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Analysis of the current status and influencing factors of cognitive frailty among community-dwelling older adults with olfactory impairment: a cross-sectional study

Liu Jie

ccucmliujie@163.com

Changchun University of Chinese Medicine

Ma Shuang

Affiliated Hospital of Changchun University of Traditional Chinese Medicine

Li Jian

Affiliated Hospital of Changchun University of Traditional Chinese Medicine

Zhang Jingzhou

Affiliated Hospital of Changchun University of Traditional Chinese Medicine

Hou Yiting

The First Hospital of Jilin University

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Abstract

Background To explore the influencing factors of cognitive frailty among community-dwelling older adults with olfactory impairment.

Methods: Convenience sampling was adopted to recruit 419 elderly individuals with olfactory impairment from three communities in Changchun City between March 2025 and March 2026. Multiple assessment tools were used for data collection, including a general information questionnaire, Fried Frailty Phenotype Scale, Chinese version of the Montreal Cognitive Assessment, Family APGAR Index, Short Form Mini Nutritional Assessment, Sarcopenia Assessment Scale, Short Geriatric Depression Scale, Oral Frailty Index-8, and Pittsburgh Sleep Quality Index. Multivariate Logistic regression analysis was applied to identify the influencing factors of cognitive frailty in community-dwelling older adults with olfactory impairment.

Results: Among the 419 older adults with olfactory impairment, 102 were diagnosed with cognitive frailty, accounting for 24.34%. There were statistically significant differences in age, gender, marital status, as well as the prevalence of sarcopenia, nutritional risk, oral frailty, and sleep efficiency between the two groups ($P < 0.05$). Multivariate Logistic regression analysis indicated that unmarried status, sarcopenia, nutritional risk, and high risk of oral frailty were independent risk factors for cognitive frailty ($P < 0.05$).

Conclusions: The incidence of cognitive frailty is relatively high among community-dwelling older adults with olfactory impairment, which is affected by multiple factors. Therefore, community administrators should attach importance to the screening and assessment of cognitive frailty in high-risk groups. Targeted interventions based on relevant influencing factors should be implemented timely to prevent and delay the occurrence and progression of cognitive frailty.

Introduction

As a common sensory disorder, olfactory impairment (OI) currently affects approximately one-fifth of the global population[1, 2]. It not only interferes with elderly individuals' personal hygiene management, food selection, and gas safety judgment but also significantly impairs their mental health status and quality of life, causing considerable inconvenience to their daily lives[3]. With the acceleration of population aging, cognitive frailty (CF), a unique syndrome in the elderly, is closely associated with the onset of cognitive impairment and dementia and has become a major public health issue threatening the health of older adults[4].

In recent years, multiple longitudinal studies have demonstrated that individuals with olfactory impairment at baseline have a markedly elevated subsequent risk of cognitive decline and dementia[5, 6]. Relevant research indicates that patients with olfactory impairment have a 2.06 times higher risk of cognitive decline than healthy individuals, and each 10% reduction in the olfactory function score is associated with an 18% increase in the risk of cognitive decline[7]. Additional studies have shown that

the majority of patients with Alzheimer's disease (AD) and Parkinson's disease (PD) have comorbid olfactory impairment[7, 8].

At present, the causal association between olfactory impairment and cognitive frailty remains unclear. It is still undetermined whether olfactory impairment is a secondary consequence of underlying neurodegeneration or a risk factor that induces neurodegeneration. Community-dwelling older adults represent a high-risk group for both olfactory impairment and cognitive frailty. Nevertheless, studies focusing on the prevalence of cognitive frailty among community-dwelling older adults with olfactory impairment, the correlation between the two conditions, and the influencing factors related to both conditions are still scarce. This scarcity fails to meet the demands of clinical intervention and public health prevention and control. Based on the above background, this study targets community-dwelling older adults with olfactory impairment, aiming to investigate the prevalence of cognitive frailty and analyze its relevant influencing factors.

Methods

Study population

A total of 419 older adults with olfactory impairment were recruited from three communities in Changchun City between March 2025 and March 2026 using a convenience sampling method. Inclusion criteria: (1) Permanent community residents aged 60 years and above; (2) Diagnosed with olfactory impairment with a total score of less than 31 points across the threshold, discrimination, and identification subtests of the Sniffin'Sticks olfactory test; (3) Clear consciousness and capable of cooperating with general demographic investigation, olfactory function evaluation, Fried frailty phenotype assessment, cognitive function testing, and other related evaluations; (4) Signed the informed consent form voluntarily and agreed to participate in this study. Exclusion criteria: (1) Those diagnosed with Alzheimer’s disease or other types of dementia, as well as individuals with other organic neurological diseases such as Parkinson’s disease and multiple sclerosis; (2) Those with mental or substance dependence including drug addiction and alcohol dependence, which may affect cognitive and olfactory function; (3) Those with severe visual and auditory impairment, aphasia, or other conditions that prevent completion of interviews and assessments; (4) Those suffering from upper respiratory tract infection, allergic rhinitis, acute sinusitis, or other diseases that may temporarily affect olfactory function within the past one month; (5) Those with severe physical dysfunction or long-term bedridden status who cannot complete physical function assessment and nutritional status assessment.

Diagnostic criteria

(1) Olfactory impairment was defined as a total score < 31 points on the Sniffin' Sticks olfactory test[9], which consists of three subtests: olfactory threshold, olfactory discrimination, and olfactory

identification. The total score of the three subtests ranges from 0 to 48 points. A total score ≥ 31 points indicates normal olfactory function, while a total score < 31 points indicates olfactory impairment.

(2) Cognitive frailty was defined as the simultaneous presence of physical frailty and mild cognitive impairment. Physical frailty was evaluated by the Fried Frailty Phenotype (FFP), developed by Fried et al. [10] in 2001. The scale includes five items: unintentional weight loss, slowed walking speed, reduced grip strength, decreased daily physical activity, and self-reported exhaustion. The total score ranges from 0 to 5 points; a score ≥ 3 points indicates frailty; 1–2 points indicates pre-frailty; and 0 points indicates non-frailty. The Cronbach's α coefficient of the scale is 0.936. Mild cognitive impairment was assessed using the Chinese version of the Montreal Cognitive Assessment (MoCA), which was cross-culturally adapted and validated by Zhang Lixiu et al.[11]. The total score is 30 points; a score below 26 points indicates mild cognitive impairment, with a cutoff of less than 25 points for participants with ≤ 12 years of education. The Cronbach's α coefficient of the Chinese MoCA is 0.818.

Data collection

(1) General information questionnaire

The questionnaire was self-designed by the researcher on the basis of literature review. It mainly includes self-reported data on age, gender, marital status, educational level, monthly income, living arrangement, regular exercise, smoking status, and drinking status, as well as measured grip strength and body mass index (BMI).

(2) Family APGAR index (APGAR)

The family APGAR index was developed by Smilkstein et al.[12]. It consists of five dimensions: family adaptability, partnership, growth, affection, and resolve. The total score ranges from 0 to 10 points. A score of ≥ 7 points indicates good family function; 4–6 points suggests mild to moderate family dysfunction; and 0–3 points represents severe family dysfunction. The Cronbach's α coefficient of this scale is 0.857.

(3) Mini nutritional assessment-short form (MNA-SF)

The MNA-SF was developed by Rubenstein et al.[13]. The scale comprises six core dimensions: appetite and dietary intake changes, weight loss, mobility, psychological problems, acute disease or stress, and anthropometric measurement (BMI or calf circumference). The total score ranges from 0 to 14 points. Scores of 12–14 points indicate normal nutritional status; 8–11 points suggest risk of malnutrition; and 0–7 points indicate malnutrition. The Cronbach's α coefficient of the scale is 0.840.

(4) Modified sarcopenia-five combined with calf circumference (SARC-CalF)

The SARC-CalF scale was developed by Barbosa-Silva et al.[14] on the basis of the original SARC-F scale by adding calf circumference measurement. The total score of the scale is 20 points. A total score of ≥

11 points on SARC-CalF, which typically indicates concurrent low muscle function (at least 1 point) and low muscle mass (10 points), is considered positive for sarcopenia screening or indicates a risk of sarcopenia. The Cronbach's α coefficient of the scale is 0.803.

(5) 5-item geriatric depression scale (GDS-5)

The GDS-5 was developed by Hoyl et al.[15]. The total score of the scale is 5 points. A score of ≥ 2 points indicates the presence of depressive symptoms, with higher scores reflecting more severe depressive symptoms. The Cronbach's α coefficient of the scale is 0.840.

(6) Oral frailty index-8 (OFI-8)

The OFI-8 was compiled by Tanaka et al.[16]. The scale consists of 8 items: inability to eat dry and hard food, history of choking, use of dentures, xerostomia, reduced frequency of going out, difficulty in chewing hard food, brushing teeth less than twice a day, and receiving dental examination less than once a year. The total score ranges from 0 to 11 points, with higher scores indicating poorer oral health status. Scores of 0–2 points represent low risk, a score of 3 points indicates moderate risk, and scores of 4 points and above are defined as high risk. The Cronbach's α coefficient of the scale is 0.949.

(7) Pittsburgh Sleep Quality Index (PSQI)

The PSQI was developed by Buysse et al.[17]. It comprises seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The total score ranges from 0 to 21 points, and sleep quality is categorized as good (0–5 points), fair (6–10 points), or poor (11–21 points). Higher scores indicate worse sleep quality. The Cronbach's α coefficient of the scale is 0.852.

Statistical analysis

SPSS 26.0 was used for data analysis. Normally distributed measurement data were expressed as mean ± standard deviation ($\bar{x} \pm s$), and the independent-samples t-test was adopted for comparison between two groups. Non-normally distributed measurement data were expressed as median (M) and interquartile range (P25, P75), while the Mann-Whitney U test was applied for comparison. Enumeration data were presented as case numbers and percentages, and the chi-square (χ^2) test was used for comparison. Multivariate logistic regression analysis was performed to explore the influencing factors of cognitive frailty in community-dwelling elderly individuals with olfactory impairment. A P-value less than 0.05 was considered statistically significant.

Results

Univariate analysis of factors associated with cognitive frailty in community-dwelling older adults with olfactory

impairment

Among the 419 community-dwelling older adults with olfactory impairment, 102 were diagnosed with cognitive frailty, yielding an incidence rate of 24.34%. Univariate analysis showed that age, gender, marital status, sarcopenia, nutritional status, oral frailty, and sleep status differed significantly between the two groups ($P < 0.05$), as shown in Table 1.

Table 1
Univariate analysis of cognitive frailty in community-dwelling older adults with olfactory impairment (n = 419)

Variables	**non-CF (n = 317)**	**CF (n = 102)**	***t/χ²***	***P***
Age (years, $\bar{x}\pm s$)	68.11 ± 6.45	72.27 ± 9.44	-4.15	< 0.001
Gender, n(%)			6.13	0.013
Male	150 (47.32)	34 (33.33)		
Female	167 (52.68)	68 (66.67)		
Educational level, n(%)			3.97	0.410
Primary school or below	92 (29.02)	21 (20.59)		
Junior high school	89 (28.08)	33 (32.35)		
Technical secondary school	78 (24.61)	29 (28.43)		
Junior college	46 (14.51)	17 (16.67)		
Bachelor’s degree or above	12 (3.79)	2 (1.96)		
Marital status, n(%)			20.85	< 0.001
Married	264 (83.28)	63 (61.76)		
Unmarried	53 (16.72)	39 (38.24)		
Smoking, n(%)			0.11	0.742
No	279 (88.01)	91 (89.22)		
Yes	38 (11.99)	11 (10.78)		
Alcohol drinking, n(%)			0.08	0.784
No	270 (85.17)	88 (86.27)		
Yes	47 (14.83)	14 (13.73)		
Living arrangement, n(%)			3.16	0.076
Living alone	106 (33.44)	44 (43.14)		
Not living alone	211 (66.56)	58 (56.86)		
Average monthly personal income, n(%)			4.13	0.127
< 2200 CNY	64 (20.19)	28 (27.45)		
2200–5999 CNY	104 (32.81)	37 (36.27)		
> 5999 CNY	149 (47.00)	37 (36.27)		

Variables	non-CF (n = 317)	CF (n = 102)	t/χ^2	*P*
Regular exercise, n(%)			0.19	0.665
No	157 (49.53)	48 (47.06)		
Yes	160 (50.47)	54 (52.94)		
BMI, n(%)			3.01	0.391
Normal	11 (3.47)	4 (3.92)		
Underweight	140 (44.16)	44 (43.14)		
Overweight	119 (37.54)	32 (31.37)		
Obese	47 (14.83)	22 (21.57)		
Sarcopenia, n(%)			30.27	< 0.001
No	264 (83.28)	58 (56.86)		
Yes	53 (16.72)	44 (43.14)		
Depression, n(%)			2.75	0.097
No	179 (56.47)	48 (47.06)		
Yes	138 (43.53)	54 (52.94)		
Nutritional status, n(%)			17.08	< 0.001
Normal	234 (73.82)	53 (51.96)		
At risk of malnutrition	71 (22.40)	42 (41.18)		
Malnutrition	12 (3.79)	7 (6.86)		
Family support, n(%)			1.13	0.569
Adequate	103 (32.49)	29 (28.43)		
Moderate impairment	158 (49.84)	57 (55.88)		
Severe impairment	56 (17.67)	16 (15.69)		
Oral frailty, n(%)			39.88	< 0.001
Low risk	111 (35.02)	24 (23.53)		
Moderate risk	164 (51.74)	35 (34.31)		
High risk	42 (13.25)	43 (42.16)		
Sleep efficiency, n(%)			8.252	0.016
Good	76 (23.98)	11 (10.78)		

Variables	non-CF (n = 317)	CF (n = 102)	t/χ^2	P
Moderate	198 (62.46)	76 (74.51)		
Poor	43 (13.57)	15 (14.71)		

Multivariate logistic regression analysis of factors associated with cognitive frailty among community-dwelling older adults with olfactory impairment

Taking cognitive frailty as the dependent variable (0 = non-cognitive frailty, 1 = cognitive frailty), variables that were statistically significant ($P < 0.05$) in the univariate analysis were included as independent variables into the logistic regression model. The results of multivariate logistic regression analysis indicated that unmarried status, sarcopenia, risk of malnutrition, and high risk of oral frailty were risk factors for cognitive frailty ($P < 0.05$), as shown in Table 2.

Table 2
Multivariate logistic regression analysis of cognitive frailty in community-dwelling older adults with olfactory impairment

Variable	β	S.E	Z	P	OR (95%CI)
Constant	-0.80	0.66	-1.21	0.228	0.45 (0.12–1.65)
Marital status (reference: married)					
Unmarried	0.83	0.29	2.86	0.004	2.30 (1.30–4.07)
Sarcopenia (reference: no)					
Yes	0.89	0.28	3.15	0.002	2.43 (1.40–4.23)
Nutritional status (reference: normal)					
At risk of malnutrition	0.73	0.28	2.60	0.009	2.07 (1.20–3.57)
Malnutrition	0.56	0.56	1.00	0.317	1.74 (0.59–5.18)
Oral frailty (reference: low risk)					
Moderate risk	-0.02	0.31	-0.07	0.943	0.98 (0.54–1.79)
High risk	1.10	0.34	3.21	0.001	3.00 (1.53–5.86)

Discussion

The present study found that the incidence of cognitive frailty among community-dwelling older adults with olfactory impairment was 25.8%, which was higher than that among older adults with diabetes mellitus (16.30%)[18]. Olfactory impairment can indirectly accelerate the progression of cognitive decline and cognitive frailty through multiple pathological mechanisms[19]. For instance, olfactory impairment reduces eating pleasure and leads to decreased appetite, which ultimately results in malnutrition.

Meanwhile, olfactory impairment is closely associated with depressive moods, and olfactory damage may induce behavioral abnormalities similar to depressive manifestations[20, 21]. Both malnutrition and depressive moods can elevate the risk of cognitive frailty[22]. In addition, relevant studies have demonstrated that patients with Parkinson's disease complicated with olfactory impairment carry a higher risk of progressing to dementia. This is because olfactory decline can reflect early pathological changes of extranigral Lewy body pathology in the cerebral cortex, thereby promoting the occurrence and development of cognitive frailty[23]. Therefore in the health management of community-dwelling older adults with olfactory impairment, routine screening for cognitive frailty should be emphasized. For high-risk individuals, personalized intervention protocols should be formulated, and targeted olfactory rehabilitation guidance should be actively implemented to prevent the onset of cognitive frailty.

The results of this study indicated that being unmarried was a risk factor for cognitive frailty among community-dwelling older adults with olfactory impairment. A possible reason is that married older adults can typically receive emotional support through communication with their spouses, whereas unmarried older adults are more likely to experience loneliness and frustration in daily life. This manifests as reduced social behavior, decreased willingness to communicate, and gradual alienation from society, thereby placing them at a higher risk of developing cognitive frailty[24]. Therefore, community administrators should provide more humanistic care for older adults without spouses, timely assess their psychological status, and actively encourage them to acquire family or social support from others, so as to enhance their sense of belonging in later life.

The results of this study indicated that sarcopenia is a risk factor for cognitive frailty among community-dwelling older adults with olfactory impairment. Relevant mechanism analysis suggests that arteriosclerosis and severe white matter hyperintensities may play important roles in the decline of cognitive function. Specifically, studies have found that brain-derived neurotrophic factor (BDNF), which is expressed in skeletal muscle, can promote neuronal survival and differentiation, enhance synaptic growth, and thereby reduce the incidence of cognitive dysfunction[25]. In addition, sarcopenia may also lead to an imbalance in actin dynamics as well as cardiovascular and cerebrovascular diseases, further resulting in memory impairment. Cardiovascular and cerebrovascular disorders can cause insufficient cerebral perfusion, reduce the supply of oxygen and nutrients, and interfere with the normal metabolism and function of nerve cells, especially in memory-related brain regions such as the hippocampus. The combined effect of these factors increases the risk of cognitive frailty[26, 27]. Therefore, it is recommended that community administrators formulate low-intensity aerobic exercise and progressive resistance training programs for older adults with olfactory impairment, so as to reduce their risk of sarcopenia and improve cognitive function.

The results of this study show that community-dwelling older adults with olfactory impairment and at risk of malnutrition are more susceptible to cognitive frailty. Previous studies have demonstrated that older adults with good nutritional status have a lower risk of developing cognitive frailty[28]. Mechanistically, malnourished older adults may develop insulin resistance, neuroinflammation, and oxidative stress. Low hemoglobin levels reduce the oxygen-carrying capacity of the blood, resulting in

chronic cerebral hypoxia and slowed metabolism. Consequently, these changes further cause neuronal damage, elevate the risk of brain atrophy, accelerate amyloid-beta protein accumulation, and ultimately contribute to the development of cognitive frailty[29, 30]. In addition, a vicious cycle exists between malnutrition and cognitive frailty. An imbalance between energy intake and expenditure leads to muscle weakness and cognitive impairment[31]. Insufficient intake of fruits, vegetables, protein, and specific micronutrients also increases the likelihood of frailty[32]. Therefore, community managers should attach importance to nutritional screening and assessment for older adults with olfactory impairment. It is recommended to formulate individualized dietary plans and popularize nutritional knowledge according to the physical conditions of older adults, so as to reduce the risk of cognitive frailty.

The results of this study show that high risk of oral frailty is a risk factor for cognitive frailty among community-dwelling older adults with olfactory impairment. Mechanistically, oral frailty may affect cognitive function by interfering with nutritional intake. For example, previous studies have demonstrated that decreased masticatory efficiency caused by oral hypofunction is often accompanied by limited food choices and reduced dietary intake, which may further lead to insufficient intake of nutrients such as vitamin B12 and folate. These nutrients are closely associated with cognitive decline[33, 34]. Meanwhile, chronic inflammation induced by tooth loss or periodontal diseases may activate the systemic inflammatory pathway, thereby affecting the central nervous system and accelerating the deterioration of cognitive function[35, 36]. In addition, oral frailty may also influence cognitive function through psychosocial factors. Oral dysfunction restricts individuals' verbal expression and social interaction abilities and reduces their willingness and frequency of participating in social activities. Long-term social isolation is recognized as a risk factor for cognitive decline[37]. Therefore, community managers should attach importance to oral health management for older adults with olfactory impairment, alleviate problems including inadequate nutritional intake, chronic inflammation, and social isolation caused by oral frailty, and ultimately reduce the incidence risk of cognitive frailty.

Conclusions

In conclusion, the prevalence of cognitive impairment is high among elderly individuals in community settings who have olfactory impairment. Unmarried status, sarcopenia, malnutrition risk, and high risk of oral frailty were independent risk factors for cognitive frailty. Community administrators should prioritize the early screening of cognitive frailty in older adults with olfactory impairment and formulate targeted intervention measures based on the above risk factors to prevent or delay the onset and progression of cognitive frailty. Limitations of this study include: this was a single-center cross-sectional study with a limited sample size, which may lead to bias in the results. In addition, this study could only reveal the correlation between various risk factors and cognitive frailty, but could not clarify the causal relationship. Further multicenter, large-sample longitudinal studies are needed in the future to clarify the trajectory of cognitive frailty among community-dwelling older adults with olfactory impairment, in order to provide scientific evidence for the formulation of individualized intervention strategies.

Declarations

Ethics approval and consent to participate

This study has been approved by the Ethics Committee of the Affiliated Hospital of Changchun University of Chinese Medicine (Approval No.: CCZYFYLL-SQ-2024). All experimental procedures involving human subjects strictly adhere to the ethical standards of this institution and/or the national research committee, and comply with the provisions of the 1964 Declaration of Helsinki and its subsequent amendments. All participants and their legal guardians signed informed consent forms before the study began.

Consent for publication

Written informed consent for publication was obtained from all participants and their legal guardians. No identifiable personal data, images, or videos of participants are included in this manuscript.

Competing interests

The authors declare no competing interests.

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Author Contribution

Liu Jie: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing-original draft preparation, Writing-reviewing and Editing. Ma Shuang: Data curation, Project administration. Li Jian: Project administration, Supervision. Zhang Jingzhou: Data curation, Investigation, Methodology. Hou Yiting: Data curation, Formal analysis.

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Data Availability

The data that support the findings of this study are available upon reasonable request from the corresponding author.

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