [45, 46], which evaluates lower-extremity performance through 4-m walking speed, balance tests (side-by-side, semi-tandem and full-tandem stands), and the five-repetition chair-stand test. Total scores range from 0 to 12, with higher scores indicating better physical function (0-6, limited; 7-9, moderate; 10-12, good). The Cronbach's α coefficient of the SPPB is 0.76.

(3) Frailty was assessed using the Fried Frailty Phenotype Scale [47], which evaluates weight loss, fatigue, low physical activity, slow walking speed and weak grip strength. Meeting three or more criteria indicates frailty, one or two criteria indicate pre-frailty, and no criteria indicate non-frailty [48]. The Cronbach's α coefficient is 0.745.

(4) Depressive symptoms were assessed using the Geriatric Depression Scale-15 (GDS-15) [48], a widely used screening tool for older adults[49]. The scale comprises 15 dichotomous items, and total scores range from 0 to 15, with higher scores indicating more severe depressive symptoms. A score of ≥ 5 suggests possible depression. The GDS-15 demonstrated acceptable internal consistency, with a Cronbach's α coefficient of 0.745 [50].

(5) Instrumental activities of daily living (IADL) were assessed using the Lawton IADL scale [51], which evaluates telephone use, shopping, cooking, housekeeping, laundry, transportation, medication management and financial management. Total scores range from 0 to 24, with higher scores indicating better function.

(6) Social participation was assessed using the National Center for Geriatrics and Gerontology Social Network Scale (NCGG-SNS) [52]. The scale comprises four dimensions, each with two items, and assesses both frequency and satisfaction of social interactions. Interaction frequency is rated on a 5-point Likert scale (0 = none to 4 = daily), and satisfaction is rated on a 4-point Likert scale (1 = very dissatisfied to 4 = very satisfied). Each item score is calculated by multiplying frequency by satisfaction. Total scores range from 0 to 64, and scores ≤ 26.5 indicate risk of social network isolation. The Cronbach's α coefficient of the NCGG-SNS is 0.96.

Participants were monitored for any adverse events or unintended effects throughout the intervention via weekly check-ins and participant diaries.

Statistical analysis

This study employed a per-protocol analysis, including participants who completed the full 12-week intervention and follow-up assessments (intervention group: n=21; control group: n=19). Missing data were not imputed because the analysis was conducted on a per-protocol basis. Statistical analyses were performed using IBM SPSS Statistics version 27.0. Categorical variables are presented as frequencies and percentages and were compared using the chi-square test or Fisher's exact test, as appropriate. Normally distributed continuous variables are presented as mean ± standard deviation and were compared using independent-samples t tests. Non-normally distributed continuous variables are presented as median and interquartile range and were compared using the Mann-Whitney U test. All statistical tests were two-sided, and P values < 0.05 were considered statistically significant.

This pilot feasibility study was reported in accordance with the CONSORT 2010 extension for pilot and feasibility trials, with adaptations appropriate for the quasi-experimental design. A completed checklist is provided as Supplementary File 2.

Results

Primary outcomes (feasibility)

Recruitment

A total of 423 individuals were screened, of whom 80 met the diagnostic criteria for MCI, and 42 provided informed consent and completed enrolment. Participants recruited between June and August 2025 were assigned to the control group (n = 20), whereas those recruited between October 2025 and January 2026 were assigned to the intervention group (n = 22). The recruitment rate was 73.33% in the intervention group and 40.00% in the control group, with a statistically significant between-group difference ($\chi^2 = 5.12$, P = 0.024). The recruitment rate in the intervention group exceeded the pre-specified feasibility criterion of ≥ 50%.During the intervention period, one participant in the control group withdrew because of poor adherence (completion rate < 30% for multidomain intervention tasks), and one participant in the intervention group withdrew because of refusal to complete the post-intervention assessment. Overall, 40 participants completed this feasibility study, yielding a retention rate of 95.2% (Figure. 3).

Adherence

Adherence was categorized as high, partial, low or dropout and assigned ordinal scores of 1, 2, 3 and 4, respectively. In the intervention group, there were 9 cases (40.90%) of high adherence, 10 cases (45.45%) of partial adherence, 2 cases (10.00%) of low adherence, and 1 case (5.00%) of dropout; in the control group, there were 2 cases (10.00%) of high adherence, 5 cases (25.00%) of partial adherence, 12 cases (60.00%) of low adherence, and 1 case (5.00%) of dropout. Overall adherence differed significantly between groups ($\chi2 = 12.082$, P = 0.007)(Table 2).

Table 2 Adherence assessment

Overall Adherence	Cognitive Training	Exercise	Diet Adherence	Social Activity	Vascular Risk Factor Follow-up	Control Group (n = 20)	Intervention Group (n = 22)
High Adherence	≥18/36	≥30/60	≥50%	≥18/36	1	2 (10.00%)	9 (40.90%)
Partial Adherence	11-18	18-29	30%-49%	11-18	1/0	5 (25.00%)	10 (45.45%)
Low Adherence	≤10	≤17	<30%	≤10	0	12 (60.00%)	2 (10.00%)
Dropout	Attendance rate for 2 or more intervention domains below 30%					1 (5.00%)	1 (5.00%)

Baseline characteristics

Baseline characteristics did not differ significantly between groups in terms of age, sex, marital status, educational level, monthly household income, family history of dementia or payment method (all P > 0.05; Table 3).

Table 3 Baseline characteristics of the two groups

Item		Intervention group (n = 22)	Control group (n = 20)	Test statistic	*P*
Age (years, mean ± SD)		69.95±5.38	67.35±5.24	1.585[a]	0.121
Gender [n (%)]				0.000[b]	1.000
	Male	11 (50.0)	10 (50.0)		
	Female	11 (50.0)	10 (50.0)		
Marital Status	[n (%)]			-0.088[c]	0.930
	Married	17 (77.3)	16 (80.0)		
	Never married	0 (0)	0 (0)		
	Divorced/Separated	3 (13.6)	1 (5.0)		
	Widowed	2 (9.1)	3 (15.0)		
Education Level [n (%)]				-0.930[c]	0.352
	Primary school	1 (4.5)	2 (10.0)		
	Junior high school	6 (27.3)	6 (30.0)		
	High school/Vocational	6 (27.3)	7 (35.0)		
	College/Bachelor	8 (36.4)	4 (20.0)		
	Postgraduate or above	1 (4.5)	1 (5.0)		
Monthly Family Income [n (%)]				-1.899[c]	0.058
	<3000	0 (0)	2 (10.0)		
	3000-6000	9 (40.9)	11 (55.0)		
	6001-10000	7 (31.8)	5 (25.0)		
	≥10000	6 (27.3)	2 (10.0)		
Family History of Dementia [n (%)]				0.132[b]	0.716
	None	19 (86.4)	18 (90.0)		
	Yes	3 (13.6)	2 (10.0)		
Medical Payment Method [n (%)]				-0.514[c]	0.607
	Fully self-paid	0 (0)	0 (0)		
	Provincial/Municipal employee insurance	16 (72.7)	13 (65.0)		
	Urban/rural resident insurance	5 (22.7)	6 (30.0)		
	Provincial/Municipal public coverage	1 (4.5)	1 (4.5)		

a.*t* value；b.$\chi 2$ value；c.*Z* value

Secondary outcomes (preliminary effectiveness)

At 12 weeks, the intervention group showed significantly better outcomes than the control group in several domains. MMSE, MoCA and NCGG-SNS scores were significantly higher in the intervention group ($P < 0.05$; Table 4). The intervention group also had higher SPPB scores and lower frailty scores than the control group (both $P < 0.05$; Table 5). For psychological status and daily functioning, the intervention group had significantly lower GDS-15 scores than the control group ($P < 0.001$). Activities of daily living (ADL) scores did not differ significantly between groups ($P > 0.05$), probably owing to a ceiling effect because all participants were independent at baseline. However, IADL scores were significantly better in the intervention group ($P < 0.05$; Table 6). No intervention-related adverse events or unintended harms were reported during the intervention or follow-up period.

Table 4 Cognitive function and social participation at 12 weeks

Group	n	MMSE		MoCA		NCGG-SNS	
		T0	T1	T0	T1	T0	T1
Intervention	21	27.33±1.68	28.47±1.57	21.19±2.46	23.81±3.34	38.24±11.69	44.10±11.56
Control	19	27.26±1.52	26.26±1.48	21.26±3.00	20.52±3.01	41.00±9.59	36.58±8.58
t		0.138	4.569	-0.084	3.254	-0.812	-2.315
P		0.891	<0.001	0.933	0.002	0.422	0.026

Table 5 Physical function and frailty at 12 weeks

Group	n	SPPB[Score, median (IQR)]		Fried[Score, median (IQR)]	
		T0	T1	T0	T1
Intervention	21	11.50(10.00,12.00)	12.00(11.00,12.00)	1.00(0.00,1.50)	0.00(0.00,0.00)
Control	19	11.50(11.00,12.00)	11.00(10.00,12.00)	1.00(0.00,2.00)	1.00(1.00,2.00)
Z		-0.370	-2.321	-0.615	-4.022
P		0.711	0.020	0.539	<0.001

Table 6 Depression, ADL and IADL at 12 weeks

Group	n	GDS-15[Score, median (IQR)]		ADL[Score, median (IQR)]		IADL[Score, median (IQR)]	
		T0	T1	T0	T1	T0	T1
Intervention	21	2.00(1.00,3.50)	1.00(0.00,1.00)	100.00(100.00,100.00)	100.00(100.00,100.00)	23.00(21.00,24.00)	24.00(22.00,24.00)
Control	19	2.00(1.00,4.00)	3.00(2.00,4.00)	100.00(100.00,100.00)	100.00(95.00,100.00)	23.00(21.00,24.00)	22.00(20.00,23.00)
Z		-0.416	-4.111	-1.007	-1.010	-0.241	-2.547
P		0.678	<0.001	0.314	0.313	0.809	0.011

Discussion

Multidomain interventions have consistently demonstrated efficacy in slowing cognitive decline among older adults with mild cognitive impairment (MCI) [53], yet their implementation in routine community settings remains limited by low intervention uptake and poor long-term adherence[15, 16]. The present study showed that incorporating the Multi-Theory Model (MTM) into a multidomain intervention substantially improved both recruitment rate (73.33% vs. 40.00%, P = 0.024) and overall adherence (P = 0.007) compared with a conventional multidomain programme. Participants in the MTM-guided group also demonstrated greater improvements in cognitive function, physical performance, frailty, depressive symptoms, instrumental activities of daily living, and social participation. These findings suggest that addressing behavioural barriers to intervention initiation and maintenance may improve the implementation of multidomain interventions and create favourable conditions for achieving better clinical outcomes in community-dwelling older adults with MCI.

The improved recruitment and adherence observed in the intervention group may be explained by the behavioural mechanisms proposed by the MTM[17]. During the initiation phase, participatory dialogue, multidisciplinary discussion, visualised disease education and environmental support may have reduced misconceptions about MCI, enhanced participants' confidence, and lowered practical barriers to participation. These mechanisms are consistent with the MTM framework and with previous behavioural intervention research showing that reducing cognitive and environmental barriers facilitates behaviour initiation[18, 54, 55]. However, successful initiation alone is insufficient to sustain long-term behavioural change. The higher adherence observed in the intervention group suggests that maintenance strategies may also have contributed to continued engagement. Goal feedback, self-monitoring, family involvement and regular communication with community nurses may have strengthened motivation, promoted habit formation and provided continuous reinforcement throughout the intervention period, findings consistent with previous research highlighting self-monitoring and caregiver support as key facilitators of long-term adherence in lifestyle interventions[56, 57]. Together, these findings suggest that improving intervention initiation and sustained adherence may increase participants' exposure to multidomain interventions, thereby facilitating their effective implementation in community settings.

The broader clinical improvements in the MTM-guided group were accompanied by substantially higher engagement. Post-hoc analyses from the FINGER trial[58] showed that participants with higher adherence to the multidomain protocol exhibited greater improvements in global cognition and across all cognitive subdomains than those with lower adherence. The J-MINT trial[7, 59] similarly suggested that intervention benefits were more evident among participants who adhered to all four intervention domains. The SUPERBRAIN-MEET study[33] and the Shanghai multimodal intervention trial[34] both of which highlighted sustained intervention engagement as an important contributor to multidimensional health benefits. These studies suggest that sustained intervention engagement is an important contributor to achieving the multidimensional benefits of multidomain interventions[43, 60]. Unlike previous multidomain intervention trials, which primarily focused on clinical efficacy, the present study incorporated a behaviour change framework to address implementation challenges in community settings. Building upon this evidence, the present study demonstrates that an MTM-guided implementation strategy can improve participant recruitment and sustained engagement in routine community settings, thereby providing an operational pathway for translating evidence-based multidomain interventions into real-world practice.

The present findings have important implications for the implementation of multidomain interventions in routine community care. Its implementation relied primarily on standardised intervention manuals, low-cost toolkits, home-based cognitive activity resources and structured behavioural support, making the programme feasible for delivery by community nurses and primary healthcare professionals without substantial additional infrastructure[61]. The hospital–community collaborative screening pathway further demonstrates the feasibility of coordinating early identification, referral and follow-up between tertiary hospitals and primary care. Within the context of China's ongoing expansion of family doctor contract services[62], this implementation strategy could be incorporated into existing community-based health management programmes for older adults, providing a practical framework for the routine delivery of multidomain interventions. Future studies should further evaluate its scalability, sustainability and cost-effectiveness across broader healthcare settings.

This study has several limitations. First, as a pilot feasibility implementation study, the sample size was small (n = 40), limiting statistical power and generalizability. Second, the quasi-experimental historical control design, rather than randomization, means that temporal confounding and unmeasured covariates cannot be fully excluded, although baseline demographic and clinical characteristics were comparable between groups. Third, blinding of participants and interventionists was not possible because of the behavioural nature of the intervention, which may have introduced performance and detection bias. Fourth, implementation required multidisciplinary collaboration, digital training platforms, online follow-up systems, intervention toolkits, home environment modification and group activities. These requirements may challenge scalability in community and primary care settings with limited workforce, funding or infrastructure[63]. Digital tools may also have introduced selection bias toward participants with higher technological literacy, limiting generalizability to older adults with limited digital access. Future studies should use multicentre, adequately powered randomized or cluster-randomized designs with longer follow-up and should adapt delivery formats, including physical toolkits and routine-based prompts, to ensure equitable access for older adults with limited digital health literacy[64].

Conclusions

This pilot study demonstrated the feasibility of an MTM-informed multidomain intervention for community-dwelling older adults with MCI. Compared with a conventional multidomain programme, the intervention was associated with higher recruitment and adherence and favourable changes across cognitive, physical, psychological, and social outcomes. These findings support the feasibility of integrating behaviour change strategies into multidomain interventions to optimise their implementation in community settings. Future multicentre randomised controlled trials with larger samples and extended follow-up are warranted to confirm its long-term effectiveness and scalability.

Abbreviations

ADL: Activities of daily living; ChiCTR: Chinese Clinical Trial Registry; FINGER: Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability; GDS-15: 15-item Geriatric Depression Scale; IADL: Instrumental activities of daily living; IQR: Interquartile range; MCI: Mild cognitive impairment; MMSE: Mini-Mental State Examination; MoCA: Montreal Cognitive Assessment; MTM: Multi-Theory Model; NCGG-SNS: National Center for Geriatrics and Gerontology Social Network Scale; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses; SD: Standard deviation; SPPB: Short Physical Performance Battery; SPSS: Statistical Package for the Social Sciences; WHO: World Health Organization.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Nanjing Drum Tower Hospital, The Affiliated Hospital of Nanjing University Medical School (Approval No.: 2024-757-02). This study was registered with the Chinese Clinical Trial Registry (Registration No.: ChiCTR2500112119.). All participants provided written informed consent prior to enrolment after receiving a full explanation of the study procedures, including the purpose, duration, potential risks, and benefits. The need for approval was not waived.

Consent for publication

Not applicable. This manuscript does not contain any individual person's data in any form (including individual details, images, or videos) that would require specific consent for publication.

Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to ongoing follow-up analyses and participant privacy restrictions, but are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

This study was supported by the Jiangsu Province Elderly Health Research Project (Grant No.: LKM2023024), the National Natural Science Foundation Project of Nanjing University of Chinese Medicine (Grant No.: XZR2023074), and the Nursing Research Project of Nanjing Drum Tower Hospital (Grant No.:

2025-A559). The funders had no role in the study design, data collection, analysis, decision to publish, or preparation of the manuscript.

Authors' contributions

R.R., H.Y.X., and W.X.X. contributed to the conception and design of the study. R.R., H.Y.X., ORTand W.Q. performed the data acquisition and intervention delivery. R.R., H.Y.X., and W.Q. conducted the statistical analysis and drafted the manuscript. S.S.T., L.K., W.L.J., Z.X.M., and S.L. provided critical supervision and revised the manuscript for important intellectual content. W.Q. and S.L. supervised the project and acquired funding. All authors read and approved the final manuscript.

Acknowledgements

The authors would like to thank all the participants and their family caregivers for their time and commitment to this study. We also extend our gratitude to the expert panel members and the clinical staff at the study sites for their support in participant recruitment and intervention implementation.

An unauthorized version of the Chinese MMSE was used by the study team without permission, however this has now been rectified with PAR. The MMSE is a copyrighted instrument and may not be used or reproduced in whole or in part, in any form or language, or by any means without written permission of PAR (www.parinc.com).

References

1. Salari N, Lotfi F, Abdolmaleki A, Heidarian P, Rasoulpoor S, Fazeli J, Najafi H, Mohammadi M: **The global prevalence of mild cognitive impairment in geriatric population with emphasis on influential factors: a systematic review and meta-analysis**. *BMC Geriatr* 2025, **25**(1):313.
2. Liu Y, Zhang Y, Shen J, Zhang C, Sang Y, Wang Y, Zhou H, Wang L, Zhang J, Yuan Y *et al*: **Spatial Distribution and Clustering Patterns of Cognitive Impairment Among the Older Population — 31 PLADs, China, 2024**. *China CDC Weekly* 2025, **7**(41):1302-1307.
3. Farias ST, Mungas D, Reed BR, Harvey D, DeCarli C: **Progression of mild cognitive impairment to dementia in clinic- vs community-based cohorts**. *Arch Neurol* 2009, **66**(9):1151-1157.
4. Yu HH, Tan L, Jiao MJ, Lv YJ, Zhang XH, Tan CC, Xu W: **Dissecting the clinical and pathological prognosis of MCI patients who reverted to normal cognition: a longitudinal study**. *BMC Med* 2025, **23**(1):260.
5. Livingston G, Huntley J, Liu KY, Costafreda SG, Selbæk G, Alladi S, Ames D, Banerjee S, Burns A, Brayne C *et al*: **Dementia prevention, intervention, and care: 2024 report of the Lancet standing Commission**. *The Lancet* 2024, **404**(10452):572-628.
6. Chowdhary N, Barbui C, Anstey KJ, Kivipelto M, Barbera M, Peters R, Zheng L, Kulmala J, Stephen R, Ferri CP *et al*: **Reducing the Risk of Cognitive Decline and Dementia: WHO Recommendations**. *Frontiers in Neurology* 2022, **Volume 12 - 2021**.
7. Sakurai T, Sugimoto T, Akatsu H, Doi T, Fujiwara Y, Hirakawa A, Kinoshita F, Kuzuya M, Lee S, Matsumoto N *et al*: **Japan-Multimodal Intervention Trial for the Prevention of Dementia: A randomized controlled trial**. *Alzheimers Dement* 2024, **20**(6):3918-3930.
8. Reparaz-Escudero I, Izquierdo M, Bischoff-Ferrari HA, Martínez-Lage P, Sáez de Asteasu ML: **Effect of long-term physical exercise and multidomain interventions on cognitive function and the risk of mild cognitive impairment and dementia in older adults: A systematic review with meta-analysis**. *Ageing Res Rev* 2024, **100**:102463.
9. Choi HY, Kim YJ, Son DS, Ahn ME, Lee SK: **Effectiveness of a 52-week multidomain intervention to maintain cognitive function in patients with mild cognitive impairment: a randomized controlled trial**. *Sci Rep* 2025, **15**(1):41141.
10. van Gils V, Waterink L, Wimmers S, Jelsma JGM, de Vugt ME, Handels R, Sikkes SAM, van der Flier WM, Deckers K, Zwan MD *et al*: **The Lifestyle Intervention in memory clinics of General and academic Hospitals Trial (LIGHT): Rationale and study design of a randomized controlled trial to reduce modifiable dementia risk**. *Alzheimers Res Ther* 2026, **18**(1):31.
11. Huang R, Amnatsatsue K, Nityasuddhi D, Kerdmongkol P, Kaewwilai L, Cai P: **The effectiveness of non-pharmacological community dementia prevention interventions on older adults with mild cognitive impairment in China: a systematic review and meta-analysis**. *Aging Ment Health* 2025:1-15.
12. Wang CY, Wang XY, Zhang LX, Wang LN. **Research progress on community screening and diagnostic management strategies for mild cognitive impairment.** Chinese General Practice. 2026;29(8):1037-1043. (Article in Chinese).
13. Kong Y, Xu Z, Zhu Z, Ye L, Zhou S: **A mixed-methods study on collaborative health governance for older adults with mild cognitive impairment in Hangzhou, China**. *Frontiers in Public Health* 2025, **Volume 13 - 2025**.
14. National Health Commission of the People's Republic of China, National Development and Reform Commission, Ministry of Education, et al. **National Action Plan for Responding to Senile Dementia (2024-2030).** 2024. (Article in Chinese).
15. Shadyab AH, LaCroix AZ, Feldman HH, van Dyck CH, Okonkwo OC, Tam SP, Fairchild JK, Welsh-Bohmer KA, Matthews G, Bennett D *et al*: **Recruitment of a multi-site randomized controlled trial of aerobic exercise for older adults with amnestic mild cognitive impairment: The EXERT trial**. *Alzheimer's & Dementia* 2021, **17**(11):1808-1817.
16. Zhen XT, Wang LN, Chen HQ, Zhao X, Liu XS, Zhang C. **Research progress on factors influencing adherence to cognitive management in community-dwelling older adults with mild cognitive impairment.** Chinese General Practice. 2020;23(10):1322-1326. (Article in Chinese).
17. Kapukotuwa S, Nerida T, Batra K, Sharma M: **Utilization of the multi-theory model (MTM) of health behavior change to explain health behaviors: A systematic review**. *Health Promot Perspect* 2024, **14**(2):121-135.

18. Han Y, Wang Q, Shao J, Zhang J, Zhang X, Sheng S: **Influencing factors of initiation and maintenance of multidomain interventions in patients with mild cognitive impairment: a qualitative study**. *Frontiers in Neurology* 2026, **Volume 16 - 2025**.
19. Zhang W, Jin Y, Xu P, Guo PP, Mao MN, Wang XJ, Feng SW. **Research progress on the application of Multi-Theory Model for health behavior change in health management.** Chinese Journal of Nursing. 2022;57(15):1893-1898. (Article in Chinese).
20. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, Clarke M, Devereaux PJ, Kleijnen J, Moher D: **The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration**. *J Clin Epidemiol* 2009, **62**(10):e1-34.
21. Fabrizi E, Ancidoni A, Locuratolo N, Piscopo P, Della Gatta F, Salemme S, Pani SM, Marconi D, Vignatelli L, Sagliocca L *et al*: **The Italian guideline on diagnosis and treatment of dementia and mild cognitive impairment**. *Age Ageing* 2024, **53**(11).
22. Chinese Medical Doctor Association Neurology Branch, Chinese Guideline Writing Group for Cognitive Training: **Chinese guidelines for cognitive training (2022 edition)**. *Natl Med J China* 2022, 102(37):2918-2925. [Article in Chinese]
23. Petersen RC, Lopez O, Armstrong MJ, Getchius TSD, Ganguli M, Gloss D, Gronseth GS, Marson D, Pringsheim T, Day GS *et al*: **Practice guideline update summary: Mild cognitive impairment [RETIRED]: Report of the Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology**. *Neurology* 2018, **90**(3):126-135.
24. Writing Group of Chinese Guidelines for the Diagnosis and Treatment of Dementia and Cognitive Impairment, Cognitive Impairment Disease Professional Committee of the Neurology Branch of the Chinese Medical Doctor Association: **2018 Chinese guidelines for the diagnosis and treatment of dementia and cognitive impairment (V): diagnosis and treatment of mild cognitive impairment.** *Natl Med J China* 2018, 98(17):1294-1301. [Article in Chinese]
25. Brain Cognitive Health Management Chinese Expert Consensus Formulation Committee, Editorial Board of Chinese Journal of Health Management: **Chinese expert consensus on brain cognitive health management (2023).** *Chin J Health Manag* 2023, 17(12):881-892. [Article in Chinese]
26. Chinese Medical Association Neurology Branch Dementia and Cognitive Impairment Study Group: **Chinese expert consensus on the diagnosis and treatment of mild cognitive impairment due to Alzheimer's disease 2024.** *Chin J Neurol* 2024, 57(7):715-737. [Article in Chinese]
27. Dunne RA, Aarsland D, O'Brien JT, Ballard C, Banerjee S, Fox NC, Isaacs JD, Underwood BR, Perry RJ, Chan D *et al*: **Mild cognitive impairment: the Manchester consensus**. *Age Ageing* 2021, **50**(1):72-80.
28. Mei XF, Zhao X, Wang YY, Wang L, Cao H: **Efficacy of multimodal nonpharmacological interventions in mild cognitive impairment: a meta-analysis.** Chin J Evid-Based Med 2019, 19(2):180-188. [Article in Chinese]
29. Zou C, Amos-Richards D, Jagannathan R, Kulshreshtha A: **Effect of home-based lifestyle interventions on cognition in older adults with mild cognitive impairment: a systematic review**. *BMC Geriatr* 2024, **24**(1):200.
30. Gómez-Soria I, Marin-Puyalto J, Peralta-Marrupe P, Latorre E, Calatayud E: **Effects of multi-component non-pharmacological interventions on cognition in participants with mild cognitive impairment: A systematic review and meta-analysis**. *Arch Gerontol Geriatr* 2022, **103**:104751.
31. Salzman T, Sarquis-Adamson Y, Son S, Montero-Odasso M, Fraser S: **Associations of Multidomain Interventions With Improvements in Cognition in Mild Cognitive Impairment: A Systematic Review and Meta-analysis**. *JAMA Netw Open* 2022, **5**(5):e226744.
32. Yang QH, Lyu X, Lin QR, Wang ZW, Tang L, Zhao Y, Lyu QY: **Effects of a multicomponent intervention to slow mild cognitive impairment progression: A randomized controlled trial**. *Int J Nurs Stud* 2022, **125**:104110.
33. Moon SY, Park YK, Jeong JH, Hong CH, Jung J, Na HR, Cho SH, Kim HS, Song HS, Choi M *et al*: **South Korean study to prevent cognitive impairment and protect brain health through multidomain interventions via face-to-face and video communication platforms in mild cognitive impairment (SUPERBRAIN-MEET): A randomized controlled trial**. *Alzheimers Dement* 2025, **21**(2):e14517.
34. Fan M, Li Q, Yang T, Yang Y, Chen Z, Xuan G, Ruan Y, Sun S, Wang M, Chen X *et al*: **Effect of Multimodal Intervention in Individuals with Mild Cognitive Impairment: A Randomized Clinical Trial in Shanghai**. *J Alzheimers Dis* 2024, **101**(1):235-248.
35. Bae S, Lee S, Lee S, Jung S, Makino K, Harada K, Harada K, Shinkai Y, Chiba I, Shimada H: **The effect of a multicomponent intervention to promote community activity on cognitive function in older adults with mild cognitive impairment: A randomized controlled trial**. *Complement Ther Med* 2019, **42**:164-169.
36. Jeong MK, Park KW, Ryu JK, Kim GM, Jung HH, Park H: **Multi-Component Intervention Program on Habitual Physical Activity Parameters and Cognitive Function in Patients with Mild Cognitive Impairment: A Randomized Controlled Trial**. *Int J Environ Res Public Health* 2021, **18**(12).
37. Zhang RF, Zhu JZ, Huang L, Hu JQ, Qian W: **Effect of multimodal nursing interventions on patients with mild cognitive impairment.** J Nurs Sci 2024, 39(19):1-6. [Article in Chinese]
38. Julious SA: **Sample size of 12 per group rule of thumb for a pilot study**. *Pharmaceutical Statistics* 2005, **4**(4):287-291.
39. Winblad B, Palmer K, Kivipelto M, Jelic V, Fratiglioni L, Wahlund LO, Nordberg A, Bäckman L, Albert M, Almkvist O *et al*: **Mild cognitive impairment--beyond controversies, towards a consensus: report of the International Working Group on Mild Cognitive Impairment**. *J Intern Med* 2004, **256**(3):240-246.
40. Chinese Medical Association Neurology Branch Dementia and Cognitive Impairment Study Group: **Expert consensus on neuropsychological assessment for mild cognitive impairment (2025 edition).** *Natl Med J China* 2025, 105(3):204-218. [Article in Chinese]
41. Avery KNL, Williamson PR, Gamble C, O'Connell Francischetto E, Metcalfe C, Davidson P, Williams H, Blazeby JM: **Informing efficient randomised controlled trials: exploration of challenges in developing progression criteria for internal pilot studies**. *BMJ Open* 2017, **7**(2):e013537.
42. Røpke A, Morville A-L, Møller TE, Delkus ECG, Juhl CB: **HIP Fracture REhabilitation Program for older adults with hip fracture (HIP-REP) based on activity of daily living: a feasibility study**. *BMC Geriatrics* 2022, **22**(1):370.

43. Tainta M, Ecay-Torres M, de Arriba M, Barandiaran M, Otaegui-Arrazola A, Iriondo A, Garcia-Sebastian M, Estanga A, Saldias J, Clerigue M *et al*: **GOIZ ZAINDU study: a FINGER-like multidomain lifestyle intervention feasibility randomized trial to prevent dementia in Southern Europe**. *Alzheimers Res Ther* 2024, **16**(1):44.
44. Zhou XX, Xie M, Tao J, Fang YH, Chen SJ, Chen LD. **Research and application of the Mini-Mental State Examination. Chinese Journal of Rehabilitation Medicine.** 2016;31(6):694-696, 706. (Article in Chinese).
45. Welch SA, Ward RE, Beauchamp MK, Leveille SG, Travison T, Bean JF: **The Short Physical Performance Battery (SPPB): A Quick and Useful Tool for Fall Risk Stratification Among Older Primary Care Patients**. *J Am Med Dir Assoc* 2021, **22**(8):1646-1651.
46. Guralnik JM, Ferrucci L, Pieper CF, Leveille SG, Markides KS, Ostir GV, Studenski S, Berkman LF, Wallace RB: **Lower extremity function and subsequent disability: consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery**. *J Gerontol A Biol Sci Med Sci* 2000, **55**(4):M221-231.
47. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, Seeman T, Tracy R, Kop WJ, Burke G *et al*: **Frailty in older adults: evidence for a phenotype**. *J Gerontol A Biol Sci Med Sci* 2001, **56**(3):M146-156.
48. Tang D: **Application of Short Form Geriatric Depression Scale (GDS-15) In Chinese Elderly.** *Chin J Clin Psychol* 2013, 21(03):402-405. [Article in Chinese]
49. Chen S, Ke W, Guan X, Hong S, Wu S, Yu Z, Lin J, Wang C, Fu M, Xiao Y *et al*: **Associations of depressive symptoms and lifestyles with cognitive function: results from two cross-sectional studies among middle-age and older Chinese populations**. *J Affect Disord* 2025, **388**:119573.
50. Zhang C, Zhang H, Zhao M, Chen C, Li Z, Liu D, Zhao Y, Yao Y: **Psychometric properties and modification of the 15-item geriatric depression scale among Chinese oldest-old and centenarians: a mixed-methods study**. *BMC Geriatr* 2022, **22**(1):144.
51. Graf C: **The Lawton instrumental activities of daily living scale**. *Am J Nurs* 2008, **108**(4):52-62; quiz 62-53.
52. Liu JL, Yang F, Hu T, Zeng LJ, Yu YQ, Qiu YF: **Chinese Version of National Center for Geriatrics and Gerontology Social Network Scale:Reliability and Validity.** *Mil Nurs* 2023, 40(09):35-38. [Article in Chinese]
53. Salzman T, Sarquis-Adamson Y, Son S, Montero-Odasso M, Fraser S: **Associations of Multidomain Interventions With Improvements in Cognition in Mild Cognitive Impairment: A Systematic Review and Meta-analysis**. *JAMA Network Open* 2022, **5**(5):e226744-e226744.
54. Chen JL, Zhang H, Shi ZX, Liu Y, Zhao YZ, Dong ZW, Ji LH, Li HY, Chen FF, Wang CP et al: **Development of a community toolkit for identifying and managing mild cognitive impairment among older adults.** *Chin J Rehabil Theory Pract* 2025, 31(06):692-702. [Article in Chinese]
55. Fujita K, Kinoshita F, Kuroda Y, Sugimoto T, Yamashita M, Sakurai H, Yamashiro D, Shimizu K, Matsumoto N, Uchida K *et al*: **Feasibility and effectiveness of a handbook-based multidomain lifestyle intervention for older adults with mild cognitive impairment: A quasi-experimental design with propensity score matching**. *J Alzheimers Dis* 2025, **107**(4):1768-1779.
56. Wittmann FG, Pabst A, Zülke A, Luppa M, Oey A, Boekholt M, Weise S, Fankhänel T, Kosilek RP, Brettschneider C *et al*: **Adherence to a lifestyle intervention – just a question of self-efficacy? Analysis of the AgeWell.de-intervention against cognitive decline**. *Alzheimer's Research & Therapy* 2024, **16**(1):133.
57. Tiga-Loza DC, Álvarez-Anaya WA, Rivera-Carvajal R, Ardila AC, Buitrago-Buitrago JA, Pabon A, Castañeda-Hernández Á, Reyes-Pulido MM, Guzmán KP, Salazar HUA *et al*: **Nonpharmacological multicomponent intervention for mild cognitive impairment with a family-patient approach: protocol for the pilot clinical trial-INTERCOG study**. *Pilot Feasibility Stud* 2026.
58. Ngandu T, Lehtisalo J, Korkki S, Solomon A, Coley N, Antikainen R, Bäckman L, Hänninen T, Lindström J, Laatikainen T *et al*: **The effect of adherence on cognition in a multidomain lifestyle intervention (FINGER)**. *Alzheimer's & Dementia* 2022, **18**(7):1325-1334.
59. Uchida K, Sugimoto T, Matsumoto N, Fujita K, Yokoyama Y, Kuroda Y, Sakurai T, Arai H: **The influence of the adherence on intervention effect: J-MINT study**. *Alzheimer's & Dementia* 2024, **20**(S7):e088996.
60. Soldevila-Domenech N, Ayala-Garcia A, Barbera M, Lehtisalo J, Forcano L, Diaz-Ponce A, Zwan M, van der Flier WM, Ngandu T, Kivipelto M *et al*: **Adherence and intensity in multimodal lifestyle-based interventions for cognitive decline prevention: state-of-the-art and future directions**. *Alzheimers Res Ther* 2025, **17**(1):61.
61. Chang H, Qiao YC: Expert consensus on cognitive training nursing clinic. Chin J Nurs 2019, 54(10):1504-1508. [Article in Chinese]
62. Wu R, Fei F, Lu T, Zhu J, Hu D: **Effect of family doctor contract services on non-communicable disease management among the elderly: a systematic review and meta-analysis**. *Front Health Serv* 2025, **5**:1462806.
63. Chen P, Li F, Harmer P: **Healthy China 2030: moving from blueprint to action with a new focus on public health**. *The Lancet Public Health* 2019, **4**(9):e447.
64. Dequanter S, Fobelets M, Steenhout I, Gagnon M-P, Bourbonnais A, Rahimi S, Buyl R, Gorus E: **Determinants of technology adoption and continued use among cognitively impaired older adults: a qualitative study**. *BMC Geriatrics* 2022, **22**(1):376.

Figures

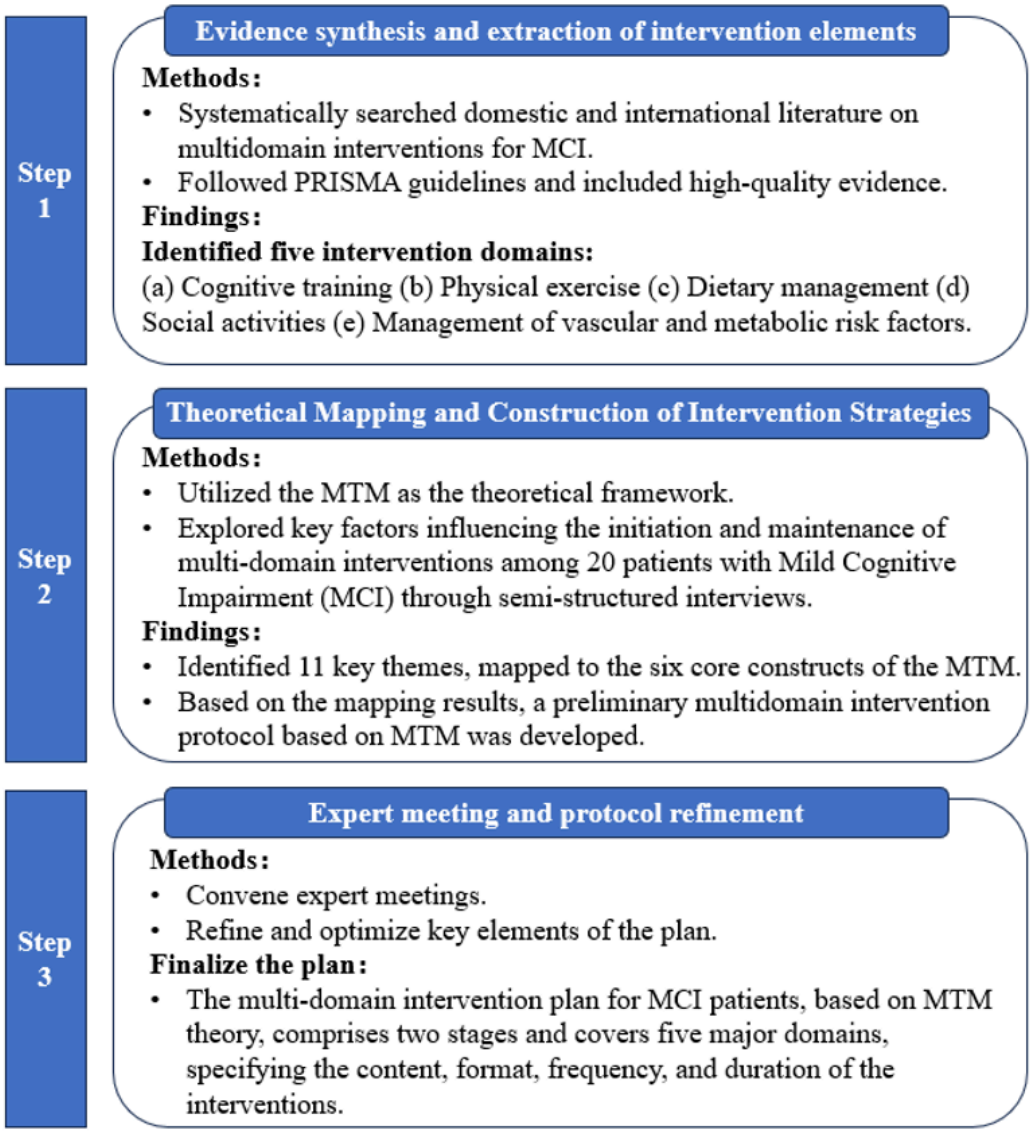


Figure 1

Intervention Program Development Flowchart

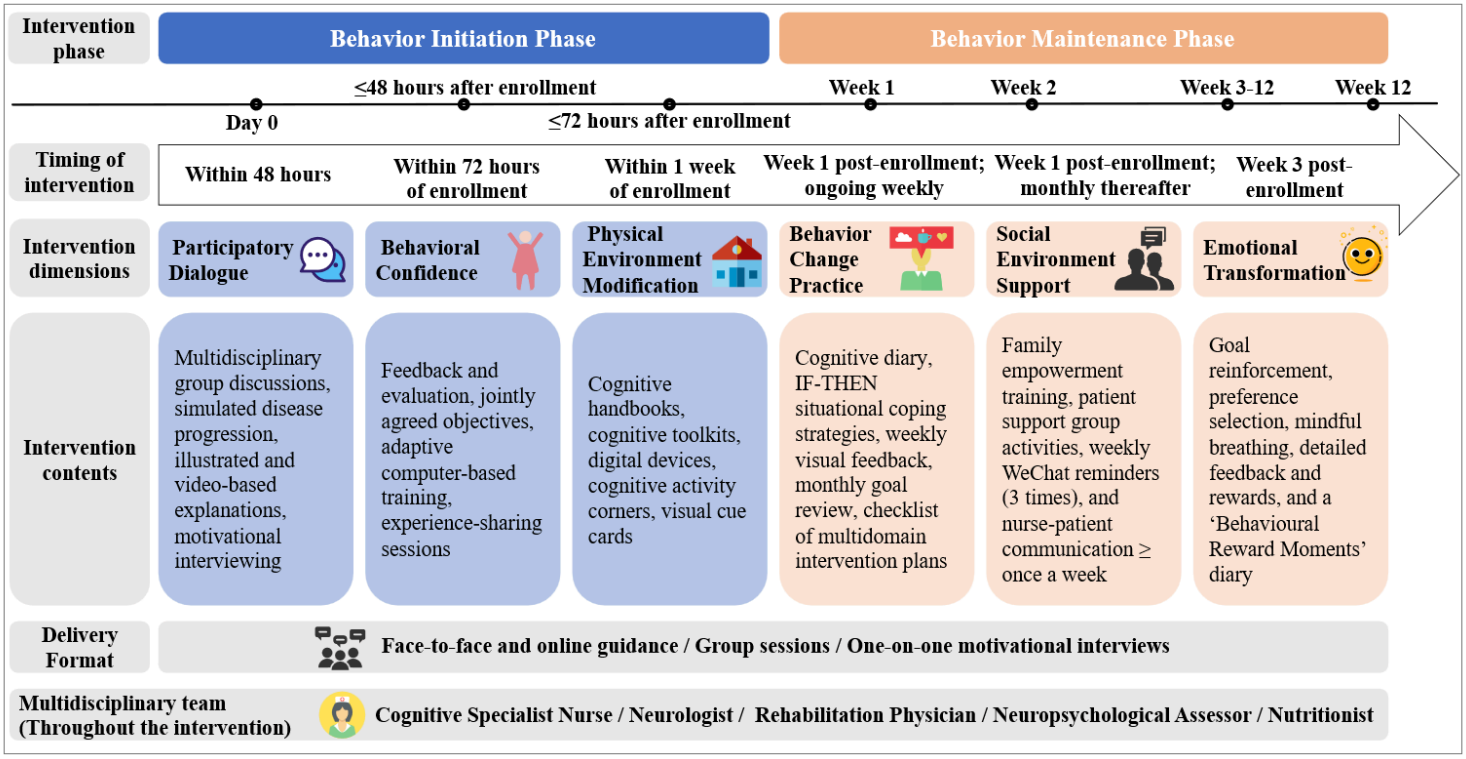


Figure 2

Implementation Plan for Multidomain Intervention for MCI Patients Based on MTM

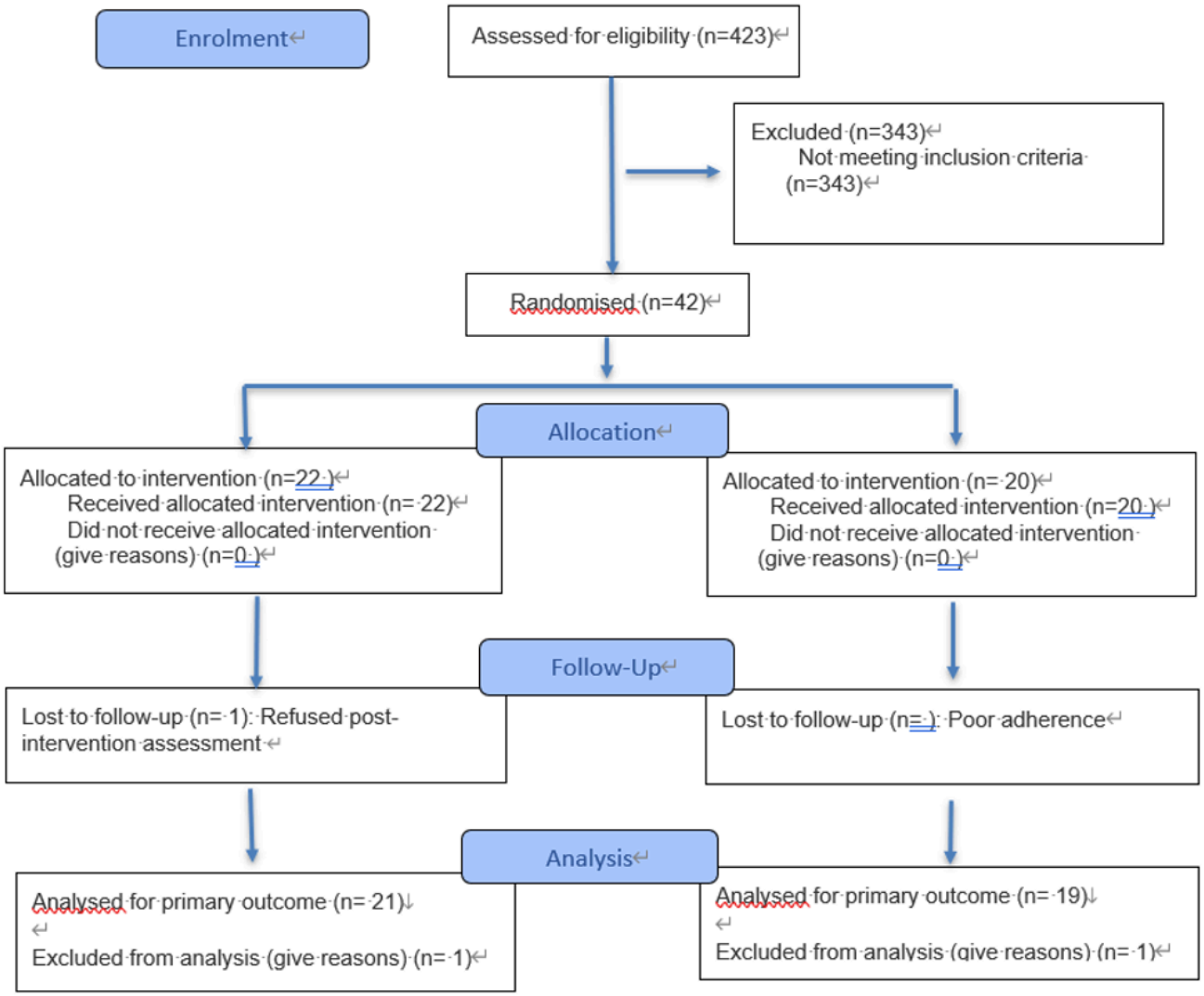


Figure 3

Participant recruitment and retention flow diagram

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryFile2CONSORTextensionforPilotandFeasibilityTrialsChecklist1.doc
- SupplementaryMaterials.docx
- MMSERenWangChineseLetterofPermission08052026signedonlybyPARSO00629177IN00619850.pdf