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Analysis of treatment for improving cognitive dysfunction in elderly patients with hypertension

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Abstract: **Background**: Geriatric hypertension is a key risk factor for mild cognitive impairment (MCI) and no MCI interventions utilize community elderly service resources. **Objectives**: To analyze lifestyle factors' effects on hypertensive patients' cognition and evaluate the cognitive impairment intervention course's improvement in those with MCI. **Methods**: A total of 280 hypertensive patients aged 60-80 years from Huacao Community were retrospectively enrolled between May 2024 and July 2025, among whom 64 were diagnosed with MCI. These 64 patients were split into two groups: conventional antihypertensive treatment (n=32) and conventional treatment + elderly service center cognitive intervention (combined group, n=32). Primary outcomes included MCI prevalence in hypertensive patients, associations between lifestyle and cognitive function and MoCA scores and blood pressure (BP) fluctuations in MCI patients. Secondary outcomes included MMSE, activities of daily living (ADL), short-form 36 (SF-36) and medication adherence scale-8 (MMAS-8) scores and adverse events. **Results**: The MCI prevalence among elderly hypertensive patients in Huacao community was 22.9%. Smoking, excessive alcohol, insufficient physical activity and high fat/sugar/salt diet were MCI risk factors in these patients (P=0.014, 0.030, 0.041, 0.018). After treatment, the combined group had significantly larger increases in MoCA, MMSE and SF-36 scores than the conventional group (P=0.013, 0.010, <0.001), narrower systolic and diastolic BP fluctuations (P<0.001, 0.002), a greater decrease in ADL total score (P=0.031) and a higher MMAS-8 score (P=0.019). No significant difference in adverse event incidence was observed between the two groups (P=0.351). **Conclusion**: Elderly hypertensive patients in Huacao community have high MCI prevalence, closely tied to lifestyle. The center's cognitive intervention course can effectively boost their cognition and fit into these patients' community management system.

Keywords: Cognitive intervention course; Elderly service center; Elderly hypertension; Lifestyle; Mild cognitive impairment

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INTRODUCTION

As the cardiovascular disease with the highest global prevalence, hypertension affects 58.3% of the elderly population in China. Cognitive impairment, a spectrum of age-related neurodegenerative disorders, takes mild cognitive impairment (MCI) as its critical transitional stage, which is mainly characterized by mild deficits in cognitive domains such as memory and executive function without impairing basic activities of daily living (ADL) (Chen, 2022). In recent years, the comorbidity association between these two conditions has become a research hotspot and a large body of epidemiological evidence has confirmed that hypertension is an independent and important risk factor for MCI and Alzheimer's disease (AD), with its damaging effects on cognitive function being insidious and progressive in nature (Fernandez-Llama *et al.*, 2021).

From a mechanistic perspective, long-term uncontrolled hypertension can impair cognitive function through multiple pathways. On the one hand, chronic cerebral hypoperfusion induced by hypertension leads to neuronal energy metabolism disorders, particularly causing selective damage to key cognitive brain regions such as the hippocampus and prefrontal cortex (Guasti *et al.*, 2022). On the other hand, hypertension-mediated vascular endothelial dysfunction, oxidative stress responses and release of inflammatory factors accelerate the progression of cerebral atherosclerosis, increase the risk of cerebrovascular pathologies, including cerebral microbleeds and leukoaraiosis and further disrupt the integrity of neural circuits (Perez Palmer *et al.*, 2022).

In terms of epidemiological characteristics, the prevalence of hypertension complicated with MCI shows significant population and regional differences. A meta-analysis involving 11 studies and covering 471.79 million participants indicated that the overall pooled prevalence of MCI in hypertensive patients was 30% (95%CI: 25 35%), which was significantly higher than that in the general elderly population (12–18%). Further subgroup analyses revealed that the prevalence rate was 26% (95%CI: 20–31%) in the Asian population, lower than the 40% (95%CI:

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14–66%) observed in the European population (Qin *et al.*, 2021), a discrepancy that may be attributed to ethnic genetic variations, dietary patterns and hypertension control rates. The prevalence of MCI among hypertensive patients aged over 60 years reached 28% (95%CI: 23–33%), with an approximate 3% increase for every 5-year rise in age. Additionally, the prevalence rate in clinic-based samples (42%, 95%CI: 23–62%) was substantially higher than that in community-based samples (17%, 95%CI: 15–19%), reflecting that a large number of mild cases in the community may have remained undiagnosed (Qin *et al.*, 2021).

Notably, MCI is characterized by significant reversibility, which provides a critical window period for the early intervention of cognitive impairment. A Swedish longitudinal study targeting individuals aged 60 to 102 years demonstrated that among 1,785 MCI patients diagnosed according to the Petersen criteria, 43.4% of them recovered to normal cognitive function levels after receiving standardized interventions within one year of diagnosis. In contrast, approximately 10–15% of patients who did not receive interventions progressed to AD annually (Overton *et al.*, 2023). These findings highlight the importance of intervention during the MCI stage. Timely identification of risk factors, implementation of early screening and delivery of precise interventions can not only reduce the incidence risk of AD but also significantly improve the healthy life expectancy of the elderly population, thus holding profound public health significance (Jellinger, 2023).

Currently, intervention research on hypertension complicated with MCI has made certain progress, but there are still many research gaps that urgently need to be addressed, mainly reflected in three aspects (Bliss *et al.*, 2021). First, existing studies mostly focus on antihypertensive drug therapy or non-pharmacological interventions for MCI separately, lacking combined intervention programs that organically integrate the two approaches. Second, there is a disconnect between research settings and actual care needs. More than 80% of current cognitive intervention studies are conducted in tertiary hospitals or research institutions, relying on professional neuropsychological assessors and sophisticated testing equipment, which makes the implementation of intervention programs costly and operationally complex (Chow *et al.*, 2021, Bai *et al.*, 2022). However, the primary care setting for elderly patients with hypertension complicated by MCI in China is the community. According to the Report on the current situation of elderly cognitive impairment management in Chinese communities (2023), only 18.3% of community health service centers in China carry out MCI screening and merely 9.7% of communities provide cognitive intervention services. Moreover, the intervention content is mostly in simple forms such as health lectures, lacking a standardized and scalable curriculum system (Chen *et al.*, 2025, Yang *et al.*, 2023). This disjuncture between research and practice prevents a large number of effective research findings from benefiting grassroots patients. Third, the evaluation system lacks a multi-dimensional perspective. Most existing studies use a single scale to assess the improvement effect of cognitive function, ignoring the comprehensive evaluation of patients' ADL, psychological status and stability of blood pressure (BP) control (Zhuang *et al.*, 2021, Karunathilaka and Rathnayake, 2021). Yet the intervention effects on hypertension complicated with MCI are often multi-dimensional; focusing solely on cognitive function may lead to a one-sided judgment of intervention value.

Based on the aforementioned research gaps, this study establishes a comprehensive evaluation system covering cognitive function, BP control, ADL and psychological status. Through community-based intervention practice, it aims to provide new insights and empirical evidence for addressing the dilemma of community management for elderly patients with hypertension complicated by MCI, ultimately helping to improve the health quality of the elderly population and alleviate the social medical burden.

MATERIALS AND METHODS

General information

A total of 280 hypertensive patients aged 60-80 years who resided in Huacao community from May 15, 2024, to July 15, 2025, were included. Among them, 64 patients were diagnosed with MCI. Based on differences in existing treatment regimens, the 64 patients were divided into two groups: the conventional antihypertensive treatment group, which included 32 patients and the group receiving conventional antihypertensive treatment combined with the cognitive impairment intervention course at the elderly service center (abbreviated as the combined group), which included 32 patients (Fig. 1).

Inclusion criteria

(1) Aged 60-80 years; (2) Diagnosed with hypertension if: systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg (1 mmHg = 0.133 kPa) as measured on 3 non-consecutive days without the use of antihypertensive drugs (Wu *et al.*, 2025, McEvoy *et al.*, 2024); or elderly individuals with a previously confirmed hypertension diagnosis who are currently taking antihypertensive drugs; (3) Educational level of primary school or above; (4) Sufficient visual, auditory and discriminative abilities; (5) Having a legal guardian.

Exclusion criteria

(1) Cerebral diseases other than stroke, such as traumatic brain injury, hydrocephalus and cerebral infection; (2) Cognitive impairment caused by non-cerebrovascular factors, including neurodegenerative diseases, congenital and hereditary diseases and Parkinson's disease; (3) Cognitive impairment secondary to diseases of organs

notably the liver, kidneys and thyroid, as well as diseases of other systems; (4) Visual impairment, hearing impairment, aphasia, or severe dementia (Zhang *et al.*, 2024); (5) Other relevant causes.

Diagnostic criteria for MCI

The diagnosis of MCI in this study strictly followed the internationally recognized diagnostic criteria for MCI developed by the National Institute on Aging-Alzheimer's Association (NIA-AA) (Weinstein *et al.*, 2022). The core criteria included the following: (1) The clinician confirms the patient's cognitive decline through medical history collection; (2) The corrected total score of the Montreal Cognitive Assessment (MoCA) is < 26 and the score of the Mini-Mental State Examination (MMSE) ranges from 21 to 26; (3) Basic ADL were largely preserved and the severity of cognitive impairment did not meet the diagnostic criteria for dementia; (4) Cognitive impairment caused by delirium, severe mental disorders, central nervous system lesions and other systemic diseases was excluded to ensure the standardization of diagnosis.

Study protocol

This study is a retrospective cohort study and the entire process strictly adheres to the Declaration of Helsinki. The study data were derived from the information of hypertensive patients in Huacao community from May 2024 to July 2025 and have been anonymized. The study results will only be used for academic research and will not cause any damage to patients' rights and interests. All personnel involved in the study have received training on medical ethics and the study protocol.

Treatment and intervention methods

After screening, a total of 64 elderly hypertensive patients with MCI were included. Based on the recorded differences in treatment approaches, 32 patients in each group received conventional antihypertensive treatment and combined treatment respectively.

Patients in the conventional group received treatment with conventional antihypertensive drugs such as amlodipine or valsartan. Specifically, they were administered either amlodipine besylate tablets (Norvasc, Huizhi Pharmaceutical (Dalian) Co., Ltd., China), 10 mg once daily (Liu *et al.*, 2024); or valsartan capsules (Diovan, Novartis Pharma Beijing Co., Ltd., China), 80 mg once daily (Ledwidge *et al.*, 2023). The medication principle for patients is to select either amlodipine besylate tablets or valsartan capsules alone based on their BP levels, comorbidities, drug allergy history and previous medication tolerance. During the treatment period, community medical staff uniformly measured the patients' BP every 2 weeks. After excluding interfering factors such as mood and sleep, the dosage was adjusted (the maximum daily dose of amlodipine does not exceed 10 mg and the maximum daily dose of valsartan does not exceed 160 mg). BP was monitored weekly after dosage adjustment until the target BP was reached.

On the basis of conventional antihypertensive treatment, patients in the combined group additionally participated in the community-based cognitive impairment intervention course at the Huacao Community Health Service Center. The intervention lasted for three months, with one session per week. Each session consisted of 2 classes, totaling 100 minutes. Weeks 1–6 consisted of the basic cognitive training module, while Weeks 7–12 implemented targeted intensive interventions. The interventions were delivered by 3 community general practitioners holding the intermediate certificate in elderly cognitive impairment Care. All practitioners completed specialized standardized training and passed the assessment and weekly teaching and research reviews were conducted to ensure the consistency of intervention delivery. The intervention materials used were adapted from the recommended protocols outlined in the Expert Consensus on Digital screening for MCI in community Settings (Sun *et al.*, 2025). The course content is detailed in table 1.

Outcome measures

Primary outcome measures

Prevalence of MCI and its influencing factors in hypertensive patients

Using data from previous questionnaires (MMSE and MoCA scales), the prevalence of MCI among hypertensive patients aged over 60 years in Huacao community was analyzed. Meanwhile, lifestyle-related influencing factors of MCI were examined. Statistical software was used to analyze the prevalence of MCI and its influencing factors in hypertensive patients in Huacao community.

MoCA scale

This study adopted the Chinese version of the MoCA scale. The cognitive domains evaluated included attention and concentration, executive function, memory, language, visuoconstructive skills, abstract thinking, as well as calculation and orientation, with a total of 11 items and a full score of 30. For participants with ≤ 12 years of education, an additional 1 point was added to their raw test scores to obtain the corrected scores, with the maximum corrected total score still capped at 30. A corrected score of ≥ 26 indicates basically normal cognitive function (Sun *et al.*, 2023).

BP fluctuation range

An OMRON fully automatic medical electronic sphygmomanometer (Model: HBP-9030, OMRON Corporation, Japan) was utilized to quantify each patient's BP at least three times per day. BP fluctuation range was calculated as the difference between the daily maximum and minimum SBP and that between the daily maximum and minimum DBP.

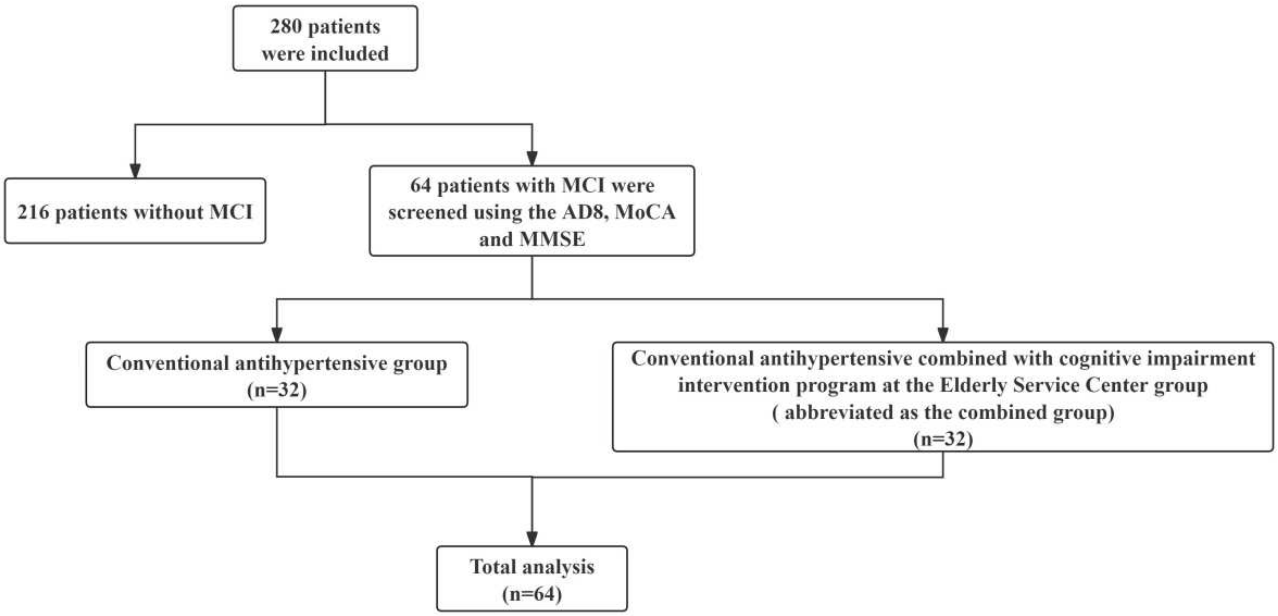

Fig. 1: Research flowchart
Note: MCI: mild cognitive impairment. A total of 280 elderly hypertensive patients were enrolled in this study, among whom 216 were non-MCI patients and 64 were MCI patients. The 64 MCI patients were divided into two groups, 32 cases in the conventional antihypertensive group and 32 cases in the combined group.

Table 1: Community intervention course for cognitive impairment

Weekly	Cognitive impairment intervention program
Week 1	(1) Overview of the four key elements for brain health (2) Improving attention (3) Finger exercises
Week 2	(1) Attention-flash association strategy (2) Daily life memory techniques (3) Brain-healthy diet
Week 3	(1) Categorization method (2) Remembering names (3) Stress management (4) Healthy sleep
Week 4	(1) Sentence-making and storytelling methods (2) Exercise management (3) Resistance band exercises (4) Calculation and rapid recall
Week 5	(1)Number memory methods (2) Memory pegging technique (3) Left and right brain functions (4) Spatial memory
Week 6	(1) Review of memory techniques (2) Memory competition (3) Subjective and objective memory assessment
Weeks 7	(1) Attention enhancement (advanced version of flashcard association) (2) Practical training of memory anchoring method (combined with patients' daily items) (3) Combined training of finger exercises and resistance bands
Weeks 8	(1) Categorization memory method (community scenario application: supermarket item classification) (2) Name memory training (combined with portraits of community neighbors) (3) Development of brain-healthy diet recipes
Weeks 9	(1) Sentence composition (family event narration) (2) Arithmetic speed memory training (grocery shopping change-giving simulation) (3) Stress management (advanced breathing relaxation technique)
Weeks 10	(1) Number memory training (intensive memorization of home phone numbers/children’s birthdays) (2) Spatial memory training (community route mapping) (3) Implementation feedback of healthy sleep plans
Weeks 11	(1) Integrated training of memory techniques across all modules (cross-method combination: e.g., memorizing drug names via categorization and anchoring methods) (2) Group memory competition (life-oriented theme: memorization of family recipes)
Weeks 12	Full-course content review (patients’ independent summarization of memory techniques)

Secondary outcome measures

MMSE scale

The MMSE is a widely used international screening tool for cognitive function, designed to quickly assess the degree of cognitive impairment in participants. It evaluates domains including orientation, memory, attention, calculation ability, language and visuospatial ability, consisting of 19 items with a total score of 30 points. A lower score indicates more severe cognitive impairment. Cognitive function is classified as follows: 27-30 points: normal cognition; 21-26 points: MCI; 10-20 points: moderate cognitive impairment; ≤9 points: severe cognitive impairment (Jia *et al.*, 2021).

ADL scale

The ADL scale is commonly used to assess the ability of the elderly to perform daily living activities. It includes 14 items, divided into two parts, (1) physical self-maintenance scale: covers 6 items, including using the toilet, eating, dressing, daily grooming, walking and bathing; (2) instrumental ADL scale: includes 8 items, such as answering/making phone calls, shopping/cooking, housework, doing laundry, taking public transportation, taking medications and managing finances. Each item is scored on a 4-point scale: normal, slight difficulty, requiring assistance and loss of ability. The minimum score is 16 points (fully normal) and a score exceeding 16 points indicates functional decline of varying degrees, with a maximum score of 56 points. A higher score indicates poorer ability to perform daily living activities (Raimo *et al.*, 2024).

36-Item short-form health survey (SF-36) scale

The SF-36 scale assesses an individual's health status and quality of life from multiple dimensions. It consists of 36 items, evaluating 8 health domains as follows: physical functioning (PF): 10 items, assessing the degree of limitation in physical activities; role-physical (RP): 4 items, assessing limitations in role activities caused by physical problems; bodily pain (BP): 2 items, assessing the level of pain and its impact on daily activities; general health (GH): 5 items, assessing the overall evaluation of one's own health status; vitality (VT): 4 items, assessing energy levels and feelings of fatigue; social functioning (SF): 2 items, assessing limitations in social activities; role-emotional (RE): 3 items, assessing limitations in role activities caused by emotional problems; mental health (MH): 5 items, assessing mental status (e.g., anxiety, depression, sense of well-being). The physical component summary (PCS) score is calculated by weighting the scores of the four domains (PF, RP, BP, GH); the mental component summary (MCS) score is calculated by weighting the scores of the four domains (VT, SF, RE, MH). Standardized scores (0-100) were derived from raw scores. A higher PCS score denotes superior overall physical function, whereas a higher MCS score signifies better overall mental health (Zhou *et al.*, 2023).

8-Item morisky medication adherence scale (MMAS-8)

The MMAS-8 is a frequently employed tool for assessing patients' medication adherence and it is particularly suitable for the long-term medication management of patients. It contains 8 items, 7 are "yes/no" items and 1 is a 5-point Likert scale item. A score of 8 denotes good adherence; scores of 6-7 indicate moderate adherence; and scores below 6 signify poor adherence (Glasser *et al.*, 2022).

Incidence of adverse events

Adverse events in this study included: intervention-related adverse events (e.g., fatigue, dizziness after cognitive courses), disease-related adverse events (e.g., transient increase in BP) (Yamamoto *et al.*, 2025) and other adverse events (e.g., accidental falls).

Sample size calculation method

Meta-analysis (He *et al.*, 2024) implemented lifestyle interventions and antihypertensive treatment (perindopril or amlodipine) to control BP in elderly hypertensive patients. The results showed a significant increase in the Quick MCI Test (Q-MCI-TR) score (41 points at baseline vs. 45.5 points at follow-up), with an estimated Cohen's d of 0.73. Using G*Power 3.1.9.7 software for analysis, when α was set at 0.05 and power (1-β) at 80%, the calculated sample size was 31 patients per group. Considering the actual situation of elderly hypertensive patients with MCI in Huacao community, a total of 64 patients were included in this study, with 32 patients in each group, to ensure the stability of the results.

Statistical analysis

Statistical analysis of patients' baseline data and outcome measures utilized SPSS 27 software for execution. Regarding continuous data: if they followed a normal distribution, data were expressed as mean ± SD. Independent samples t-test was used for comparisons between groups and paired t-test was used for comparisons within the same group before and after treatment; in cases of non-conformity to a normal distribution, data were expressed as median (interquartile range, IQR) and Mann-Whitney U test was used for between-group comparisons. Categorical data were presented as n(%) and Chi-Square Test was used for between-group comparisons. Lifestyle-related influencing factors of MCI were analyzed using logistic regression analysis. Statistical significance was classified as a two-tailed P-value < 0.05 across all outcomes.

RESULTS

Prevalence of MCI and its influencing factors in elderly hypertensive patients

A total of 280 elderly patients with hypertension from Huacao community were enrolled, among whom 64 cases were diagnosed with MCI. The prevalence of MCI among

elderly hypertensive patients was 22.9% (64/280). Logistic regression analysis was conducted on the general data of the 280 elderly hypertensive patients. As shown in table 2, smoking, excessive alcohol consumption, lack of physical activity and a diet high in sugar, fat and salt were recognized as risk factors for MCI in elderly hypertensive patients (P=0.014, P=0.030, P=0.041, P=0.018).

Comparison of baseline data between The two groups of elderly hypertensive patients with MCI

This study was a retrospective controlled analysis. Baseline information was collected from the patients' previous questionnaires, including the patients' age, body mass index (BMI), gender, smoking status, excessive alcohol consumption status, physical activity status, dietary status, ethnicity, height, weight and income status. Comparison of the data between the two groups showed that there were no statistically significant differences in the aforementioned baseline data (all P>0.05) (Tables 3 and 4). This indicates that the two groups of patients are well comparable and thus the comparison of outcome measures between them is valid.

Comparison of MoCA scale and MMSE scale scores between the two groups

Table 5 mainly presents the changes in MoCA and MMSE scores. It can be seen that after treatment, the scores of these two scales increased in both groups (all P<0.05) and the magnitude of the increase in MoCA and MMSE scores in the combined group was higher than those in the conventional antihypertensive treatment group (95%CI: -1.56, -0.19, P=0.013; 95%CI: -2.13, -0.30, P=0.010). The results outlined above demonstrate that participating in the cognitive impairment intervention course at the elderly service center can improve patients' cognitive function better than conventional antihypertensive treatment alone.

Comparison of BP fluctuation ranges between the two groups

After treatment, the fluctuation ranges of SBP and DBP narrowed in both groups (all P<0.05). Moreover, compared with the conventional antihypertensive treatment group, the narrowing of SBP and DBP fluctuation ranges in the combined group was more significant (*95%CI*: 2.42, 4.04, P<0.001; *95%CI*: 0.45, 1.97, P=0.002). This indicates that participating in the cognitive impairment intervention course at the elderly service center can improve patients' BP fluctuation more effectively than conventional antihypertensive treatment alone. (Table 6).

Comparison of ADL scale scores between the two groups

The statistical results of ADL scores showed (Table 7) that after treatment, the ADL scores of patients in both groups decreased significantly (all P<0.05). Moreover, compared with the conventional antihypertensive treatment group, the decrease in ADL scores in the combined group was more significant (*95%CI*: 0.15, 3.04, P=0.031). This indicates that participating in the cognitive impairment intervention course at the elderly service center can better improve the ability of elderly hypertensive patients with MCI to perform ADL, compared with conventional antihypertensive treatment alone.

Comparison of SF-36 scale scores between the two groups

In terms of the two dimensions of PCS score and MCS score, after treatment, the patients' PCS and MCS scores in both groups increased (all P<0.05). Moreover, compared with the conventional antihypertensive treatment group, the increases in PCS and MCS scores in the combined group were more significant (*95%CI*: -5.24, -2.89, P<0.001; *95%CI*: -7.53, -5.29, P<0.001) (Table 8). The results of these two scores indicate that participating in the cognitive impairment intervention course at the elderly service center can better improve the physical health and mental health of elderly hypertensive patients with MCI, compared with conventional antihypertensive treatment alone.

Comparison of MMAS-8 scores between the two groups

As shown in table 9, after treatment, the MMAS-8 scores of patients in both groups increased significantly (all P<0.05). Moreover, compared with the conventional antihypertensive treatment group, the increase in MMAS-8 score in the combined group was more significant (*95%CI*: -1.15, -0.11, P=0.019). This implies that participating in the cognitive impairment intervention course at the elderly service center can improve patients' medication adherence better than conventional antihypertensive treatment alone.

Comparison of the incidence of adverse events between the two groups

Table 10 records the adverse events of patients in the two groups. During the treatment period in the conventional antihypertensive treatment group, 4 patients experienced transient increases in BP and 4 patients had accidental falls, there were a total of 8 adverse events, with an incidence rate of 25.0%. In the combined group, 2 patients reported fatigue and dizziness after cognitive courses, 2 patients had transient increases in BP, and 1 patient had an accidental fall. There was a total of 5 adverse events, with an incidence rate of 15.6%. Adverse event incidence did not differ significantly between the two regimens (P=0.351).

DISCUSSION

In China, as of 2024, the number of elderly hypertensive patients aged over 60 has exceeded 350 million. Moreover, due to factors such as the intensification of population aging and the westernization of lifestyles, the prevalence of MCI has been on an annual rise, imposing a heavy burden on family care and social medical resources (Guasti *et al.*, 2022).

Table 2: Regression analysis of influencing factors for mci in elderly patients with hypertension

Variables (n=280)	Beta coefficient	Standard error	*P*	*EXP(B)*	*EXP(B) 95%CI*
Age (years)	0.024	0.047	0.601	1.025	0.935,1.123
Gender (male/female)	-0.027	0.310	0.931	0.974	0.531,1.786
BMI (kg/m^2)	0.087	0.103	0.399	1.091	0.897,1.335
Smoking	1.617	0.656	0.014	5.039	1.392,18.245
Excessive alcohol consumption	-1.121	0.517	0.030	0.326	0.118,0.899
Lack of physical activity	0.888	0.435	0.041	2.430	1.036,5.700
Dietary pattern (balanced/high in sugar, fat, and salt)	0.823	0.347	0.018	2.277	1.153,4.500
Ethnicity (Han/other)	-0.325	0.411	0.429	0.722	0.322,1.618
Height (cm)	-0.010	0.032	0.767	0.990	0.930,1.055
Weight (kg)	-0.010	0.048	0.826	0.990	0.901,1.086
Economic status (low income/middle income and above)	0.003	0.421	0.994	1.003	0.440,2.290

Note: BMI: body mass index.

Table 3: Baseline data [*mean ±SD*, *n (%)*]

Variables	Conventional antihypertensive group (n=32)	Combined group (n=32)	*Difference 95%CI*	*P*	*Effect size*
Age (years)	69.13±5.39	68.72±5.88	-2.41,3.22	0.774	Cohen's d=0.072
BMI (kg/m^2)	23.81±1.67	24.29±1.42	-1.26,0.29	0.219	Cohen's d=-0.310
Gender					
Male	16(50.0)	16(50.0)		1.00	Phi=0.00
Female	16(50.0)	16(50.0)			
Smoking	20(62.5)	24(75.0)		0.281	Phi=-0.135
Drinking	13(40.6)	15(46.9)		0.641	Phi=-0.063
Lack of physical activity	12(37.5)	14(43.8)		0.611	Phi=-0.064
Dietary pattern					
Balanced	15(46.9)	16(50.0)		0.802	Phi=-0.031
High in sugar, fat, and salt	17(53.1)	16(50.0)			
Ethnicity					
Han	27(84.4)	25(78.1)		0.522	Phi=0.080
Other	5(15.6)	7(21.9)			
Height (cm)	155.10±5.73	156.39±5.97	-4.22,1.63	0.380	Cohen's d=-0.221
Weight (kg)	60.22±4.15	60.23±4.12	-2.08,2.06	0.993	Cohen's d=-0.002
Economic status					
Low income	11(34.4)	10(31.3)		0.790	Phi=0.033
Middle income and above	21(65.6)	22(68.8)			

Table 4: Results of logistic regression analysis

Variables	B	*P*	OR	*OR 95%CI*
Age (years)	0.021	0.365	1.021	0.977~1.067
BMI (kg/m^2)	-0.032	0.501	0.969	0.882~1.065
Gender	0.315	0.305	1.369	0.776~2.413
Smoking	0.428	0.218	1.534	0.793~2.967
Drinking	0.297	0.357	1.345	0.718~2.519
Lack of physical activity	0.386	0.228	1.469	0.795~2.716
Dietary pattern	0.512	0.210	1.668	0.765~3.636
Ethnicity	0.439	0.255	1.551	0.732~3.284
Height (cm)	0.476	0.177	1.610	0.825~3.142
Weight (kg)	-0.328	0.368	0.720	0.365~1.420
Economic status	0.215	0.623	1.240	0.515~3.009

Table 5: Comparison of MoCA/MMSE scores (*mean* ± *SD*, scores)

Variables	Time	Conventional antihypertensive group (n=32)	Combined group (n=32)	*Difference 95%CI*	*P*	*Effect size (Cohen's d)*
MoCA scores	Before treatment	21.28±1.53	21.03±1.28	-0.46,0.96	0.481	0.177
	After treatment	23.16±1.46*	24.03±1.28*	-1.56,-0.19	0.013	-0.636
MMSE scores	Before treatment	24.22±1.48	24.41±1.41	-0.91,0.53	0.605	-0.130
	After treatment	25.25±1.39*	26.47±2.17*	-2.13,-0.30	0.010	-0.669

Note: *P<0.05 vs. before treatment; MoCA: Montreal cognitive assessment; MMSE: mini-mental state examination.

Table 6: Comparison of BP fluctuation ranges (*mean* ± *SD*, mmHg)

Variables	Time	Conventional antihypertensive group (n=32)	Combined group (n=32)	*Difference 95%CI*	*P*	*Effect size (Cohen's d)*
SBP	Before treatment	27.54±1.66	27.93±1.62	-1.21,0.42	0.340	-0.240
	After treatment	25.10±1.74*	21.87±1.48*	2.42,4.04	<0.001	1.998
DBP	Before treatment	16.24±1.33	16.61±1.24	-1.02,0.27	0.247	-0.292
	After treatment	12.93±1.64*	11.72±1.38*	0.45,1.97	0.002	0.799

Note: *P<0.05 vs. before treatment; BP: blood pressure; SBP: systolic blood pressure; DBP: diastolic blood pressure.

Table 7: Comparison of ADL scores (*mean* ± *SD*, scores)

Variables	Time	Conventional antihypertensive group (n=32)	Combined group (n=32)	*95%CI*	*P*	*Effect size (Cohen's d)*
ADL	Before treatment	48.88±3.07	49.88±2.90	-2.49,0.49	0.185	-0.335
	After treatment	32.03±3.25*	30.44±2.47*	0.15,3.04	0.031	0.552

Note: *P<0.05 vs. before treatment; ADL: activities of daily living.

Table 8: Comparison of SF-36 scores (*mean* ± *SD*, scores)

Variables	Time	Conventional antihypertensive group (n=32)	Combined group (n=32)	*Difference 95%CI*	*P*	*Effect size (Cohen's d)*
PCS	Before treatment	46.84±2.73	47.84±2.65	-2.34,0.34	0.142	-0.372
	After treatment	48.84±2.73*	52.91±1.91*	-5.24,-2.89	<0.001	-1.727
MCS	Before treatment	44.84±2.73	46.06±2.64	-2.56,0.12	0.074	-0.454
	After treatment	46.56±2.40*	52.97±2.07*	-7.53,-5.29	<0.001	-2.861

Note: *P<0.05 vs. before treatment; SF-36: short form 36; PCS: physical component summary; MCS: mental component summary.

Table 9: Comparison of MMAS-8 scores (*mean* ± *SD*, scores)

Variables	Time	Conventional antihypertensive group (n=32)	Combined group (n=32)	*Difference 95%CI*	*P*	*Effect size (Cohen's d)*
MMAS-8	Before treatment	5.47±1.24	5.52±1.18	-0.66,0.56	0.877	-0.039
	After treatment	6.44±1.19*	7.06±0.85*	-1.15,-0.11	0.019	-0.604

Note: *P<0.05 vs. before treatment; MMAS-8: 8-item Morisky medication adherence scale.

Table 10: Comparison of adverse events [*n(%)*]

Variables	Fatigue/Dizziness	Transient increase in BP	Accidental fall	Total
Conventional antihypertensive group (n=32)	0(0.0)	4(12.5)	4(12.5)	8(25.0)
Combined group(n=32)	2(6.3)	2(6.3)	1(3.1)	5(15.6)
P	-	-	-	0.351
Effect size (Cramer's V)	-	-	-	0.117

Currently, there are two core issues in the intervention for elderly hypertension complicated by MCI: (1) Most existing interventions focus on a single field, either controlling BP solely through medications or conducting cognitive training in isolation; (2) Intervention scenarios are mostly limited to tertiary hospitals and standardized intervention models relying on community elderly service resources are scarce. This leads to low intervention accessibility and insufficient patient participation. Against this backdrop, the study on the combination of cognitive impairment intervention courses and conventional antihypertensive treatment conducted in Huacao community holds significant practical significance for alleviating the disease burden of elderly hypertension complicated by MCI in Chinese communities.

The prevalence of MCI among elderly hypertensive patients in Huacao community is approximately 22.9%. Among the contributing factors, smoking, excessive alcohol consumption, physical inactivity and a diet high in fat, sugar and salt are identified as important risk factors. Compared with conventional antihypertensive therapy alone, the comprehensive intervention regimen combining conventional antihypertensive treatment with the cognitive impairment intervention course provided by the community elderly service center not only improves patients' cognitive function and narrows the range of BP fluctuations, but also more effectively enhances their quality of life, ADL and medication compliance. Furthermore, this combined regimen is comparable in safety to conventional antihypertensive therapy alone, with no statistically significant difference in the incidence of adverse events between the two groups.

This study recorded the prevalence of MCI to be 22.9%, which exceeds the 15-20% prevalence range reported in research conducted in other regions. This result requires comprehensive analysis in combination with the pathophysiological characteristics of elderly hypertension and the current status of health management for community populations. From the perspective of disease mechanisms, elderly hypertensive patients remain in a state of elevated BP for a long time, which leads to progressive damage to the structure and function of cerebral blood vessels. On one hand, sustained high BP causes thickening of the walls of small cerebral arteries and narrowing of their lumens, resulting in insufficient cerebral perfusion. This leads to disorders in neuronal energy metabolism and reduced synaptic transmission efficiency, ultimately impairing memory and executive functions (Ungvari *et al.*, 2021). On the other hand, hypertension activates the renin-angiotensin-aldosterone system (RAAS), promoting increased production of angiotensin II. This substance not only exacerbates vascular endothelial inflammatory responses but also crosses the blood-brain barrier to enter brain tissue, inducing the release of neuroinflammatory factors and accelerating neuronal apoptosis and cognitive decline (Hainsworth *et al.*, 2024). In addition, from the perspective of community population characteristics, psychosocial factors commonly present in the elderly community, such as loneliness and reduced social activities, may also indirectly exacerbate cognitive impairment by affecting neuroendocrine regulation. This finding corroborates the high prevalence of MCI observed in this study.

Smoking exerts dual toxicity that impairs cognitive function in elderly hypertensive patients. On one hand, nicotine in cigarettes can act directly on the central nervous system, activating the sympathetic nervous system and causing sudden increases and decreases in BP. This exacerbates fluctuations in cerebral hemodynamics and raises the risk of cerebral microinfarction and leukoaraiosis. On the other hand, harmful substances such as tar and carbon monoxide produced by tobacco combustion can damage vascular endothelial cells through oxidative stress, promote the formation of atherosclerotic plaques, reduce cerebral vascular elasticity and impair cerebral perfusion reserve function (Puri *et al.*, 2023). Alcohol-induced cognitive impairment manifests in multiple ways. Alcohol can directly inhibit the central nervous system, interfere with the synthesis and release of neurotransmitters and disrupt memory encoding and retrieval. Long-term alcohol consumption can also lead to vitamin B1 deficiency, triggering Wernicke encephalopathy and causing irreversible damage to cognition-related brain regions such as the thalamus and mammillary bodies (Puri *et al.*, 2023, Yen *et al.*, 2022). A cross-sectional study (Muhammad *et al.*, 2021) involving 9,453 participants showed that compared with non-smoking elderly individuals, smoking elderly individuals were 24% more likely to develop cognitive impairment [*OR*: 1.24, *CI*: 1.02, 1.49]. Additionally, elderly individuals who consumed alcohol were significantly 30% more likely to suffer from cognitive impairment [*OR*: 1.02, 1.65]. A diet high in fat, salt and sugar indirectly affects cognitive function. Dyslipidemia caused by a high-fat diet accelerates atherosclerosis; a high-salt diet exacerbates BP fluctuations; and insulin resistance induced by a high-sugar diet damages cerebral vascular endothelial cells (Hepsomali and Coxon, 2022, Cakir, 2025). These three factors act synergistically to further reduce cerebral perfusion and worsen neuronal damage. Regular physical activity exerts a protective effect on cognitive function. First, moderate exercise (such as brisk walking and tai chi) can increase cardiac output and cerebral blood flow, providing sufficient oxygen and glucose to neurons. Second, exercise stimulates the secretion of brain-derived neurotrophic factor (BDNF), which facilitates neuronal survival, synaptogenesis and neural circuit remodeling, playing a crucial regulatory role especially in hippocampal neurogenesis. A 3-year follow-up study (Palazuelos-Gonzalez *et al.*, 2025), which included 12,212 participants aged 45-86 years, found that sedentary behavior was associated with greater cognitive

decline across all cognitive domains (memory: $\beta = -0.061$, *95%CI*: −0.100, −0.021; executive function: $\beta = -0.049$, *95%CI*: −0.090, −0.008; global cognition: $\beta = -0.067$, *95%CI*: −0.106, −0.027), further verifying the hazards of insufficient physical activity.

The cognitive impairment community intervention courses offered by elderly service centers enhance cognitive function through targeted training. Memory training modules in the courses (such as number memory, memory anchoring and left-right brain function exercises) can repeatedly stimulate the hippocampus and prefrontal cortex, strengthen the synaptic connection intensity between neurons and promote the remodeling of neural circuits. Executive function games (including sentence-making, calculation and flash memory exercises) can improve the neural activity efficiency of the prefrontal cortex and enhance patients' attention and problem-solving abilities (Deckers *et al.*, 2024, Peral-Suarez *et al.*, 2025). In addition, the lifestyle education module (covering brain-healthy diets and healthy sleep) within the courses forms a synergistic effect with conventional antihypertensive treatment, may help reduce the range of BP fluctuations. On one hand, a brain-healthy diet reduces sodium intake and minimizes diurnal BP fluctuations; on the other hand, the courses guide patients to monitor their BP regularly, preventing sudden increases or decreases in BP. A randomized study (Blumenthal *et al.*, 2021) included 140 patients with resistant hypertension, a 4-month structured dietary program, when used as adjuvant therapy, could significantly reduce ambulatory BP, an effect similar to that observed in this study. Meanwhile, the improvement in cognitive function enhances patients' decision-making and executive abilities in daily activities such as dressing, eating and bathing, leading to a decrease in ADL scores. The improvement in quality of life stems from the dual enhancement of cognitive function and physical condition, as reflected by the simultaneous increase in PCS and MCS dimension scores in the SF-36 scale, forming a positive cycle of "cognition-function-quality of life". Meta-analysis (Sun *et al.*, 2024) used personalized health intervention manuals in community health services and found that they improved medication adherence in elderly patients with hypertension (P=0.001). Similarly, the cognitive impairment intervention courses at the elderly service center used in this study were shown to improve medication adherence in elderly hypertensive patients with MCI. In terms of safety, the content of the intervention courses (such as memory training and lifestyle guidance) involves no invasive procedures and has no interactions with conventional antihypertensive drugs. The two groups had no difference in adverse event incidence, confirming that this intervention program has good safety and providing an important basis for clinical promotion.

Critical evaluation of strengths and limitations

This study conducts an in-depth analysis of the associations between MCI and lifestyle. Incorporating lifestyle interventions into the comprehensive program demonstrates the selection of precise intervention targets. From a public health perspective, lifestyle factors are modifiable, cost-effective and easy to promote. Developing intervention measures targeting these factors can reduce the risk of MCI at its source. For instance, the brain-healthy diet plan in the course enables patients to practically adjust their daily dietary structure; by organizing exercise programs suitable for the elderly (such as finger exercises), the study enhances patients' participation in physical activities.

This study adopts a retrospective controlled design. Although it can analyze intervention effects through historical data, it is inevitably subject to bias risks. First, the retrospective design relies on previous questionnaires and patient recall. Some data (e.g., patients' past smoking duration, intensity of physical activity) may be incompletely recorded or affected by recall bias, which undermines the accuracy of risk factor analysis. Second, the retrospective design cannot implement random grouping and there may be unrecognized baseline differences between the two groups of patients. These confounding factors may interfere with the evaluation of intervention effects. This study enrolled 64 MCI patients, with a relatively small sample size. Additionally, no subgroup analysis was conducted, which may lead to insufficient statistical power and make it difficult to draw stable conclusions. Furthermore, the study is limited to Huacao community. The community's population structure, economic level and medical resource allocation may differ from those in other regions and these factors may make the intervention effects more likely to be observed. This study only evaluates the effects at the end of the intervention without long-term follow-up, so it cannot clarify the duration of the intervention effects or their impact on the progression of MCI to dementia. To address the above limitations, future studies can be optimized in the following three aspects: First, adopt a prospective randomized controlled design. Random grouping can reduce baseline confounding factors and blinded assessment can minimize evaluation bias. Second, expand the sample size and conduct multi-center studies. Including patients from communities in different regions with varying economic levels can improve sample representativeness. Meanwhile, ensuring the sample size meets the requirements for subgroup analysis will further clarify the differences in intervention effects among different populations. Third, improve the long-term follow-up mechanism. Setting multiple follow-up time points can evaluate the sustained impact of the intervention effects.

CONCLUSION

In summary, the comprehensive program combining cognitive impairment intervention courses at community

elderly service centers with conventional antihypertensive treatment can improve cognitive function, BP stability, ADL ability, quality of life and medication adherence in elderly hypertensive patients with MCI from multiple dimensions. It also demonstrates good safety and possesses adaptability for community promotion and value for collaborative application. Future multicenter, large-sample prospective studies can be conducted to further verify the conclusions of this study.

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Authors' contributions
Qiang Yi, Yu Pang: Developed and planned the study, performed experiments and interpreted results. Edited and refined the manuscript with a focus on critical intellectual contributions; Houyou Ding: Participated in collecting, assessing and interpreting the data. Made significant contributions to data interpretation and manuscript preparation; Qiang Yi, Yu Pang: Provided substantial intellectual input during the drafting and revision of the manuscript. All authors have read and approved the final manuscript.

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Data availability statement
All data generated or analysed during this study are included in this published article.

Ethical approval
This study was approved by the Ethics Committee of the Huacao Community Health Service Center with a waiver of informed consent granted (Ethics Approval Number: K2025-163).

Conflict of interest
The authors declare that they have no conflict of interest.

Consent to participate
We secured a signed informed consent form from every participant.

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