Association of Qi-stagnation and Subjective Sleep Characteristics with Mild Cognitive Impairment Among Non-depressed Elderly in Community: A Cross-Sectional Study

Zhizhen Liu

Fujian University of Traditional Chinese Medicine <https://orcid.org/0000-0002-4594-0325>

Jingsong Wu

Fujian University of Traditional Chinese Medicine

Youze He

Fujian University of Traditional Chinese Medicine

Jingnan Tu

Fujian University of Traditional Chinese Medicine

Lei Cao

Fujian University of Traditional Chinese Medicine

Jia Huang

Fujian University of Traditional Chinese Medicine

Jing Tao

Fujian University of Traditional Chinese Medicine

Lidian Chen (✉ cld@fjtcn.edu.cn)

Fujian University of Traditional Chinese Medicine

Research

Keywords: Depression , sleep disturbance, mild cognitive impairment (MCI), Community

Posted Date: September 21st, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-895682/v1>

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Abstract

Objective: Depression and sleep disturbance is commonly reported in patients with mild cognitive impairment (MCI). However, it remains unclear whether Qi-stagnation is still a risk factor for MCI before the older adults suffer from depression. The purpose of this study was to examine the association between Qi-stagnation and subjective sleep quality with MCI among non-depressed elderly in the Chinese community.

Methods: A simple random sampling method was used to abstract research subjects from 34 community elderly day care centers in Fuzhou city based on their electronic health records from March 2019 to December 2020. Intensive face-to-face interviews were conducted using tools such as Montreal cognitive function assessment, AD8 dementia screening questionnaire, Pittsburgh Sleep Quality Index, and TCM constitution assessment scale, among others to analyze the proportion of older adults with MCI who suffer from sleep disturbance and Qi-stagnation in the community. Multi-factor logistical regression was employed to analyze the association among subjective sleep quality, TCM constitution, and MCI.

Results: A total of 1,268 subjects were investigated and 1,071 cases were included in this study, among which 314 cases were of MCI patients, with a morbidity of 29.3%. The proportion of individuals having Qi-deficiency (12.4%) and Qi-stagnation (11.1%) was higher in MCI patients than in the controls with normal cognitive function ($P<0.05$). After adjusting for age, gender, and years of education, the probability of the old with Qi-deficiency and Qi-stagnation suffering from MCI was 1.559 times [95% confidence interval (CI): 1.009–2.407] and 1.706 times (95% CI: 1.078–2.700) higher than that of the older adults without Qi-deficiency and Qi-stagnation, respectively. In the Pittsburgh sleep quality index (PSQI) scale, individuals with MCI had poorer subjective sleep quality ($Z=-3.404$, $P=0.001$), longer sleep latency ($Z=-3.398$, $P=0.001$), shorter sleep duration ($Z=-2.237$, $P=0.025$), and aggravated daytime dysfunction ($Z=-3.723$, $P<0.001$) compared with those without MCI. The intergroup differences showed no statistical significance in the three dimensions including habitual sleep efficiency, sleep disturbance, and hypnotics between groups. The results of multi-factor logistical regression showed that sleep latency [odds ratio (OR)=1.168, 95% CI: 1.016–1.342], daytime dysfunction (OR=1.261, 95% CI: 1.087–1.463), and Qi-stagnation (OR=1.449, 95% CI: 1.022–2.055) were the risk factors for MCI; the OR for older adults with sleep disturbance and Qi-stagnation suffering from MCI was 2.581 (95% CI 1.706–3.907).

Conclusion: MCI patients have a higher incidence of sleep disorders and Qi-stagnation, and may show specific changes in their daytime and nighttime sleep characteristics, with the specific manifestations such as difficulty in falling asleep, easily waking up at night/ early morning, and daytime dysfunction, among others.

Introduction

Patients with mild cognitive impairment (MCI) are at a high risk of developing Alzheimer's disease (AD) and other forms of dementia. In the current situation, given that dementia cannot be cured, early

prevention and control of the risk factors for cognitive decline are of particular importance. Previous studies have discovered that sleep quality is closely associated with MCI[1]. Levels of biomarkers, such as A β , tau, brain cell damage, and inflammation, are increased in the cerebrospinal fluid of AD patients with poor sleep quality, sleep disturbance, and daytime sleepiness [2]. Tranah et al. [3] conducted a longitudinal study including 1,282 healthy females in the American communities and found that elderly women with reduced activity rhythms (OR = 1.57; 95% CI: 1.09–2.25) are more likely to suffer from dementia or MCI. However, because of limitations concerning the extrapolation of factors such as race and gender, the observational studies on sleep characteristics and MCI in the Chinese elderly population need further in-depth investigation.

Differences in TCM constitutions affect the susceptibility of older adults to pathogenic factors and the tendency of disease morbidity, determining the association between a particular constitution and cognitive impairment[4]. Previous studies have indicated that Qi-stagnation in Chinese medicine is a constitution associated with a higher risk of depression and sleep disturbance[5]. At present, a bidirectional relationship between depression and sleep disturbance have been fully demonstrated, which has a definite connection with the subsequent decline in cognitive function. However, it remains unclear whether Qi-stagnation is still a risk factor for MCI before the older adults suffer from depression. If so, the specific sleep characteristics of the circadian rhythm that are associated with Qi-stagnation in older adults and their relationship with MCI are unclear.

To better clarify the association of Qi-stagnation and sleep quality with MCI, we investigated subjective sleep quality, Qi-stagnation exposure, and cognitive function level in older adults of the community of China. The research objectives were as follows: (1) to compare the incidence rate of sleep disturbance and Qi-stagnation in MCI patients in contrast with that in individuals with normal cognition; (2) to analyze the subjective sleep characteristics of patients with MCI and investigate the association of overall sleep quality, daytime dysfunction, time in bed, sleep duration, sleep disruption, and other characteristics with diseases of cognitive function as well as influencing factors. These findings will enrich the theoretical connotation of biased constitution-induced disease in TCM, and provide a basis for the medical personnel to formulate early prevention and treatment strategies for “adjustable constitution”, thus improving the sleep quality of the MCI population and delaying disease exacerbation.

Methods

Study design

This study is a cross-sectional survey. Based on the estimated sample size of the survey, a simple random sampling method was used to interview and investigate 34 community day care centers under the jurisdiction of Fuzhou City, Fujian Province, and 30–40 cases of elderly individuals were randomly selected from the health records of each day care center in the community. If the following situations occurred, re-sampling was conducted: (1) the selected individuals refuse to participate; (2) the archival

information is old or false; or (3) the selected individuals have died and therefore, the corresponding individuals cannot be contacted.

Study subjects

Individuals aged 55-75 years; those with permanent residence in communities of Fuzhou; those having normal activities of daily living and self-care or basic self-care ability; and those able to understand and cooperate, voluntarily participate, and sign the informed consent form were included in the analysis.

The exclusion criteria were as follows: (1) GDS-15 > 8 points[6], or a history of depression; (2) presence of brain tumors, Parkinson's disease, or other unstable internal medical diseases that can affect brain function or the assessment of cognitive function; (3) an acute disease history within the past 3 months; (4) current diagnosis of active epilepsy; (5) secondary disturbance of sleeping-waking rhythms caused by somatic diseases or mental disorders; and (6) rejection or poor cooperation with the research.

MCI diagnostic criteria were as follows[7]: (1) cognitive impairment reported by patients or informant, or detected by experienced clinicians; (2) objective evidence of impairments in one or more cognitive fields (from cognitive testing); (3) slight impairments in complex instrumental activities of daily living, but maintenance of the ability to independently lead daily life; and (4) No current diagnosis of dementia.

Sample size estimation

According to the literature, the prevalence rate of cognitive impairment in older adults staying at home and in nursing institutions for the aged in Fuzhou is 30.17%[8]. The test level α was set at 0.05, and the permissible error δ was 3%. The sample size according to the calculation formula was about 931 subjects. Considering the possibility that 15% of survey data are incomplete, the survey sample size was accordingly adjusted to be approximately 1,071.

The calculation formula for sample size is

$$n = \left\{ \frac{Z_{\alpha/2}}{\arcsin \left[\delta / \sqrt{P(1-P)} \right]} \right\}^2 .$$

Evaluation item

(1) General survey

Demographic data: age, gender, ethnicity, years of education, marital status, current state of residence, status of work, etc.

Behavior and lifestyle: diet structure, sports activities, social participation, etc.

Health status: This included self-reported smoking and drinking status, past medical history, and medication use and height, weight, BMI, and blood pressure as measured by the assessors.

The cardiovascular risk scoring was conducted according to the “Chinese ICVD 10-year Morbidity Risk Assessment Form” recommended in *Chinese Cardiovascular Disease Prevention Guidelines*[9]. Based on the levels of seven risk factors of subjects (age, gender, systolic blood pressure, body mass index, hypercholesterolemia, smoking status, and diabetes status), the total scores for cardiovascular risks were calculated.

(2) Cognitive function assessment

MoCA scale of Fuzhou version: The MoCA scale of Fuzhou version that has passed the reliability and validity test[10] was used to assess the subjects’ cognitive function in a face-to-face interview, involving eight cognitive fields: executive function, visual space structure, memory, attention, speech fluency, abstract ability, calculation ability, and orientation ability. The total score for the scale is 30 points; ≥ 24 points, and 19–24 points if the years of education are ≤ 6 years, indicate normal cognition, and 14–19 points indicate MCI[11].

AD8 Dementia Screening Scale: The AD8 Dementia Screening Scale was compiled by the University of Washington in 2005, which involves a total of eight items[12]. In its Chinese version, ≥ 2 points is considered as the cut-off value for cognitive dysfunction, with the sensitivity of 85.7% and the specificity of 77.6%[13]. The Chinese version of AD8 quicker and is convenient for the elderly to understand and self-assess. Accordingly, it is widely applied in non-specialist medical institutions such as communities and general medicine.

(3) Instrumental activity of daily living

The scale is compiled by Lawton et al., with good reliability and validity[14]. The scale involves eight items such as phone use, shopping, food cooking, housekeeping, clothes washing, transportation, drug administration, and financial management. The total score ranges between 0 and 23. The higher the score, the more complete the ability of daily living. A score that is 2 standard deviations less than the norm indicates that the ability of daily living is severely impaired[15].

(4) Subjective sleep quality assessment

The subjects completed the assessment of the Pittsburgh Sleep Quality Index (PSQI) through self-assessment[16]. Its Chinese version has passed the reliability and validity test[17]. The PSQI scale is composed of 19 self-assessment items, constituting seven dimensions such as sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, hypnotics, and daytime dysfunction. Each dimension is scored from 0 to 3, with a total score of 21 points. The higher the points, the worse the sleep quality. The result of 0-5 points indicates good sleep quality; points ≥ 6 indicate sleep disturbance.

(5) Determination of TCM constitution

The data of the surveyed subjects were collected according to the 33 items in the standard questionnaire of “TCM Service Record Sheet for the Elderly” issued by the State Administration of Traditional Chinese Medicine in 2013, and the results of constitution determination were analyzed. The types of TCM constitution included biased constitution (Qi deficiency, Yang deficiency, Yin deficiency, phlegm, damp-heat, blood stasis, Qi stagnation, and special constitution) and gentle constitution. Criteria for the identification of biased constitution were: “Yes” if the cumulative score of all items ≥ 11 ; “Tendency” if the cumulative score of all items =9-10; “No” if the cumulative score of all items ≤ 8 . Criteria for the identification of gentle constitution: “Yes” if the cumulative score of all items ≥ 17 and the final score of each of the other eight constitutions < 8 ; “Roughly yes” if the cumulative score of all items ≥ 17 and the final score of each of the other eight constitutions < 10 .

(6) Evaluation of the simplified geriatric depression scale

The geriatric depression scale has been simplified by Burke et al. [18], and the Cronbach's α coefficient for internal consistency in the Chinese version of the scale is 0.82[19]. The scale involves 15 items, among which items 1, 5, 7, 11, and 13 have negative scoring, and the remaining 10 items have positive scoring. A score of 0 or 1 point is given to each item, with the maximum score of 15 points. The higher the score, the more obvious the tendency of depression. If GDS-15 score is higher than 8 points, it indicates the existence of depressive symptoms.

Ethical approval and clinical trial registration

This study strictly follows “The Helsinki Declaration” by the World Medical Association and has passed the ethical review by the ethics committee of the Rehabilitation Hospital affiliated to Fujian University of Traditional Chinese Medicine (2019KY-002-02) and the Second Affiliated Hospital of Fujian University of Traditional Chinese Medicine (SPHFJP-K2019001-1). The research project is registered in the Chinese Clinical Trial Registry (<http://www.chictr.org.cn/index.aspx?ChiCTR2000039411>).

Statistical analysis

The SPSS 24.0 software was used for data processing and analysis. Independent sample t test was used for the intergroup comparison of measurement data conforming to the normal distribution; the Mann-Whitney U test was performed for the intergroup comparison of the measurement data not conforming to normal distribution; the χ^2 test was used for the intergroup comparison of disordered classification data; chi-square trend test and Wilcoxon test were used for the intergroup comparison of ranked data. Inspection level was set at $\alpha=0.05$. The binary logistical stepwise regression model was used to screen the influencing factors, and the OR value for relative risk of a single factor and the corresponding 95% confidence interval were obtained. The dependent variables were MCI events (binary classification), and the exposure variables were age, gender, years of education, BMI, ICVD, marital status, status of work, exercise, smoking, PSQI score, various sleep dimensions, and TCM constitution.

Based on the selected potential influencing factors, multi-factor logistical regression model was constructed:

- (1) Model 1: a crude model only with the exposure as independent variables;
- (2) Model 2: Based on of Model 1, the general demographic data such as age and the years of education were adjusted;
- (3) Model 3: A Fully adjusted model. Through the Directed Acyclic Graph (DAG) theory[20], the causal relationship network was explored to determine the independent variables that fit the model, with the focus on exploring the association of subjective sleep characteristics and Qi-stagnation with the MCI outcome (Figure 1). After the construction of different models, the Akaike information criterion (AIC) and Area Under the Curve (AUC) were calculated, and the AIC and AUC of different models were compared. The smaller the values of AIC and AUC, the better performance of the model.

The Delta method was employed to analyze the additive interaction between sleep disturbance and Qi-stagnation, and the obtained regression coefficient β for the independent factors and interactive items was substituted into the Excel table compiled by Andersson[21] to calculate the three important indices for the interaction strength of the additive model: relative excess risk due to interaction (RERI), attributable proportion due to interaction (AP), and Synergy index (S) as well as their 95% CI. When the 95% CI of RERI and AP does not contain 0, or the 95% CI of S does not contain 1, it is considered that an additive model interaction synergy exists.

Missing data processing: If the exposure factors (PSQI scale, TCM constitution scale) in the research hypothesis was missing without being evaluated, they were removed. For other missing data, the multiple imputation method was used to perform statistical analysis on the filled data.

Results

Characteristics of study subjects

From March 2019 to December 2020, a total of 1,821 subjects were recruited, among whom 1,268 subjects completed the assessment, and 181 subjects without Pittsburgh sleep scale data and 37 without TCM constitution scale data were excluded. Finally, 1,071 cases were included in the statistical analysis, with the research flowchart shown in Figure 2.

Among the 1,071 study subjects, 314 suffered from MCI, with the prevalence rate of 29.3%. Compared with the control group with normal cognition, the subjects with MCI were more likely to be females, who had a lower educational level and working status, and a higher proportion of them were widows and lived with children. The MCI group shows more types of combined chronic diseases. Compared with the control group with normal cognition (45.6%), the MCI group showed a higher possibility of suffering from sleep disturbance (57.6%), and the intergroup differences were statistically significant ($P < 0.05$), as shown in Table 1.

TCM constitution distribution of MCI patients

The proportion of MCI patients with Qi-deficiency (12.4%) and Qi-stagnation (11.1%) was higher than that of normal controls ($P < 0.05$). After correcting for age and years of education, individuals with Qi-deficiency and Qi-stagnation presented increased risk of MCI, with the OR (95% CI) of 1.559 (1.009-2.407) and 1.706 (1.078-2.700), respectively, as shown in Table 2.

Subjective sleep quality of MCI patients

With regard to the sleep characteristics as per the PSQI scale with sub-dimensions, the subjective sleep quality of individuals with MCI was poorer ($Z = -3.404$, $P = 0.001$), with prolonged sleep latency ($Z = -3.398$, $P = 0.001$), shortened sleep duration ($Z = -2.237$, $P = 0.025$), and aggravated daytime dysfunction ($Z = -3.723$, $P = 0.001$), than that of individuals with normal cognition. However, the differences in the three dimensions of sleep efficiency, nighttime sleep disturbances, and hypnotics were not statistically significant (Table 3).

Multi-factor analysis of the influence of sleep characteristics and Qi-stagnation on MCI

Multi-factor logistical regression was conducted on the screened single-factor variables. Among them, Qi-deficiency and daytime dysfunction represented similar scale items, with a moderate rank correlation between the two variables ($r_s = 0.436$, $P < 0.001$). Therefore, only select daytime dysfunction was selected to be included in the models. The results in Table 4 show that the dangerous effect of sleep duration on MCI was replaced by sleep latency, daytime dysfunction, and Qi-stagnation; therefore, it was not included in the models. In Model 1, sleep latency (OR=1.181, 95% CI: 1.035–1.347), daytime dysfunction

(OR=1.197, 95% CI: 1.039–1.379), and Qi-stagnation (OR=1.436, 95% CI: 1.031–1.999) were included in the core index set. The OR values for corrected Model 2 and Model 3 did not change significantly, indicating that the results are robust.

Analysis of the additive interaction effect of Qi-stagnation and sleep quality on MCI

Considering the bidirectional effect of sleep and mood, and taking MCI as the dependent variable and the sleep disturbance and Qi-stagnation as independent variables, the interaction of sleep disturbance and Qi-stagnation with MCI was further analyzed through logistic regression, after controlling the confounding factors of age, gender, and education level. The results in Table 5 show that the risk of suffering from MCI for older adults with sleep disturbance and Qi-stagnation was 2.581 times higher than that for those without sleep disturbance or Qi-stagnation, with RERI=0.167 [95% CI: (-1.154, 1.488)], AP=0.065 [95% CI (-0.434, 0.564)], and S=1.118 [95% CI (0.456, 2.741)], indicating that sleep quality and Qi-stagnation have no synergistic effect on the occurrence of MCI in the elderly.

Discussion

The study in this paper investigated the correlation between the subjective sleep quality and MCI among 1,071 older adults without depression in the community in Fuzhou. The research results verify the research hypothesis. Compared with the control group with normal cognitions, older adults with MCI have a higher prevalence of sleep disturbance (57.6%) and Qi-stagnation (11.1%). The risk of MCI occurrence was 1.625 times higher than that of sleep problems. This ratio is comparable to the result of 1.68 times reported in a systematic review and meta-analysis[22].

The TCM constitution refers to the comprehensive and relatively stable intrinsic characteristics in terms of morphological structure, physiological function, and psychological state of the human body in the course of life, which is formed on the basis of congenital endowments and acquired in the postnatal period[23]. The differences in individuals' constitution determine the differences in their susceptibility to and tendency of suffering from certain diseases. Therefore, they show differences in the time of cognitive impairment. Accordingly, delaying the cognitive impairment should follow the principle of taking measures suited to individual conditions[24]. According to the research in this study, it was found that the risk of MCI among older adults with sleep disturbances and Qi-stagnation is 2.581 times higher than that among normal controls. Those with MCI may suffer from a more serious sleep disturbance, and their daytime and nighttime sleep rhythms may have undergone specific changes, which is especially manifested as having difficulty falling asleep, being easy to wake or wake earlier at night, and having daytime dysfunction and is related to the Qi-stagnation physique. However, sleep quality and Qi-stagnation have no interactive synergistic effect on the onset of MCI among older adults.

Consistent with the results of previous studies, yin-yang maladjustment and ying-wei disharmony are the main pathogenesis of insomnia, with Qi-stagnation[25]. If not adjusted in a timely manner, this can lead to an introvert personality, emotional instability, sentimentality, depression, and anxiety in individuals. Thus, these individuals often have the symptom of hyperarousal, resulting in difficulty in falling asleep, cognitive decline, as well as MCI[26]. A previous meta-analysis[27] report indicated that the prevalence rate of MCI patients with the complication of depression from community source samples was 25% (95% CI: 19–30). Relatively stable Qi-stagnation and low mood are closely associated with sleep disturbances, which mediate the deterioration of the disease in cognitive impairment[28].

However, although Qi-stagnation is a risk factor for MCI patients, Qi-stagnation combined with sleep disturbance does not have a synergistic effect on the occurrence of MCI. Compared with the formed relatively stable depression, Qi-stagnation is adjusted in a timely manner to improve the sleep quality, the occurrence of MCI can be prevented. Some studies have reported that Qi-stagnation can significantly and positively predict depression in older adults, and has a direct impact on depression in older adults (95% CI: 0.017–0.249), with the relative effect value of 24.01%[29]. A series of studies conducted by the California Pacific Medical Center[30] evaluated the depressive symptoms among 3,020 older women. Their Circadian rhythms were measured by wrist activity tractography, and it was found that the higher the level of depressive symptoms, the less synchronous the Circadian rhythms. Higher scores for depression are associated with decreased diurnal amplitudes (height df = 3014, $t = -11.31$, linear trend $p < 0.001$). Among the evaluated women, 1282 were followed up for 4.9 years[31]; of these 195 (15%) suffered from dementia and 302 (24%) suffered from MCI. The amplitude of Circadian rhythms was reduced, and the risk of dementia and MCI among elderly healthy women with delayed rhythms was increased.

The strong association between Qi-stagnation and sleep disturbance reminds healthcare workers to evaluate mood and sleep status of individuals with MCI. Ignoring any symptom will cause patients with MCI to fall into a vicious cycle of low mood and lack of sleep. The important effects of Qi-stagnation and depressive symptoms on sleep disturbance among individuals with MCI can also be treated through the adoption of evidence-based psychological interventions (including cognitive behavioral therapy, supportive psychotherapy, problem-solving therapy, and interpersonal therapy). Based on the theories of “body recuperation and preventive treatment of diseases” including “body-disease correlation,” “adjustable constitution,” and “body regulation intervention,” regulating the body is proposed to improve the state of Qi-stagnation, thus providing reference and guidance for the early prevention and clinical intervention of MCI[32].

This study has several limitations. First, the cross-sectional design of this study fails to determine the direction of the relationship. A longitudinal study design should be performed to further verify the causal inference of the research results of this study in future studies. Second, because of the limitation of manpower and material resources, although the research sites involve the community daycare centers in the six districts and counties under the jurisdiction of Fuzhou City, the method of simple random sampling may result in uncertainties in the parameter estimation results. Hence, stricter random sampling

methods are required to be employed in future studies to enhance the universality of research results. Third, limited by the sample size, only the relationships of main TCM constitution and sleep disturbance with MCI was investigated in this study. However, the effects of ambidextrous TCM constitution on sleep quality and cognitive disturbance need to be further explored to more comprehensively evaluate the prediction model. Finally, only subjective sleep exposure is used in this study. In exploring the correlation of sleep with MCI, other objective sleep-related indices should be tested as independent variables in future models.

Conclusion

MCI patients have a high incidence of sleep disturbance and Qi-stagnation, and their Circadian sleep rhythms may show specific changes, especially manifested as having difficulty falling asleep, being easy to wake at night, waking up early, and daytime dysfunction.

Abbreviations

TCM constitution:

Traditional Chinese medicine constitution

PSQI:

Pittsburgh Sleep Quality Index

MCI

Mild Cognitive Impairment

MoCA:

Montreal Cognitive Assessment

GDS-15:

The Geriatric Depression Scale

Declarations

Ethics approval and consent to participate

This study has passed the ethical review by the ethics committee of the Rehabilitation Hospital affiliated to Fujian University of Traditional Chinese Medicine (2019KY-002-02) and the Second Affiliated Hospital of Fujian University of Traditional Chinese Medicine (SPHFJP-K2019001-1). Written informed consent was obtained from all participants prior to questionnaire administration.

Consent for publication

All the authors listed have read the manuscript and approved for the submission. All authors have contributed to and agreed with the content of the manuscript.

Availability of data and materials

The data used and/or analyzed during the study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

This study is funded by the National Natural Science Foundation of China (Grant No. 81973928) and Central Government Guides Local Science and Technology Development Fund Projects of Fujian Province (Grant No. 2020L3013).

Authors' contributions

Zhizhen Liu: Performed the experiment, Data analysis, Writing- Reviewing and Editing.

Jingsong Wu: Performed the experiment

Youze He, Jingnan Tu and Lei Cao: Data curation

Jia Huang: Methodology, performed the experiment

Jing Tao: Project administration, Funding acquisition.

Lidian Chen: Project administration, Supervision.

All authors had read and approved the final manuscript.

Acknowledgements

We would like to thank all participants in the study, all the staffs for coordinating the work and all investigators for data collection.

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Tables

Table 1

Comparison of the distribution of general demographic data between the two groups (n=1071)

Items	Mild cognitive impairment		z/ χ^2	P-value
	No(n=757)	Yes(n=314)		
Female n(%)	487(64.3)	215(68.5)	1.683	0.195
Age year, M(IQR)	65(9.0)	66(9)	-1.357	0.175
Education year, M(IQR)	11(5.0)	9(4.5)	-7.615	0.001
Current Marital Status n(%)				
Married with a living spouse	674(89.0)	264(84.1)	5.745	0.057
Married and widowed	65(8.6)	42(13.4)		
Unmarried or divorced	18(2.4)	8(2.5)		
Current living status ^a n(%)				
Living alone	33(3.5)	17(3.9)	7.894	0.096
Living with spouse	527(55.8)	232(53.8)		
Living with children	355(37.6)	177(41.1)		
Live with friends and relatives	29(3.1)	5(1.2)		
Current working status n(%)	83(11.0)	23(7.3)	3.244	0.072
Current systolic blood pressure (mmHg) M(IQR)	126(18)	125(15)	-0.251	0.802
Current diastolic blood pressure (mmHg) M(IQR)	78(14)	80(15)	-0.510	0.610
BMI (kg/m ²) Mean(SD)	23.7(3.0)	23.8(3.2)	-0.278	0.781
Smoking status (%)				
Never	649(85.7)	279(88.9)	2.867	0.413
Quit smoking	35(4.6)	13(4.1)		
Rarely (<1 time/week)	19(2.5)	8(2.5)		
Often	54(7.1)	14(4.5)		
Drinking status(%)				
Never	598(79.0)	239(76.1)	2.011	0.570
Quit drinking	13(1.7)	9(2.9)		
Rarely (<1 time/week)	116(15.3)	52(16.6)		
Often	30(4.0)	14(4.5)		
Dietary habit n(%)				

Preference for meat	43(6.7)	17(5.8)	0.860	0.835
Preference for vegetarian food	136(21.1)	68(23.1)		
Meat and vegetable balance	466(72.3)	209(71.1)		
Physical Activity (times per week)				
≤1 time	14(1.8)	4(1.3)	2.259	0.323
1-3 times	99(13.1)	32(10.2)		
≥3 times	644(85.1)	278(88.5)		
ICVD scores	7(4)	7(4)	-1.296	0.195
Types of combined chronic diseases				
2 types or less	614(95.5)	273(93.5)	1.644	0.200
2 or more	29(4.5)	19(6.5)		
GDS-15 scores M(IQR)	2(3)	3(3)	-5.337	0.001
Sleep disturbance n(%)	345(45.6)	181(57.6)	12.935	0.001
AD8 scores M(IQR)	1(2)	3(2)	-15.449	0.001
Moca scores M(IQR)	24(5)	18(6)	-18.309	0.001
Note: ^a Current residence is multiple choice; M(IQR), median (inter-quartile range)				

Table 2

Comparison of distribution of various TCM constitution between the two groups (n=1071)

TCM constitution		Mild cognitive impairment		Z	P-value	OR(95%CI)*
n(%)		No(n=757)	Yes(n=314)			
Qi-deficiency	Yes	69(9.1)	39(12.4)	-2.609	0.009	1.559(1.009-2.407)
Trend		107(14.1)	58(18.5)			1.431(0.993-2.063)
No		581(76.8)	217(69.1)			Reference
Yang-deficiency	Yes	204(26.9)	77(24.5)	-0.505	0.613	1.075(0.777-1.488)
Trend		80(10.6)	52(16.6)			1.756(1.174-2.627)
No		473(62.5)	185(58.9)			Reference
Yin-deficiency	Yes	238(31.4)	115(36.6)	-1.692	0.091	1.307(0.960-1.780)
Trend		164(21.7)	67(21.3)			1.191(0.833-1.702)
No		355(46.9)	132(42.0)			Reference
Phlegm-dampness	Yes	225(29.7)	88(28.0)	-0.484	0.628	0.862(0.625-1.190)
Trend		158(20.9)	67(21.3)			0.947(0.665-1.347)
No		374(49.4)	159(50.6)			Reference
Dampness-heat	Yes	72(9.5)	28(8.9)	-0.440	0.660	1.044(0.648-1.681)
Trend		111(14.7)	44(14.0)			1.054(0.712-1.559)
No		574(75.8)	242(77.1)			Reference
Blood-stasis	Yes	74(9.8)	39(12.4)	-1.519	0.129	1.386(0.895-2.145)
Trend		148(19.6)	67(21.3)			1.112(0.791-1.565)
No		535(70.7)	208(66.2)			Reference
Qi-stagnation	Yes	61(8.1)	35(11.1)	-3.247	0.001	1.706(1.078-2.700)
Trend		67(8.9)	46(14.6)			1.837(1.210-2.791)
No		629(83.1)	233(74.2)			Reference
Special constitution	Yes	40(5.3)	17(5.4)	-0.194	0.846	1.164(0.636-2.133)
Trend		65(8.6)	25(8.0)			1.034(0.629-1.700)
No		652(86.1)	272(86.6)			Reference
Balance	Yes	750(99.1)	312(99.4)	-0.466	0.641	Reference
Trend		6(0.8)	1(0.3)			0.401(0.048-3.368)
No		1(0.1)	1(0.3)			3.207(0.199-51.647)

Table 3

Comparison of Pittsburgh sleep quality index scores between the two groups (n=1071)

Items	Mild cognitive impairment		Z	P-value
	No(n=757)	Yes(n=314)		
Subjective sleep quality	0.93(0.73)	1.11(0.78)	-3.404	0.001
Sleep latency	0.99(0.99)	1.23(1.05)	-3.398	0.001
Sleep duration	1.03(0.98)	1.18(1.03)	-2.237	0.025
Habitual sleep efficiency	0.67(1.00)	0.71(1.02)	-0.641	0.522
Nighttime Sleep disturbances	1.21(0.52)	1.26(0.53)	-0.426	0.670
Use of sleep medication	0.08(0.42)	0.09(0.44)	-1.168	0.243
Daytime dysfunction	0.99(0.92)	1.23(0.99)	-3.723	0.001
PSQI score	5.90(3.63)	6.82(3.66)	-4.102	0.001

Table 4

Multivariate Logistic regression analysis of Qi-stagnation and sleep characteristics influencing MCI in elderly people (n=1071)

Items	Model 1		Model 2		Model 3	
	Beta	OR(95%CI)	Beta	OR(95%CI)	Beta	OR(95%CI)
Qi-stagnation	0.362	1.436 (1.031,1.999)	0.393	1.481 (1.000,1.049)	0.371	1.449 (1.022,2.055)
Sleep latency	0.166	1.181 (1.035,1.347)	0.155	1.168 (1.021,1.337)	0.155	1.168 (1.016,1.342)
Daytime dysfunction	0.180	1.197 (1.039,1.379)	0.218	1.244 (1.074,1.440)	0.232	1.261 (1.087,1.463)
AIC	1278.4		1225.2		1234.6	
AUC	0.602		0.682		0.683	
Note: Model 1: crude model with only the exposure as an independent variable; model 2: additionally adjusted for age, sex and education; model 3: a fully adjusted model including all variables suggested by the DAG.						

Table 5

Additive interactive effect of Qi-stagnation and sleep disturbance on MCI in elderly (n=1071)

Sleep disturbance	Qi-stagnation	β	SE	Wald χ^2	OR (95% CI)	P-value
Yes	Yes	0.948	0.211	20.115	2.581 (1.706 to 3.907)	<0.001
Yes	No	0.520	0.159	10.672	1.681 (1.231 to 2.296)	0.001
No	Yes	0.549	0.285	3.702	1.731 (1.000 to 3.028)	0.050
Note* Age, sex, education were adjusted in the models						

Figures

Figure 1

Directed Acyclic Graph

Figure 2

Flow diagram of the study