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Psychosocial-functional profiles among older adults with chronic subjective tinnitus in long-term care facilities: a cross-sectional latent profile analysis

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Research Article

Keywords: Older adults, long-term care facilities, chronic subjective tinnitus, latent profile analysis, psychosocial vulnerability, tinnitus-related disability, geriatric assessment

Posted Date: June 25th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9701292/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

Tinnitus is a persistent but often under-recognized symptom in long-term care facilities. In older residents, chronic subjective tinnitus may affect sleep, mood, communication, social participation, and care needs, particularly when psychosocial resources are limited. Whether tinnitus-related disability and psychosocial vulnerability cluster together in this setting remains unclear. This study identified psychosocial-functional profiles of older long-term care residents with chronic subjective tinnitus and examined correlates of profile membership.

Methods

A cross-sectional survey was conducted from July to November 2025 in 13 long-term care facilities in Wuhan, China. Eligible residents were aged 60 years or older, had subjective tinnitus for at least 6 months, and had lived in the facility for at least 6 months. Latent profile analysis used standardized, risk-oriented indicators of health-related appraisal, tinnitus-related fear, perceived social support, chronic disease self-efficacy, and tinnitus-related disability. One- to five-profile models were evaluated using fit indices, entropy, likelihood ratio tests, class size, parsimony, and interpretability. Multinomial logistic regression examined correlates of profile membership.

Results

The sample included 390 residents (mean age, 79.85 years [SD, 8.32]; 60.8% women). A four-profile solution was retained (entropy = 0.854), with profile sizes ranging from 16.9% to 32.3%. The profiles were low psychosocial risk–low disability (n = 126, 32.3%), moderate psychosocial risk–moderate disability (n = 117, 30.0%), high psychosocial risk–high disability (n = 81, 20.8%), and health appraisal and support vulnerability–low disability (n = 66, 16.9%). The latter profile combined low tinnitus-related disability with more unfavorable health appraisal, stronger tinnitus-related fear, and lower perceived social support. Junior high school education or above was associated with higher odds of membership in the three non-reference profiles (ORs = 5.92–39.17). Smoking and alcohol histories showed profile-specific associations; hypertension estimates required caution because of sparse covariate distributions.

Conclusions

Older long-term care residents with chronic subjective tinnitus showed distinct psychosocial-functional profiles. A low-disability but psychosocially vulnerable subgroup suggests that disability-focused assessment may overlook clinically relevant support needs. Brief screening of health appraisal, tinnitus-related fear, perceived support, and self-efficacy may help guide tinnitus management and psychosocial support in long-term care.

Background

Population aging has increased the demand for long-term care, where residents often experience chronic health problems, functional limitations, and reduced social contact. In this setting, persistent symptoms that are not readily visible to care staff may be missed, even when they affect daily functioning, psychological adjustment, and care needs. Tinnitus is one such symptom. In long-term care, assessment therefore needs to extend beyond diagnosed diseases to include chronic symptoms that may affect coping, communication, social engagement, and daily functioning.

Tinnitus is the subjective perception of sound in the absence of a corresponding external source [1]. In this study, chronic subjective tinnitus was defined as subjective tinnitus persisting for at least 6 months [2]. Tinnitus is common in later life: a systematic review estimated a global prevalence of 14.4% among adults, increasing to 23.6% among adults aged 65 years or older [3]. Although often described as an auditory symptom, tinnitus may affect sleep, emotional distress, attention, communication, fear-related beliefs, social participation, and quality of life [4–8]. Most evidence on tinnitus in older adults has come from population-based cohorts or clinical samples, whereas residents of long-term care facilities remain under-studied [9, 10].

Older residents with chronic subjective tinnitus may differ substantially in how they experience and respond to the symptom. Residents with similar tinnitus-related disability may vary in health-related appraisal, tinnitus-related fear, perceived social support, and self-efficacy [11–13]. Conversely, psychosocial vulnerability may be present even when tinnitus-related disability is relatively low. Previous studies have often examined tinnitus severity, psychological distress, hearing-related factors, or quality of life as separate variables [10, 14, 15]. These variable-centered approaches help estimate associations, but they do not show how psychosocial resources and functional consequences cluster within individual residents. It therefore remains unclear whether distinct psychosocial-functional subgroups exist in this population.

Latent profile analysis (LPA) is a person-centered method for identifying such subgroups based on shared patterns across continuous indicators [16]. Prior person-centered studies have shown that people with hearing impairment, chronic tinnitus, or related health-risk profiles may differ not only in symptom severity, but also in combinations of distress, coping resources, and functional impact [17–20]. However, these studies have rarely focused on older adults in long-term care facilities or jointly considered psychosocial resources, fear-related cognition, self-efficacy, social support, and tinnitus-related disability. This limits the direct relevance of existing profiles for assessment and care planning in long-term care settings.

To address these gaps, this study used indicators of health-related appraisal, tinnitus-related fear, perceived social support, self-efficacy, and tinnitus-related disability to identify latent profiles among older long-term care residents with chronic subjective tinnitus. We also examined demographic and clinical factors associated with profile membership. This approach was intended to identify residents whose psychosocial support needs may not be apparent from tinnitus-related disability scores alone and to inform more tailored care planning in long-term care facilities.

Methods

Study design and setting

This cross-sectional study aimed to identify psychosocial-functional profiles among older adults with chronic subjective tinnitus living in long-term care facilities and to examine demographic and clinical factors associated with profile membership. The survey was conducted between July and November 2025 in urban Wuhan, Hubei Province, China. Long-term care facilities were purposively selected from seven urban administrative districts: Wuchang, Hongshan, Jianghan, Jiang'an, Hanyang, Qingshan, and Qiaokou. Facilities were eligible if they were formally registered with the civil affairs department, had at least 50 beds, had an occupancy rate of 70% or higher, and granted administrative permission for the survey. Seventeen eligible facilities were invited to participate. Three declined, and one was undergoing maintenance during the study period. Thirteen facilities therefore participated, corresponding to a facility-level response rate of 76.5%. The participating facilities included five public and eight private institutions, with bed capacities ranging from 50 to 1,300 beds.

Participants

With assistance from facility staff, the research team approached residents aged 60 years or older in the participating facilities and screened them for tinnitus symptoms. Of 3,320 residents contacted, 1,130 self-reported tinnitus symptoms and were further assessed for eligibility.

The inclusion criteria were as follows: (1) age 60 years or older; residence in a long-term care facility for at least 6 months; (2) chronic subjective tinnitus, defined as self-perceived tinnitus lasting for at least 6 months; (3) sufficient cognitive and communicative ability to understand the survey questions and provide reliable responses, either independently or with interviewer assistance; (4) willingness to participate.

Residents were excluded if they met any of the following criteria: (1) hearing impairment severe enough to prevent effective communication; (2) total functional dependence; (3) documented or suspected objective or secondary tinnitus attributable to identifiable causes; (4) inability to provide consistent responses during the assessment; or (5) current long-term use of ototoxic or psychotropic medications. Eligibility and exclusion criteria were assessed using resident interviews, facility health records, medication records, staff confirmation, and available clinical documentation where applicable. Long-term medication use was defined as continuous or regular use documented in facility medication records for at least 3 months before the survey. Residents using long-term ototoxic or psychotropic medications were excluded because these medications may influence tinnitus symptoms or self-reported psychosocial responses.

Of the 1,130 residents who self-reported tinnitus, 420 did not meet the inclusion criteria: 68 had lived in the facility for less than 6 months, 101 had insufficient comprehension or communication ability, and 251 did not meet the criterion for chronic subjective tinnitus. A further 188 residents met at least one exclusion criterion, including hearing impairment that prevented effective communication with the research team (n = 15), total functional dependence (n = 54), documented or suspected objective or secondary tinnitus (n =

78), and long-term use of ototoxic or psychotropic medications (n = 41). Among the remaining eligible residents, 132 declined to participate, mainly because of lack of interest, temporary physical discomfort, or lack of agreement from a legally authorized representative when required. The final analytic sample comprised 390 residents. The recruitment process is shown in Supplementary Fig. 1.

Sample size

The sample size was determined by considering both the expected recruitment scale for a cross-sectional survey and the analytic requirements of LPA. For the survey component, previous psychometric and factor-analytic studies have commonly recommended a minimum of 5–10 participants per observed variable [21, 22]. The target sample size was further adjusted according to the reported prevalence of tinnitus in later life [3] and an anticipated 20% rate of non-response or invalid questionnaires. For the LPA, sample adequacy was considered in relation to the number of observed indicators, potential number of latent profiles, separation between profiles, expected size of the smallest profile, model convergence, fit indices, profile proportions, and classification quality. The final sample of 390 residents was deemed acceptable for the exploratory LPA conducted in this study.

Data collection and quality control

Questionnaire data were collected in quiet, private areas within the participating long-term care facilities. Before fieldwork, interviewers completed 6 hours of training and were assessed on the study protocol, eligibility criteria, informed consent procedures, questionnaire administration, assisted completion procedures, and ethical requirements. Residents completed the questionnaire independently where possible. For those requiring assistance, interviewers read each item and its response options verbatim and recorded the resident's oral response without prompting, rephrasing, or interpretation. When clarification was needed, interviewers provided only predefined literal explanations. Each questionnaire was reviewed on site by two researchers for completeness and logical consistency. Completion mode was documented: 248 residents completed the questionnaire independently, whereas 142 completed it with interviewer assistance. These procedures were used to minimize interviewer influence and ensure consistency in questionnaire administration.

Measures

General characteristics

A researcher-designed form collected sociodemographic, lifestyle, and disease-related information. Sociodemographic variables included sex, age, body mass index (BMI), income, marital status, education level, and previous occupation. Lifestyle-related variables included smoking history, alcohol history, regular exercise, and usual device listening volume. Disease-related variables included tinnitus location, treatment history, hearing-aid use, and chronic disease comorbidity.

Tinnitus-related health cognition

Tinnitus-related health cognition was assessed using the subjective tinnitus health cognition questionnaire revised by Zhang in 2019 [23]. The questionnaire includes 20 items covering susceptibility, severity, perceived benefits, perceived barriers, and cues to action. Items are scored on a 5-point Likert scale. The barrier cognition domain is reverse scored in the original instrument. In this study, scores were converted so that higher scores represented lower health cognition and greater risk. Cronbach's alpha and McDonald's omega were 0.839 and 0.840, respectively.

Tinnitus-related health appraisal was assessed using the Subjective Tinnitus Health Cognition Questionnaire revised by Zhang in 2019 [23]. Although the original instrument uses the term “health cognition”, it assesses tinnitus-related health beliefs and appraisal, including perceived susceptibility, severity, benefits, barriers, and cues to action, rather than objective cognitive function. The questionnaire includes 20 items scored on a 5-point Likert scale. The barrier cognition domain is reverse scored in the original instrument. In this study, scores were transformed so that higher scores represented more unfavorable tinnitus-related health appraisal and greater psychosocial risk. Cronbach's alpha and McDonald's omega were 0.839 and 0.840, respectively.

Fear of Tinnitus Questionnaire

Tinnitus-related fear was measured using the Fear of Tinnitus Questionnaire (FTQ), originally proposed by Cima et al. [24] and translated and validated in Chinese by Xu et al. [25]. The Chinese version contains 15 dichotomous items covering tinnitus-related cognition, tinnitus-related somatic symptoms, and fear of the future. Items are scored 1 for yes and 0 for no, giving a total score from 0 to 15. Higher scores indicate greater tinnitus-related fear [26]. In this study, Cronbach's alpha and McDonald's omega were both 0.803.

Short-form Social Support Appraisals Scale for older adults

Perceived social support was measured using the 13-item Short-form Social Support Appraisals Scale for older adults (SSA-13) [27–29]. The scale covers family support, friend support, and support from others. Items are scored from 1 (strongly disagree) to 4 (strongly agree), with total scores ranging from 13 to 52. Higher original scores indicate greater perceived social support. For latent profile analysis, the total score was reverse-coded so that higher values indicated lower perceived support and greater psychosocial risk. Cronbach's alpha and McDonald's omega were 0.826 and 0.836, respectively.

Chronic Disease Self-Efficacy Scale

Chronic disease self-efficacy was assessed using the six-item Chronic Disease Self-Efficacy Scale developed by Lorig et al. [30]. Items are scored from 1, not at all confident, to 10, totally confident, and the scale score is calculated as the mean item score [31]. Higher original scores indicate greater self-efficacy. For latent profile analysis, scores were reverse coded so that higher values indicated lower self-efficacy and greater risk. Cronbach's alpha and McDonald's omega were both 0.884.

Tinnitus Handicap Inventory

Tinnitus-related disability was assessed using the Tinnitus Handicap Inventory developed by Newman et al. [32] and translated and validated in Chinese by Shi et al. [33]. The instrument contains 25 items, with responses scored as no, 0; sometimes, 2; and always, 4. The total score ranges from 0 to 100, with higher scores indicating greater tinnitus-related disability. The original severity categories are minimal, 0–16; mild, 18–36; moderate, 38–56; severe, 58–76; and catastrophic, 78–100. The total score was used as the tinnitus-related disability indicator. Cronbach's alpha and McDonald's omega were 0.910 and 0.917, respectively.

Latent profile indicators

Five continuous indicators were included in the latent profile analysis: tinnitus-related health cognition risk, tinnitus-related fear, social support risk, self-efficacy risk, and tinnitus-related disability. Protective indicators were reverse coded before analysis so that higher scores consistently represented greater psychosocial risk or functional burden. Specifically, perceived social support and chronic disease self-efficacy were reverse coded according to their observed scale ranges before standardization. All five indicators were then standardized as Z scores to reduce the influence of different scale ranges.

No intervention was delivered in this observational study. Profile comparisons were based on the latent profiles derived from these five standardized indicators.

Statistical analysis

Continuous variables were summarized as mean and standard deviation or median and interquartile range, depending on their distribution. Categorical variables were summarized as frequency and percentage. Differences in demographic, lifestyle, and clinical characteristics across latent profiles were examined using one-way analysis of variance or the Kruskal-Wallis test for continuous variables, and the chi-square test or Fisher's exact test for categorical variables. A two-sided P value < 0.05 was considered statistically significant.

Internal consistency reliability was assessed using Cronbach's alpha and McDonald's omega. Latent profile analysis was conducted using the five standardized continuous indicators. Models with one to five profiles were estimated. The primary latent profile analysis used tidyLPA Model 1, corresponding to equal variances across profiles and zero covariances between indicators.

Model selection was guided by statistical fit, classification quality, model stability, profile size, parsimony, and substantive interpretability. Fit indices included log-likelihood, Akaike information criterion, Bayesian information criterion, sample-size-adjusted Bayesian information criterion, entropy, and the bootstrap likelihood ratio test where available. Lower information criteria were interpreted as indicating better relative fit, and entropy values closer to 1 were interpreted as indicating better classification accuracy. The bootstrap likelihood ratio test was based on 1,000 bootstrap draws. The Lo-Mendell-Rubin adjusted likelihood ratio test was not available from the analysis output and was therefore not used.

Solutions with very small profiles, non-convergence, evidence of local maxima, or profiles without clear substantive separation were not favored. After the final model was selected, individuals were assigned to the profile for which they had the highest posterior probability. Average posterior probabilities were calculated to assess classification precision.

After profile assignment, demographic, lifestyle, and clinical characteristics were compared across profiles. Multinomial logistic regression was then used to examine factors associated with profile membership. Candidate covariates were selected based on clinical relevance and previous literature, while also considering sparse categories and model stability. Age and sex were retained in the model because of their clinical importance. The profile with the highest psychosocial risk and most severe tinnitus-related disability was used as the reference category. Results are presented as odds ratios, 95% confidence intervals, and P values. Multicollinearity was assessed using variance inflation factors, with values below 5 considered acceptable.

Missing data were handled using complete-case analysis for the variables included in each analysis. Participants with missing values on any latent profile indicator were excluded from the latent profile analysis. For between-profile comparisons and multinomial logistic regression, observations with missing values in the variables required for a given analysis were excluded from that analysis. Responses recorded as unknown were treated as missing.

All analyses were conducted in R version 4.5.3. Internal consistency reliability was estimated using the psych package version 2.6.3. Latent profile analysis was performed using tidyLPA version 2.0.2 with the mclust version 6.1.2 backend. Multinomial logistic regression was performed using the nnet package version 7.3–20.

Ethics approval

The study was approved by the Ethics Committee of the Department of Science and Training, General Hospital of Central Theater Command, China, approval number [2025]193-01. All procedures were conducted in accordance with the Declaration of Helsinki. All participants took part voluntarily and provided written informed consent. When required according to facility procedures or participant capacity, written consent was also obtained from a legally authorized representative.

Results

Participant characteristics

The study included 390 older residents with chronic subjective tinnitus. The mean age was 79.85 years (SD 8.32), and 237 participants (60.8%) were women. Table 1 summarizes the characteristics of the total sample and the distribution of these characteristics across the four latent profiles.

Significant differences across profiles were observed for sex (P = 0.008), education level (P < 0.001), smoking history (P < 0.001), alcohol history (P = 0.017), tinnitus duration (P < 0.001), and hypertension (P <

0.001). No significant differences were found for the other demographic, lifestyle, tinnitus-related, or health-service variables.

Table 1
Baseline characteristics of residents by latent psychosocial-functional profile

Variable	Overall (n = 390)	Profile 1 (n = 126)	Profile 2 (n = 117)	Profile 3 (n = 81)	Profile 4 (n = 66)	P-value
Age (years)	79.85 (8.32)	79.21 (8.87)	80.49 (8.63)	79.94 (7.02)	79.83 (8.26)	0.696
Age group						0.307
60–69	47 (12.1)	21 (16.7)	10 (8.5)	7 (8.6)	9 (13.6)	
70–79	138 (35.4)	39 (31.0)	44 (37.6)	34 (42.0)	21 (31.8)	
80–89	156 (40.0)	49 (38.9)	44 (37.6)	32 (39.5)	31 (47.0)	
≥90	49 (12.6)	17 (13.5)	19 (16.2)	8 (9.9)	5 (7.6)	
Sex						0.008
Male	153 (39.2)	42 (33.3)	61 (52.1)	29 (35.8)	21 (31.8)	
Female	237 (60.8)	84 (66.7)	56 (47.9)	52 (64.2)	45 (68.2)	
BMI (kg/m²)	23.89 (3.71)	23.88 (4.02)	23.88 (3.30)	23.86 (3.71)	23.98 (3.85)	0.998
BMI category (kg/m²)						0.351
Underweight (< 18.5)	39 (10.0)	17 (13.5)	9 (7.7)	7 (8.6)	6 (9.1)	
Normal weight (18.5–23.9)	143 (36.7)	42 (33.3)	47 (40.2)	32 (39.5)	22 (33.3)	
Overweight (24.0–27.9)	156 (40.0)	43 (34.1)	49 (41.9)	34 (42.0)	30 (45.5)	
Obesity (≥ 28.0)	52 (13.3)	24 (19.0)	12 (10.3)	8 (9.9)	8 (12.1)	
Marital status						0.199
Unmarried	26 (6.7)	7 (5.6)	6 (5.1)	10 (12.3)	3 (4.5)	

Notes: Profile 1, low psychosocial risk–low disability; Profile 2, moderate psychosocial risk–moderate disability; Profile 3, high psychosocial risk–high disability; Profile 4, health appraisal and support vulnerability-low disability. Data are presented as mean (SD) or n (%). BMI, body mass index; CNY, Chinese yuan. p values were calculated using one-way analysis of variance or Kruskal-Wallis tests for continuous variables and chi-square or Fisher's exact tests for categorical variables.

Variable	Overall (n = 390)	Profile 1 (n = 126)	Profile 2 (n = 117)	Profile 3 (n = 81)	Profile 4 (n = 66)	P-value
Married	126 (32.3)	44 (34.9)	39 (33.3)	29 (35.8)	14 (21.2)	
Divorced	61 (15.6)	19 (15.1)	19 (16.2)	8 (9.9)	15 (22.7)	
Widowed	177 (45.4)	56 (44.4)	53 (45.3)	34 (42.0)	34 (51.5)	
Education level						< 0.001
No formal education	124 (31.8)	35 (27.8)	6 (5.1)	65 (80.2)	18 (27.3)	
Primary school	102 (26.2)	27 (21.4)	41 (35.0)	15 (18.5)	19 (28.8)	
Junior middle school	81 (20.8)	25 (19.8)	42 (35.9)	0 (0.0)	14 (21.2)	
Senior high school or technical school	46 (11.8)	12 (9.5)	23 (19.7)	0 (0.0)	11 (16.7)	
College or above	37 (9.5)	27 (21.4)	5 (4.3)	1 (1.2)	4 (6.1)	
Monthly income						0.884
<2000 CNY	44 (11.3)	12 (9.5)	14 (12.0)	11 (13.6)	7 (10.6)	
2000–4000 CNY	127 (32.6)	47 (37.3)	40 (34.2)	23 (28.4)	17 (25.8)	
4000–6000 CNY	155 (39.7)	47 (37.3)	46 (39.3)	33 (40.7)	29 (43.9)	
>6000 CNY	64 (16.4)	20 (15.9)	17 (14.5)	14 (17.3)	13 (19.7)	
Medical insurance						0.964
Self-funded	16 (4.1)	4 (3.2)	7 (6.0)	3 (3.7)	2 (3.0)	
Resident medical insurance	91 (23.3)	31 (24.6)	27 (23.1)	18 (22.2)	15 (22.7)	

Notes: Profile 1, low psychosocial risk–low disability; Profile 2, moderate psychosocial risk–moderate disability; Profile 3, high psychosocial risk–high disability; Profile 4, health appraisal and support vulnerability-low disability. Data are presented as mean (SD) or n (%). BMI, body mass index; CNY, Chinese yuan. p values were calculated using one-way analysis of variance or Kruskal-Wallis tests for continuous variables and chi-square or Fisher's exact tests for categorical variables.

Variable	Overall (n = 390)	Profile 1 (n = 126)	Profile 2 (n = 117)	Profile 3 (n = 81)	Profile 4 (n = 66)	P-value
Employee medical insurance	283 (72.6)	91 (72.2)	83 (70.9)	60 (74.1)	49 (74.2)	
Previous occupation						0.809
Worker	118 (30.3)	42 (33.3)	33 (28.2)	25 (30.9)	18 (27.3)	
Farmer	102 (26.2)	33 (26.2)	33 (28.2)	20 (24.7)	16 (24.2)	
Teacher	37 (9.5)	11 (8.7)	9 (7.7)	8 (9.9)	9 (13.6)	
Accountant	10 (2.6)	4 (3.2)	4 (3.4)	0 (0.0)	2 (3.0)	
Administrative/managerial staff	63 (16.2)	14 (11.1)	23 (19.7)	14 (17.3)	12 (18.2)	
Other	60 (15.4)	22 (17.5)	15 (12.8)	14 (17.3)	9 (13.6)	
Type of institution						0.280
Public	234 (60.0)	71 (56.3)	75 (64.1)	44 (54.3)	44 (66.7)	
Private	156 (40.0)	55 (43.7)	42 (35.9)	37 (45.7)	22 (33.3)	
Integrated medical and elderly care service						0.490
Yes	184 (47.2)	55 (43.7)	57 (48.7)	36 (44.4)	36 (54.5)	
No	206 (52.8)	71 (56.3)	60 (51.3)	45 (55.6)	30 (45.5)	
Smoking history						< 0.001
No	304 (77.9)	106 (84.1)	113 (96.6)	30 (37.0)	55 (83.3)	
Yes	86 (22.1)	20 (15.9)	4 (3.4)	51 (63.0)	11 (16.7)	

Notes: Profile 1, low psychosocial risk–low disability; Profile 2, moderate psychosocial risk–moderate disability; Profile 3, high psychosocial risk–high disability; Profile 4, health appraisal and support vulnerability-low disability. Data are presented as mean (SD) or n (%). BMI, body mass index; CNY, Chinese yuan. p values were calculated using one-way analysis of variance or Kruskal-Wallis tests for continuous variables and chi-square or Fisher's exact tests for categorical variables.

Variable	Overall (n = 390)	Profile 1 (n = 126)	Profile 2 (n = 117)	Profile 3 (n = 81)	Profile 4 (n = 66)	P-value
Alcohol history						0.017
No	310 (79.5)	110 (87.3)	93 (79.5)	56 (69.1)	51 (77.3)	
Yes	80 (20.5)	16 (12.7)	24 (20.5)	25 (30.9)	15 (22.7)	
Volume level	6.39 (1.41)	6.29 (1.30)	6.50 (1.53)	6.64 (1.34)	6.06 (1.39)	0.052
Regular exercise						0.905
No	272 (69.7)	86 (68.3)	84 (71.8)	55 (67.9)	47 (71.2)	
Yes	118 (30.3)	40 (31.7)	33 (28.2)	26 (32.1)	19 (28.8)	
Tinnitus location						0.529
Left ear only	150 (38.5)	46 (36.5)	45 (38.5)	32 (39.5)	27 (40.9)	
Right ear only	88 (22.6)	31 (24.6)	30 (25.6)	20 (24.7)	7 (10.6)	
Bilateral ears	76 (19.5)	26 (20.6)	22 (18.8)	13 (16.0)	15 (22.7)	
Cephalic tinnitus	76 (19.5)	23 (18.3)	20 (17.1)	16 (19.8)	17 (25.8)	
Tinnitus pattern						0.395
Persistent	138 (35.4)	48 (38.1)	40 (34.2)	32 (39.5)	18 (27.3)	
Intermittent	252 (64.6)	78 (61.9)	77 (65.8)	49 (60.5)	48 (72.7)	
Duration of tinnitus						< 0.001
0.5–1 year	77 (19.7)	21 (16.7)	5 (4.3)	43 (53.1)	8 (12.1)	

Notes: Profile 1, low psychosocial risk–low disability; Profile 2, moderate psychosocial risk–moderate disability; Profile 3, high psychosocial risk–high disability; Profile 4, health appraisal and support vulnerability-low disability. Data are presented as mean (SD) or n (%). BMI, body mass index; CNY, Chinese yuan. p values were calculated using one-way analysis of variance or Kruskal-Wallis tests for continuous variables and chi-square or Fisher's exact tests for categorical variables.

Variable	Overall (n = 390)	Profile 1 (n = 126)	Profile 2 (n = 117)	Profile 3 (n = 81)	Profile 4 (n = 66)	P-value
1–5 years	115 (29.5)	33 (26.2)	30 (25.6)	38 (46.9)	14 (21.2)	
5–10 years	133 (34.1)	37 (29.4)	71 (60.7)	0 (0.0)	25 (37.9)	
≥10 years	65 (16.7)	35 (27.8)	11 (9.4)	0 (0.0)	19 (28.8)	
Hearing decline since tinnitus onset						0.507
No	104 (26.7)	31 (24.6)	34 (29.1)	18 (22.2)	21 (31.8)	
Yes	286 (73.3)	95 (75.4)	83 (70.9)	63 (77.8)	45 (68.2)	
Hearing aid use						0.197
No	321 (82.3)	110 (87.3)	92 (78.6)	63 (77.8)	56 (84.8)	
Yes	69 (17.7)	16 (12.7)	25 (21.4)	18 (22.2)	10 (15.2)	
Hypertension						< 0.001
No	288 (73.8)	118 (93.7)	105 (89.7)	8 (9.9)	57 (86.4)	
Yes	102 (26.2)	8 (6.3)	12 (10.3)	73 (90.1)	9 (13.6)	

Notes: Profile 1, low psychosocial risk–low disability; Profile 2, moderate psychosocial risk–moderate disability; Profile 3, high psychosocial risk–high disability; Profile 4, health appraisal and support vulnerability-low disability. Data are presented as mean (SD) or n (%). BMI, body mass index; CNY, Chinese yuan. p values were calculated using one-way analysis of variance or Kruskal-Wallis tests for continuous variables and chi-square or Fisher's exact tests for categorical variables.

Latent profile model selection

Table 2 shows the fit indices and profile sizes for the one- to five-profile models with equal variances across profiles and zero covariances between indicators (EEI). The information criteria decreased as the number of profiles increased. The four-profile EEI model showed good classification performance, with an entropy of 0.854, a significant bootstrap likelihood ratio test result (p = 0.010), and profile sizes ranging from 66 (16.9%) to 126 (32.3%).

Models with freely varying variances and covariances across profiles (VVV) produced lower information criteria than the corresponding EEI models, but the solutions were less stable and more sensitive to initialization. Therefore, the EEI model family was retained for interpretation. Although the five-profile EEI model had lower information criteria and slightly higher entropy than the four-profile model, the additional profile mainly divided the low-risk group and did not substantially change the overall profile structure. Based on model fit, classification quality, profile size, stability, and interpretability, the four-profile EEI solution was selected as the final model.

Table 2
Fit indices for EEI latent profile models with one to five profiles

Model	LL	AIC	BIC	aBIC	Entropy	BLRT, p	Profile sizes, n (%)	Smallest profile, n (%)
1-class	-2764.427	5548.854	5588.515	5556.786	—	—	390 (100.0%)	390 (100.0%)
2-class	-2483.743	4999.486	5062.945	5012.178	0.831	0.010	233 (59.7%), 157 (40.3%)	157 (40.3%)
3-class	-2435.012	4914.023	5001.278	4931.474	0.760	0.010	193 (49.5%), 121 (31.0%), 76 (19.5%)	76 (19.5%)
4-class	-2361.320	4778.640	4889.692	4800.850	0.854	0.010	126 (32.3%), 117 (30.0%), 81 (20.8%), 66 (16.9%)	66 (16.9%)
5-class	-2325.082	4718.164	4853.013	4745.133	0.860	0.010	117 (30.0%), 80 (20.5%), 76 (19.5%), 67 (17.2%), 50 (12.8%)	50 (12.8%)

Notes: EEI indicates a model with equal variances across profiles and zero covariances between indicators. LL, log-likelihood; AIC, Akaike information criterion; BIC, Bayesian information criterion; aBIC, sample-size-adjusted Bayesian information criterion; BLRT, bootstrap likelihood ratio test. BLRT was based on 1000 bootstrap draws, and P values are reported with a minimum resolution of 0.01. The Lo–Mendell–Rubin adjusted likelihood ratio test was not available from the present analysis output and was therefore not reported. Profile sizes are listed in descending order within each model. The four-profile EEI solution was retained as the final model.

Profile characteristics

The four retained profiles are presented in Fig. 1.

Profile 1, low psychosocial risk–low disability, was the largest group and included 126 participants (32.3%). This profile showed negative standardized scores across all five indicators, reflecting relatively

low psychosocial risk and low tinnitus-related disability.

Profile 2, moderate psychosocial risk–moderate disability, included 117 participants (30.0%). This profile showed intermediate scores across the indicators, with moderately elevated self-efficacy risk and tinnitus-related disability.

Profile 3, high psychosocial risk–high disability, included 81 participants (20.8%). This profile showed elevated scores across the psychosocial indicators and tinnitus-related disability, indicating the highest overall burden among the four profiles.

Profile 4, health appraisal and support vulnerability–low disability, included 66 participants (16.9%). This profile was characterized by elevated health cognition risk, tinnitus-related fear, and social support risk, while tinnitus-related disability remained relatively low.

All indicators were coded in the risk direction before standardization. Higher scores indicate greater risk or impairment.

Differences across profiles

The high psychosocial risk–high disability profile had higher proportions of residents with no formal education, smoking history, and hypertension than the other profiles. In this profile, 65 of 81 residents (80.2%) had no formal education, 51 of 81 (63.0%) had a smoking history, and 73 of 81 (90.1%) had hypertension. Tinnitus duration also differed across profiles; no resident in the high psychosocial risk–high disability profile reported tinnitus duration longer than 5 years.

The health appraisal and support vulnerability–low disability profile was predominantly female, with 45 of 66 participants (68.2%) being women. These descriptive differences should be interpreted cautiously because some category distributions were sparse.

Factors associated with profile membership

Table 3 presents the multinomial logistic regression results, with the high psychosocial risk–high disability profile as the reference category. Age and sex were not significantly associated with profile membership.

Educational level was consistently associated with profile membership. Compared with participants with primary school education or below, those with junior high school education or above had higher odds of membership in the low psychosocial risk–low disability profile (OR 5.92, 95% CI 2.00–17.50, P = 0.001), the moderate psychosocial risk–moderate disability profile (OR 39.17, 95% CI 10.75–142.79, P < 0.001), and the health appraisal and support vulnerability–low disability profile (OR 6.35, 95% CI 2.09–19.29, P = 0.001).

Smoking history was significant only for the moderate psychosocial risk–moderate disability profile, with lower odds relative to the reference profile (OR 0.10, 95% CI 0.02–0.45, P = 0.002). Alcohol history was significant only for the low psychosocial risk–low disability profile (OR 0.25, 95% CI 0.08–0.77, P = 0.016).

Hypertension was associated with markedly lower odds of membership in all three non-reference profiles: the low psychosocial risk–low disability profile (OR 0.009, 95% CI 0.003–0.027, P < 0.001), the moderate psychosocial risk–moderate disability profile (OR 0.017, 95% CI 0.005–0.054, P < 0.001), and the health appraisal and support vulnerability–low disability profile (OR 0.021, 95% CI 0.007–0.066, P < 0.001). These estimates should be interpreted cautiously, given the concentration of hypertension in the reference profile.

Tinnitus duration was not included in the final adjusted model because of complete separation: no participants in the reference profile reported tinnitus duration longer than 5 years.

Table 3
Multinomial logistic regression analysis of factors associated with latent profile membership

Variable	Profile 1 vs Profile 3 OR (95% CI)	P-value	Profile 2 vs Profile 3 OR (95% CI)	P-value	Profile 4 vs Profile 3 OR (95% CI)	P-value
Age (per 1-year increase)	0.98 (0.93, 1.05)	0.626	1.03 (0.96, 1.09)	0.445	1.00 (0.93, 1.06)	0.893
Sex (Female vs Male)	1.46 (0.54, 3.93)	0.453	0.69 (0.25, 1.89)	0.475	1.52 (0.55, 4.24)	0.420
Education, junior high school or above vs primary school or below	5.92 (2.00, 17.50)	0.001	39.17 (10.75,142.79)	< 0.001	6.35 (2.09, 19.29)	0.001
Smoking history (Yes vs No)	0.48 (0.15, 1.47)	0.198	0.10 (0.02,0.45)	0.002	0.40 (0.12,1.28)	0.121
Alcohol history (Yes vs No)	0.25 (0.08, 0.77)	0.016	0.55 (0.18, 1.71)	0.302	0.54 (0.17,1.66)	0.282
Hypertension (Yes vs No)	0.009 (0.003, 0.027)	< 0.001	0.017 (0.005, 0.054)	< 0.001	0.021 (0.007, 0.066)	< 0.001

Notes: Profile 3, the high psychosocial risk-high disability profile, was used as the reference category. Profile 1 = low psychosocial risk-low disability; Profile 2 = moderate psychosocial risk-moderate disability; Profile 4 = health appraisal and support vulnerability-low disability. OR, odds ratio; CI, confidence interval. Education was collapsed into primary school or below versus junior high school or above because sparse and zero cells were observed in the original multi-category coding. Tinnitus duration was not included in the final adjusted model because no participants in the reference profile had tinnitus duration longer than 5 years, resulting in complete separation. Estimates for hypertension should be interpreted cautiously because hypertension was highly concentrated in the reference profile.

Discussion

Principal findings

This study adds to the limited evidence on chronic subjective tinnitus among older adults in long-term care by showing that psychosocial vulnerability may be present even when tinnitus-related disability is relatively low. Using a person-centered approach, we identified four psychosocial-functional profiles: the low psychosocial risk–low disability profile (n = 126, 32.3%), the moderate psychosocial risk–moderate disability profile (n = 117, 30.0%), the high psychosocial risk–high disability profile (n = 81, 20.8%), and the health appraisal and support vulnerability–low disability profile (n = 66, 16.9%).

Three profiles broadly followed a gradient from lower to higher psychosocial risk and tinnitus-related disability. The health appraisal and support vulnerability–low disability profile, however, showed a non-concordant pattern, with relatively low tinnitus-related disability but more unfavorable health appraisal, stronger tinnitus-related fear, and lower perceived social support. In this study, unfavorable health appraisal refers to residents' negative evaluation or interpretation of their health status as captured by the study indicator, rather than objectively assessed cognitive impairment.

Interpretation in the geriatric long-term care context

Chronic tinnitus in long-term care facilities occurs in a setting shaped by multimorbidity, dependence on care routines, reduced autonomy, communication difficulties, and limited informal support [34–37]. In this context, tinnitus is not only an auditory symptom. Its impact may also depend on how residents appraise their health, how fearful they are of tinnitus-related consequences, how much support they perceive, and how confident they feel in managing symptoms.

The high psychosocial risk–high disability profile accounted for about one fifth of the sample, indicating a subgroup with both substantial tinnitus-related disability and broader psychosocial vulnerability. By contrast, the health appraisal and support vulnerability–low disability profile suggests that some residents may have less visible support needs, particularly when fear, negative health appraisal, and weak perceived support coexist with lower disability scores.

The association between hypertension and profile membership should be interpreted cautiously. Hypertension appeared more common in the high psychosocial risk–high disability profile, but sparse data and limited covariate variability may have affected the estimates. This finding should therefore be regarded as hypothesis-generating rather than evidence that hypertension independently characterizes psychosocial-functional profile membership. Future studies with larger samples and more complete measures of multimorbidity, frailty, medication burden, and cardiovascular health are needed.

Health-appraisal and support vulnerability with low disability

The health appraisal and support vulnerability–low disability profile is particularly relevant for geriatric assessment. Residents in this profile reported relatively low tinnitus-related disability but showed more unfavorable health appraisal, stronger tinnitus-related fear, and lower perceived social support. This pattern suggests that psychosocial vulnerability and functional burden do not always move in parallel.

One explanation is that structured routines and staff support in long-term care facilities may help some residents maintain daily functioning despite psychosocial vulnerability. Another possibility is that this

profile represents an earlier stage of risk, before disability, distress, sleep problems, or care needs become more prominent. Because this study was cross-sectional and lacked several relevant clinical variables, this interpretation remains exploratory and requires longitudinal confirmation.

Comparison with previous literature

The observed heterogeneity is consistent with previous tinnitus research showing substantial variation in distress, disability, and psychological functioning among people with chronic tinnitus [38–40]. It also aligns with person-centered studies in hearing impairment and other chronic symptom populations, where latent profiles can reveal combinations of vulnerability and resilience that are not easily captured by variable-centered analyses [18, 20].

The present study extends this perspective to older adults living in long-term care facilities. From a geriatric perspective, these findings are also consistent with broader evidence linking social support, psychological distress, multimorbidity, and frailty-related vulnerability in later life [41–43]. Most tinnitus studies have been conducted in community or outpatient samples, whereas long-term care residents often have more complex health conditions, weaker informal support, and greater dependence on the care environment. In this population, modest tinnitus disability may still coexist with clinically relevant fear, negative health appraisal, low support, or poor self-efficacy.

Implications for assessment and support

These findings support a broader approach to tinnitus-related assessment in long-term care. Admission assessment and periodic care review could include brief screening for tinnitus-related disability, tinnitus-related fear, perceived social support, and self-efficacy. Staff may also need to attend to sleep disturbance, communication avoidance, anxiety responses, repeated reassurance-seeking, or withdrawal from activities.

Profile-informed care planning may help teams match support to residents' needs. Residents in the low psychosocial risk–low disability profile may need routine monitoring and reassurance. Those in the moderate psychosocial risk–moderate disability profile may benefit from structured tinnitus education, communication support, and self-management reinforcement. Residents in the health appraisal and support vulnerability–low disability profile may warrant early psychosocial support despite lower disability scores. Residents in the high psychosocial risk–high disability profile may require more comprehensive assessment involving nursing staff, geriatric clinicians, audiology or otolaryngology services, and psychological support when available.

Strengths and limitations

A strength of this study is its focus on older adults with chronic subjective tinnitus living in long-term care facilities, a population that has received limited attention in tinnitus research. In this setting, sensory symptoms, psychosocial resources, chronic disease burden, and functional reserve are closely intertwined. The use of latent profile analysis provided a person-centered view of this heterogeneity and identified a subgroup with relatively low tinnitus-related disability but clear psychosocial vulnerability.

Several limitations should be considered. First, the cross-sectional design precludes conclusions about temporal order or causality. Second, latent profile analysis depends on the selected indicators, model specification, model selection criteria, and sample characteristics; the profiles should therefore be interpreted as exploratory classifications rather than fixed clinical subtypes. Third, small profile sizes and sparse covariate distributions may have affected the stability of regression estimates, particularly for hypertension. Fourth, all measures were self-reported and may have been influenced by recall, comprehension, social desirability, or assisted-completion bias. Fifth, the dataset lacked several clinically relevant variables, including objective hearing loss, objective cognitive function, frailty, depression, anxiety, sleep quality, pain, medication burden, and tinnitus loudness. Although tinnitus duration was collected, it could not be retained in the final adjusted model because of complete separation. Finally, participants were recruited from long-term care facilities in urban Wuhan using non-probability sampling, which may limit generalizability beyond similar settings. Despite these limitations, the findings highlight a clinically relevant pattern of psychosocial vulnerability among long-term care residents with chronic tinnitus and provide a basis for future longitudinal and intervention studies.

Future research

Future studies should examine whether these profiles can be reproduced in other long-term care populations and whether they remain stable over time. Longitudinal research incorporating objective auditory assessment, geriatric vulnerability indicators, psychological symptoms, sleep and pain measures, medication burden, and detailed tinnitus characteristics would help determine whether health-appraisal/support vulnerability with low disability predicts later functional decline, distress, or increased care needs. External validation is also needed before these profiles can be used as clinical risk categories.

Conclusions

Older adults with chronic subjective tinnitus living in long-term care facilities showed distinct psychosocial-functional profiles. One subgroup was characterized by health-appraisal/support vulnerability despite relatively low tinnitus-related disability, suggesting that support needs may be missed when assessment focuses only on disability burden. Person-centered profiling may help inform geriatric assessment, psychosocial screening, risk stratification, and targeted support in long-term care facilities. Future longitudinal studies are needed to externally validate these profiles and evaluate their stability and prognostic significance.

Abbreviations

aBIC	sample-size-adjusted Bayesian information criterion
AIC	Akaike information criterion
BIC	Bayesian information criterion

BLRT	bootstrap likelihood ratio test
BMI	body mass index
CI	confidence interval
CNY	Chinese yuan
EEI	model with equal variances across profiles and zero covariances between indicators
FTQ	Fear of Tinnitus Questionnaire
LL	log-likelihood
LMR-LRT	Lo–Mendell–Rubin adjusted likelihood ratio test
LPA	latent profile analysis
OR	odds ratio
SD	standard deviation
SSA-13	13-item Short-form Social Support Appraisals Scale for older adults
THI	Tinnitus Handicap Inventory
VVV	model with freely varying variances and covariances across profiles

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of the Department of Science and Training, General Hospital of Central Theater Command, approval number [2025]193-01. All participants provided written informed consent.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

No funding was received for this study.

Authors' contributions

ZL and LYC conceptualised and designed the study, ZL, LYC, LY, and WMM did data acquisition, ZL did formal analysis and visualization, ZL did writing—original draft, LYC, LY, WMM, LHF, and SY did writing—reviewing and editing. ZL and LYC were co-first authors. LHF and SY were co-corresponding authors. All authors read and approved the final manuscript.

Acknowledgements

The authors would like to thank all participants for their time and cooperation. We also thank the administrators and staff of the participating nursing homes for their support and assistance during participant recruitment and data collection.

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Figures

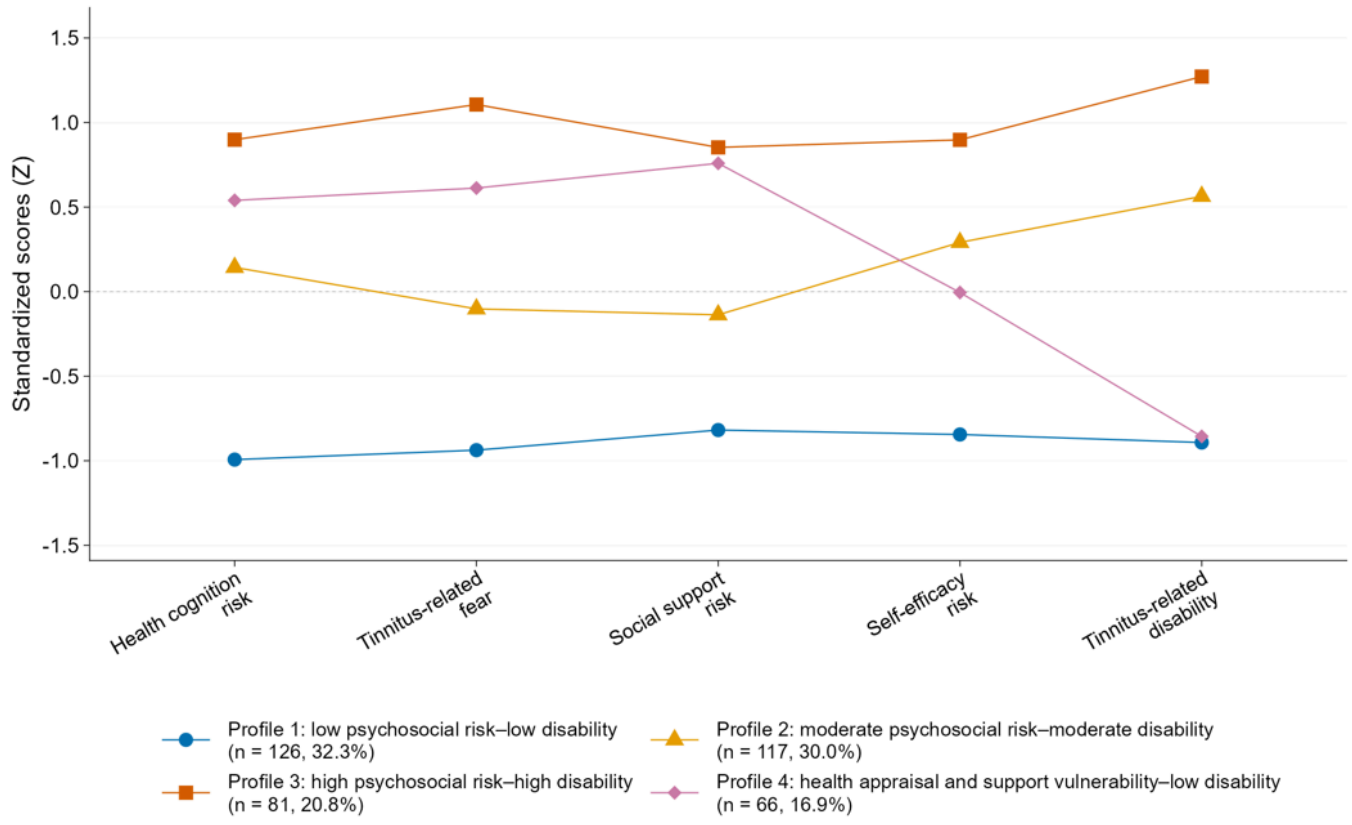


Figure 1

Mean standardized (Z) scores of the five latent profile indicators across the four retained profiles

All indicators were coded in the risk direction before standardization. Higher scores indicate greater risk or impairment.

Supplementary Files

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