The Role of Lifestyle in the Association Between Cardiometabolic Disease Duration and Mild Cognitive Impairment: Postprint

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Abstract

Background: As population aging intensifies, the prevalence of cognitive dysfunction continues to rise, with cardiometabolic diseases being closely associated as significant influencing factors. Currently, research on the association between the duration of cardiometabolic diseases and mild cognitive impairment (MCI) is scarce, lacking comprehensive consideration of lifestyle factors and large-scale investigations in Chinese community-dwelling elderly populations. The comprehensiveness and reliability of such research require further validation.

Objective: To investigate the association between the duration of cardiometabolic diseases and MCI in the elderly, and to assess the potential role of lifestyle factors, thereby providing scientific evidence for MCI prevention and intervention.

Methods: Based on the Hubei Elderly Memory Cohort Study (HMACS), cluster sampling was employed to recruit elderly individuals aged $ $65 years from 3 communities in Wuhan city and 48 villages in Dawu County, Hubei Province, between 2018 and 2023. Cognitive function was assessed using standardized scales, and lifestyle was evaluated based on six factors: smoking, alcohol consumption, dietary habits, physical exercise, intellectual activities, and body mass index (BMI). The prevalence of MCI and its influencing factors were analyzed, and multivariate Logistic regression was conducted to examine the association between the duration of cardiometabolic diseases and MCI, as well as the effect of lifestyle on this association.

Results: A total of 8,635 subjects were included, with an MCI prevalence of 26.9% (2,322/8,635). MCI prevalence was significantly higher among elderly individuals who were female, aged >75 years, without a spouse, had low education levels, resided in rural areas, had abnormal BMI, engaged in no

physical exercise or intellectual activities, had depression, and suffered from cardiometabolic diseases (P<0.05). Multivariate Logistic regression analysis revealed that the duration of hypertension (OR=1.263, 95%CI=1.093~1.458, P=0.002), diabetes (OR=1.907, 95%CI=1.476~2.463, P<0.001), coronary heart disease (OR=1.550, 95%CI=1.173~2.047, P=0.002), and cerebrovascular disease (OR=2.129, 95%CI=1.627~2.786, P<0.001) were risk factors for MCI in the elderly. Among elderly individuals with disease duration >10 years (hypertension: OR=2.377, 95%CI=1.560~3.623, P<0.001; diabetes: OR=2.083, 95%CI=1.035~4.194, P=0.040; coronary heart disease: OR=1.778, 95%CI=1.079~2.930, P=0.024; cerebrovascular disease: OR=2.589, 95%CI=1.056~6.345, P=0.038), unhealthy lifestyle was identified as a risk factor for MCI.

Conclusion: Longer duration of cardiovascular disease in the elderly is associated with higher risk of MCI, with unhealthy lifestyle exacerbating this risk. Early lifestyle modification and effective management of cardiometabolic diseases are recommended to reduce MCI incidence.

Full Text

The Impact of Lifestyle on the Relationship Between Duration of Cardiovascular Metabolic Diseases and Mild Cognitive Impairment

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Abstract

Background: As population aging intensifies, the prevalence of cognitive dysfunction continues to rise annually. Cardiovascular metabolic diseases, as important influencing factors, are closely associated with cognitive dysfunction. Currently, research on the relationship between the duration of cardiovascular metabolic diseases and mild cognitive impairment (MCI) remains scarce, lacking comprehensive consideration of lifestyle factors and large-scale investigations among Chinese community-dwelling elderly populations. The comprehensiveness and reliability of existing research require further verification.

Objective: To investigate the association between the duration of cardiovascular metabolic diseases and MCI among older adults, and to evaluate the potential role of lifestyle factors in this relationship, thereby providing a scientific basis for MCI prevention and intervention.

Methods: Based on the Hubei Memory and Aging Cohort Study (HMACS), we employed cluster sampling to select elderly individuals aged $ $65 years from three communities in Wuhan City and 48 villages in Dawu County, Hubei Province between 2018 and 2023. Cognitive function was assessed using standardized scales, while lifestyle was evaluated across six domains: smoking, alcohol consumption, dietary habits, physical exercise, intellectual activities, and body mass index (BMI). We analyzed the prevalence of MCI and its influencing factors, and used multivariate logistic regression to examine the correlation between disease duration and MCI, as well as the moderating effect of lifestyle on this association.

Results: A total of 8,635 participants were included, with an MCI prevalence of 26.9% (2,322/8,635). Higher MCI prevalence was observed among women, individuals aged >75 years, those without a spouse, those with low education levels, rural residents, those with abnormal BMI, those lacking physical and intellectual activities, those with depression, and those with cardiovascular metabolic diseases (P<0.05). Multivariate logistic regression analysis revealed that longer disease duration for hypertension (OR=1.263, 95%CI=1.093~1.458, P=0.002), diabetes (OR=1.907, 95%CI=1.476~2.463, P<0.001), coronary heart disease (OR=1.550, 95%CI=1.173~2.047, P=0.002), and cerebrovascular disease (OR=2.129, 95%CI=1.627~2.786, P<0.001) were risk factors for MCI. Among elderly individuals with disease duration >10 years, an unhealthy lifestyle emerged as a significant risk factor for MCI (hypertension: OR=2.377, 95%CI=1.560~3.623, P<0.001; diabetes: OR=2.083, 95%CI=1.035~4.194, P=0.040; coronary heart disease: OR=1.778, 95%CI=1.079~2.930, P=0.024; cerebrovascular disease: OR=2.589, 95%CI=1.056~6.345, P=0.038).

Conclusion: Longer duration of cardiovascular metabolic diseases in older adults is associated with higher MCI risk, and unhealthy lifestyles exacerbate this risk. Early lifestyle modification and effective management of cardiovascular metabolic diseases are recommended to reduce MCI incidence.

Keywords: Cognitive impairment; Cardiovascular disease; Lifestyle; Disease duration; Influencing factor analysis

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Introduction

As population aging accelerates, cognitive dysfunction has become a major public health concern. It is estimated that approximately 38.77 million people in China suffer from mild cognitive impairment (MCI). MCI represents a state of cognitive decline between normal aging and dementia, characterized by mild

impairment in memory and other cognitive domains while daily living abilities remain intact. Identifying and intervening in high-risk MCI populations is crucial for preventing progression to dementia.

Previous research has demonstrated that cardiovascular metabolic diseases (including hypertension, diabetes, coronary heart disease, and cerebrovascular disease) in older adults are closely associated with cognitive decline, with increased disease duration further exacerbating this risk. Lifestyle represents another critical factor influencing both cardiovascular metabolic diseases and MCI in older adults. Unlike age, gender, or other non-modifiable factors, lifestyle can be modified through behavioral changes. However, the extent to which lifestyle influences the association between cardiovascular metabolic diseases and cognitive decline remains unclear, as most previous studies have focused on single lifestyle factors rather than comprehensive lifestyle patterns, and large-scale targeted investigations in community-dwelling elderly populations are scarce.

Therefore, this study, based on a large-scale community cross-sectional survey, aims to explore the association between the duration of cardiovascular metabolic diseases and MCI prevalence, and to further evaluate the potential moderating role of overall lifestyle patterns. Our findings will provide evidence for personalized interventions that modify lifestyle to reduce cardiovascular disease risk and cognitive dysfunction incidence.

Methods

1.1 Study Participants This study utilized baseline survey data from the Hubei Memory and Aging Cohort Study (HMACS) (Registration Number: ChiCTR1800019164). We collected cognitive screening data from 10,537 older adults aged $ $65 years across three communities in Wuhan City and 48 villages in Dawu County, Hubei Province between 2018 and 2023. Inclusion criteria were: (1) age $ $65 years; (2) clear consciousness and signed informed consent; (3) completion of sociodemographic survey and comprehensive cognitive assessment. Exclusion criteria were: (1) diagnosed dementia; (2) missing key indicators (including disease status, disease duration, smoking, alcohol consumption, dietary habits, physical exercise, intellectual activities, and cognitive assessment data). A total of 8,635 participants were ultimately included. The study was approved by the Ethics Committee of Wuhan University of Science and Technology (NO.201945), and all participants voluntarily enrolled.

1.2 Assessment Methods 1.2.1 General Characteristics Survey

We collected participants' sociodemographic characteristics (including gender, age, education level, marital status, and residence), personal medical history (including hypertension, diabetes, coronary heart disease, and cerebrovascular disease), and lifestyle information (including smoking, alcohol consumption, dietary habits, physical exercise, and intellectual activities). Clinical examinations included height, weight, blood pressure, head circumference, waist cir-

cumference, hip circumference, and internal medicine/surgery assessments. All clinical indicators were collected by community health examination centers and HMACS staff. Disease diagnoses and duration were self-reported by participants and confirmed by medical institutions.

1.2.2 Cognitive Function Assessment and Diagnosis

HMACS employed standardized scales for cognitive assessment: (1) Global cognitive function: Mini-Mental State Examination (MMSE, total score 30), assessing orientation, immediate recall, attention and calculation, delayed recall, and language. Normal cutoff scores: >17 for illiterate group, >20 for primary school group, >24 for junior high school and above group. Montreal Cognitive Assessment Basic Edition (MoCA-BC, total score 30), assessing executive function, immediate recall, language fluency, orientation, calculation, abstraction, delayed recall, visuospatial ability, naming, and attention. Normal cutoff scores: >19 for illiterate and primary school group, >22 for middle school group, >24 for college and above group. (2) Cognitive domain functions: Auditory Verbal Learning Test (AVLT), Shape Trails Test (STT-A&STT-B), Digit Span Test (DST), Boston Naming Test (BNT), Verbal Fluency Test (VFT), and Clock Drawing Task (CDT) assessed memory, executive function, attention, language, and visuospatial abilities. (3) Daily living abilities: Activity of Daily Living (ADL) scale. (4) Depression status: Geriatric Depression Scale (GDS-15).

MCI diagnosis followed Petersen' s criteria and the Chinese Dementia and Cognitive Impairment Guidelines: cognitive dysfunction reported by patient, informant, or experienced clinician; objective evidence of impairment in one or more cognitive domains (primarily based on MMSE and MoCA-BC scores 1.5 standard deviations below age- and education-matched normal controls); minimal impairment in complex instrumental activities but preserved independent daily living abilities; no dementia diagnosis.

1.2.3 Lifestyle Assessment

Lifestyle was evaluated across six domains: smoking, alcohol consumption, dietary habits, physical exercise, intellectual activities, and BMI. Criteria included: never smoking; no or moderate alcohol consumption ($ $25g/day for men, $ $14g/day for women, or never drinking$); $balanced diet (daily intake of vegetables, fruits, grains, and lean p
$25.0 kg/m^{2}$); $physical activity$($150 minutes/week of moderate exercise$); $intellectual activities$($30 minutes/day including reading, playing chess/cards, puzzle games, stock trading). Each met criterion scored 1 point, with total scores ranging 0-6 (higher scores indicating healthier lifestyle). Participants were categorized into three groups: unhealthy (0-2 points), moderate (3-4 points), and healthy (5-6 points).

1.2.4 Statistical Analysis

Statistical analysis was performed using SPSS 26.0. Continuous variables were expressed as ($\bar{x}\pm s$), categorical variables as percentages. Inter-group comparisons used ^{2} tests. Multivariate logistic regression models analyzed the association between disease duration and MCI prevalence, and the influence of differ-

ent lifestyle patterns on this association. All tests were two-tailed, with P<0.05 considered statistically significant. Missing values for confounding factors were imputed using multiple imputation.

Results

2.1 Comparison of General Characteristics and MCI Prevalence Among 8,635 participants, 4,020 (46.6%) were male and 4,615 (53.4%) female, with mean age (72.1$±$5.6) years. Overall MCI prevalence was 26.9%. Higher MCI prevalence was significantly associated with female gender, age >75 years, absence of spouse, low education level, rural residence, abnormal BMI, lack of physical and intellectual activities, smoking, depression, meat-based or vegetarian diets, and unhealthy lifestyle (P<0.05) .

2.2 Comparison of Disease Duration and MCI Prevalence Across Cardiovascular Metabolic Disease Groups In different cardiovascular metabolic disease groups, MCI prevalence was significantly higher in hypertension, diabetes, and cerebrovascular disease groups compared to non-diseased groups (P<0.05). Among subgroups with disease duration >10 years, MCI prevalence was significantly higher than in subgroups with duration $ $10 years for hypertension, diabetes, and cerebrovascular disease (P<0.05) .

2.3 Multivariate Logistic Regression Analysis of Disease Duration and MCI Using MCI status as the dependent variable (yes=1, no=0) and disease duration as the independent variable ($ $10 years=0, >10 years=1), multivariate logistic regression analysis adjusting for gender, age, residence, education, marital status, BMI, smoking, alcohol consumption, physical exercise, intellectual activities, dietary habits, depression, hypertension, diabetes, coronary heart disease, and cerebrovascular disease showed that longer disease duration for hypertension (OR=1.263, 95%CI=1.093~1.458, P=0.002), diabetes (OR=1.907, 95%CI=1.476~2.463, P<0.001), coronary heart disease (OR=1.550, 95%CI=1.173~2.047, P=0.002), and cerebrovascular disease (OR=2.129, 95%CI=1.627~2.786, P<0.001) were risk factors for MCI .

2.4 Influence of Lifestyle on the Association Between Disease Duration and MCI Combined analysis of disease duration and lifestyle revealed that in groups with disease duration >10 years (including diabetes, hypertension, coronary heart disease, and cerebrovascular disease) and groups with disease duration $ $10 years (including hypertension, coronary heart disease, and cerebrovascular disease), unhealthier lifestyle was associated with higher MCI prevalence (P<0.05). In the subgroup with diabetes duration $ $10 years, the moderate lifestyle group showed higher MCI prevalence than both healthy and unhealthy lifestyle groups, with statistically significant differences (P<0.05) .

Logistic regression analysis with MCI status as the dependent variable (yes=1, no=0) and lifestyle as the independent variable (healthy=1, mod-

erate=2, unhealthy=3), adjusting for gender, age, residence, education, marital status, depression, hypertension, diabetes, coronary heart disease, and cerebrovascular disease, demonstrated that: hypertension duration >10 years (moderate: OR=1.367, 95%CI=1.086~1.720, P=0.008; unhealthy: OR=2.377, 95%CI=1.560~3.623, P<0.001), diabetes duration >10 years (moderate: OR=1.688, 95%CI=1.134~2.514, P=0.010; unhealthy: OR=2.083, 95%CI=1.035~4.194, P=0.040), and coronary heart disease duration $ $10 years (moderate: OR=1.495, 95%CI=1.030~2.169, P=0.034; unhealthy: OR=2.062, 95%CI=1.155~3.682, P=0.014) were risk factors for MCI. Additionally, unhealthy lifestyle was a risk factor for coronary heart disease duration >10 years (OR=1.778, 95%CI=1.079~2.930, P=0.024), cerebrovascular disease duration $ $10 years (OR=2.589, 95%CI=1.056~6.345, P=0.038), and cerebrovascular disease duration >10 years (OR=2.589, 95%CI=1.056~6.345, P=0.038) .

Discussion

This study, based on cross-sectional survey data from urban and rural residents aged $ $65 years in Hubei Province, examined the influence of lifestyle on the association between cardiovascular metabolic disease duration and MCI. Among 8,635 surveyed individuals, the MCI prevalence of 26.9% was higher than results from a 2014 Changsha community survey (16.3%) and DENG et al.' s national survey (15.4%), as well as JIA et al.' s 2020 national survey of individuals aged $ $60 years (15.6%). These discrepancies may relate to differences in survey populations, age composition, and MCI diagnostic criteria, and may also indicate rising MCI prevalence among Chinese older adults.

Our findings that sociodemographic factors including female gender, age >75 years, absence of spouse, low education level, rural residence, abnormal BMI, lack of physical and intellectual activities, smoking, and depression were associated with higher MCI prevalence are consistent with previous studies. We further confirmed that longer disease duration, particularly >10 years, for hypertension, diabetes, and cerebrovascular disease significantly increases MCI risk, supporting findings from SINGH-MANOUX et al.

While previous research has demonstrated associations between individual lifestyle factors and MCI, most focused on single behaviors. For instance, Mediterranean diets rich in vegetables, fruits, whole grains, and healthy fats improve cognitive function and reduce MCI risk. Smoking induces oxidative stress and inflammation, impairing vascular health and reducing cerebral blood supply. Excessive alcohol consumption directly damages brain cells and indirectly harms cognitive health through liver dysfunction. Physical exercise enhances cerebral blood flow and cognitive function, while sedentary behavior increases chronic disease risk and cognitive impairment. Our study integrated lifestyle into a composite score to examine its combined effect with disease duration on MCI risk in cardiovascular disease populations. Results showed that both disease duration >10 years and unhealthy lifestyle significantly increased MCI risk across all four disease categories. Notably, among diabetic

patients with disease duration $ $10 years, the moderate lifestyle group showed higher MCI risk than both healthy and unhealthy lifestyle groups, possibly reflecting metabolic fluctuations, intermittent healthy behaviors, or transitional lifestyle changes that destabilize glycemic control and increase psychological burden, thereby elevating MCI risk. Multimorbidity in older adults affects cognition not only directly but also indirectly through medication side effects, psychological stress, depleted cognitive reserve, and social isolation.

This study has several limitations: (1) Cross-sectional design precludes establishing causal relationships; (2) Sample limited to Hubei Province reduces generalizability; (3) Reliance on self-reported data may introduce reporting bias; (4) Focus on individual disease durations without examining multimorbidity interactions; (5) Limited lifestyle indicators lacking comprehensive assessment of mental health, social activities, sleep quality, and stress management. Future longitudinal studies with objective measures, expanded lifestyle indicators, and broader geographic coverage are needed to establish causal relationships and enhance generalizability.

In conclusion, MCI prevalence is influenced not only by disease presence but also by cumulative disease duration, with unhealthy lifestyle further amplifying this risk. Unhealthy dietary patterns, smoking, excessive alcohol consumption, abnormal BMI, and lack of intellectual and physical activities are closely associated with increased MCI risk. Lifestyle interventions offer a promising strategy to reduce MCI risk, and cardiovascular metabolic disease patients should be encouraged to adopt healthy lifestyles to decrease future dementia risk. Personalized prevention and intervention strategies should consider specific disease characteristics, duration, and lifestyle patterns.

Author Contributions

LI Yiqing and CHENG Guirong conceptualized and designed the study, supervised implementation, and drafted the manuscript. LI Yiqing, XU Lang, HU Chenlu, and LI Chunli collected and organized data, performed statistical analysis, and prepared tables and figures. CHENG Guirong and XU Lang revised the manuscript. LI Luhan oversaw quality control, reviewed the article, and provided supervision.

Conflict of Interest

The authors declare no conflict of interest.

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Note: Figure translations are in progress. See original paper for figures.