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Cross Sectional Associations among Oral Health Status Oral Health Related Quality of Life and Psychological Distress in Community Dwelling Older Adults with Functional Disability

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ABSTRACT: Background: Older adults with functional disability are particularly vulnerable to poor oral health and psychological distress, yet the role of oral health-related quality of life in linking these conditions remains insufficiently understood. This study assessed oral health status, OHRQoL, and psychological distress among community-dwelling older adults with functional disability and examined whether OHRQoL was statistically associated with an indirect pathway between oral health status and psychological distress. **Methods:** A cross-sectional study was conducted involving 168 older adults with functional disability recruited from a community outpatient clinic in Nanjing. Oral health, OHRQoL, and psychological distress were assessed using the Brief Oral Health Status Examination (BOHSE), Geriatric Oral Health Assessment Index (GOHAI), and Kessler Psychological Distress Scale (K10). Associations were examined using Spearman's rank correlation and a covariate-adjusted cross-sectional indirect-association analysis with PROCESS Model 4 and 5000 bootstrap resamples. **Results:** Median BOHSE, GOHAI, and K10 scores were 9 (6, 12), 30 (26, 40.75), and 17 (14, 23.75), respectively. Correlation analysis revealed that BOHSE was significantly negatively correlated with GOHAI (Spearman's $\rho = -0.643$, $p < 0.001$) and positively correlated with K10 ($\rho = 0.546$, $p < 0.001$), while GOHAI was significantly negatively correlated with K10 ($\rho = -0.562$, $p < 0.001$). The bootstrap analysis identified a statistically significant indirect association through OHRQoL (indirect effect $B = 0.27$, 95% CI: 0.08 to 0.48), corresponding descriptively to 24.6% of the total association. **Conclusions:** Poorer oral health was associated with greater psychological distress, and OHRQoL represented a statistically significant indirect pathway in this cross-sectional model. Interventions aimed at improving OHRQoL may represent a promising strategy for enhancing psychological distress in this population.

KEYWORDS: Oral health status; oral health-related quality of life (OHRQoL); psychological distress; cross-sectional indirect association

1 Introduction

With the accelerating process of global population aging and the continuous increase in life expectancy, the number of older adults living with chronic diseases is rapidly expanding [1]. Disability, defined as

limitations in activities of daily living due to impairments in physical or cognitive function, has emerged as a major challenge in the aging population. In addition to bearing a substantial burden of physical illness, older adults with functional disability often experience compromised mental health, characterized by an increased risk of depression and anxiety, as well as reduced subjective well-being, all of which significantly impair their quality of life in later years [2–4].

Within the long-term care system for older adults with functional disability, oral health is frequently marginalized or overlooked compared with chronic conditions that pose immediate life-threatening risks, such as cardiovascular and cerebrovascular diseases. However, due to factors including impaired manual dexterity affecting oral hygiene practices, decreased cognitive function leading to poor treatment compliance, and xerostomia induced by long-term polypharmacy, this population is particularly vulnerable to oral health problems. These commonly include a high prevalence of dental caries, rapid progression of periodontal disease, and widespread tooth loss or edentulism [5–7].

Previous studies have demonstrated that poor oral health not only compromises essential physiological functions such as mastication and swallowing, thereby affecting nutritional intake, but is also significantly associated with deteriorated psychological distress in older adults [8–10]. Nevertheless, the potential statistical pathways underlying the association between impaired oral health and psychological distress remain insufficiently understood. The associations examined in this study were conceptually informed by the Wilson and Cleary model of health-related quality of life, which organizes patient outcomes into five levels comprising biological and physiological factors, symptom status, functional status, general health perceptions, and overall quality of life [11]. In adapting this framework to the present study, Brief Oral Health Status Examination (BOHSE) was considered an indicator of clinically assessed oral health status corresponding broadly to biological and physiological factors. Geriatric Oral Health Assessment Index (GOHAI) captured patient-reported oral symptoms, pain or discomfort, functional limitations, and psychosocial experiences, thereby spanning aspects of symptom status, functional status, and health perceptions. Kessler Psychological Distress Scale (K10) was treated as a distal patient-reported measure of psychological distress, although it is not equivalent to the overall quality-of-life construct in the original model. Previous studies have examined related associations in general older populations [12–14]; however, evidence regarding this statistical pathway among older adults with functional disability remains limited. Functional limitations may compound the adverse experiences associated with oral problems, including difficulties with eating and social participation, making this population particularly important to investigate.

Addressing this gap, the present cross-sectional study aimed to describe oral health status, OHRQoL, and psychological distress; evaluate their pairwise associations; and estimate the cross-sectional indirect association through OHRQoL. The findings are expected to provide a theoretical basis for optimizing oral health management and psychological intervention strategies in this vulnerable population.

2 Methods

2.1 Study Participants

This study employed a cross-sectional survey design. Using a convenience sampling method, older adults with functional disability attending the geriatric outpatient clinic of a community in Nanjing from January 2023 to June 2025 were recruited as study participants. The inclusion criteria were as follows: (1) age ≥ 60 years; (2) Barthel Index score ≤ 95 ; and (3) provision of informed consent by the participant or their legal guardian. The exclusion criteria were as follows: (1) individuals in the acute phase or critical stage of disease, or with unstable vital signs; (2) those with previously diagnosed severe psychiatric disorders, such as schizophrenia or current major depressive episodes, or cognitive impairment (such as Alzheimer's

disease) that precluded effective communication or cooperation with the examination; (3) those with a history of head and neck radiotherapy or currently undergoing chemotherapy.

A Barthel Index (BI) score of ≤ 95 was used as the inclusion criterion to identify individuals with any degree of functional impairment. In geriatric clinical practice, a BI score of 100 represents total independence, whereas a score of 95 or below indicates that the individual has at least one limitation or requires some level of assistance in activities of daily living (ADL). Using this cutoff allowed the study to capture a broad spectrum of functional disability within the community-dwelling population. Based on a conservative rule of 15 participants per predictor, and considering that the most highly adjusted regression equation included a maximum of 10 predictors comprising oral health status, oral health-related quality of life, and eight prespecified covariates, the minimum required analyzable sample size was set at 150 participants.

This study was approved by the Ethics Committee of Nanjing Stomatological Hospital (No. NJSJH-2021NL-020) and was conducted in accordance with the Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects.

2.2 Measures

2.2.1 Assessment of Oral Health Status

The oral health status of the participants was comprehensively and objectively assessed using the BOHSE [15]. The Chinese version of the BOHSE has demonstrated good reliability, with a Cronbach's α coefficient of 0.873 and a test-retest reliability of 0.775, indicating its suitability for use by non-dental professionals in evaluating the oral health status of hospitalized older adults [16].

The BOHSE consists of 10 objectively assessed items based on visual inspection, covering the condition and hygiene of both oral soft and hard tissues. The specific domains include lymph nodes, lips, tongue, oral mucosa, gums, saliva (moisture), natural teeth (e.g., caries/fracture), dentures (e.g., damage/retention), oral cleanliness (e.g., plaque/food debris), and oral odor. Each item is rated on a 3-point scale according to the severity of the problem: 0 = normal/no abnormality, 1 = mild abnormality, and 2 = severe abnormality. The total score ranges from 0 to 20, with higher scores indicating poorer oral health status.

All BOHSE assessments were performed by a single trained registered nurse. Before data collection, the nurse received standardized training from an experienced dentist. During the calibration phase, the nurse and the dentist independently assessed a pilot group of 10 older adults (not included in the final sample) to ensure scoring consistency, achieving a strong inter-rater reliability (Cohen's kappa = 0.86).

2.2.2 Assessment of OHRQoL

Participants' oral health-related quality of life (OHRQoL) was assessed using the Chinese version of the GOHAI [17]. The GOHAI contains 12 items covering three major domains: physical function (e.g., difficulty chewing and swallowing), psychosocial function (e.g., social avoidance and impaired self-image), and pain or discomfort (e.g., oral pain and sensitivity). To ensure that higher total scores represent better OHRQoL, the three positively worded items (Item 3: swallowed comfortably; Item 5: able to eat without discomfort; and Item 7: pleased with appearance) were reverse-scored (1 = never to 5 = always). The remaining nine negatively worded items were scored normally (1 = always to 5 = never). The total GOHAI score is calculated by summing the scores of all 12 items, yielding a possible range of 12 to 60. Higher scores indicate better OHRQoL. Participants with any missing responses on the GOHAI scale were excluded from the analysis. In the current sample, the GOHAI demonstrated acceptable internal consistency (Cronbach's α = 0.75).

2.2.3 Assessment of Psychological Distress

Participants' overall psychological distress was evaluated using the 10-item Kessler Psychological Distress Scale (K10). This scale has demonstrated excellent reliability, with a Cronbach's α coefficient of 0.93 [18]. The K10 consists of 10 items assessing the frequency of specific negative emotional states experienced over the past 30 days, such as feeling nervous, hopeless, or that everything was an effort. Each item is rated on a 5-point scale: 1 = none of the time, 2 = a little of the time, 3 = some of the time, 4 = most of the time, and 5 = all of the time. The total K10 score is obtained by summing the scores of all 10 items, resulting in a score range of 10 to 50. Higher scores indicate greater psychological distress and poorer psychological distress. In the current sample, the K10 demonstrated excellent internal consistency (Cronbach's α = 0.88).

2.2.4 Assessment of Covariates

Researchers collected demographic and clinical baseline characteristics at enrollment using a standardized data collection form through face-to-face interviews with the participants or their legal guardians, supplemented by verification against outpatient medical records. The variables collected included age, gender, educational level, marital status, self-reported economic status, number of physician-diagnosed chronic comorbidities, and duration of disability. Trained investigators assessed participants' level of dependence in activities of daily living using the Barthel Index, which evaluates 10 activities of daily living and yields a total score ranging from 0 to 100, with higher scores indicating greater functional independence. Disability severity was categorized as mild (61–95 points), moderate (41–60 points), or severe (0–40 points).

2.2.5 Data Collection Procedures

All participants provided their own responses to the GOHAI and K10. Both scales were administered through face-to-face interviews by trained researchers. For participants with limited literacy, visual impairment, or difficulty reading the questionnaire, each item and its response options were read aloud verbatim, and the researchers recorded the response selected by the participant. Guardians could provide background information or facilitate communication when necessary but were not permitted to answer GOHAI or K10 items on behalf of the participants.

2.3 Statistical Analysis

Data were processed and analyzed using SPSS version 31.0 (IBM Corp., Armonk, NY, USA). Data normality was verified using the Shapiro-Wilk test. Continuous variables with non-normal distribution were expressed as median (interquartile range [IQR]). Comparisons between two independent groups were performed using the Mann-Whitney U test, whereas comparisons among three or more groups were conducted using the Kruskal-Wallis H test. When the Kruskal-Wallis test indicated a significant overall difference, post-hoc pairwise comparisons were performed using Dunn's test with Bonferroni correction for multiple comparisons. These subgroup comparisons were exploratory. Spearman's rank correlation coefficients (ρ) were used to examine pairwise associations among BOHSE, GOHAI, and K10 total scores. PROCESS Model 4 [19] with 5000 bootstrap resamples was used to estimate the cross-sectional indirect association of OHRQoL (GOHAI) in the association between oral health status (BOHSE) and psychological distress (K10), with adjustment for the prespecified demographic and clinical covariates. Unstandardized coefficients (B) and 95% confidence intervals (CIs) were reported. An indirect association was considered statistically significant when its bootstrap 95% CI excluded zero. The ratio of the indirect to total association

was calculated descriptively as $(a \times b)/c$ and was not interpreted as the proportion of a causal mechanism explained. All tests were two-sided, and $p < 0.05$ was considered statistically significant.

3 Results

3.1 Baseline Characteristics of the Study Participants

Initially, 215 individuals were approached and screened for eligibility. Of these, 25 declined to participate. Among the remaining 190 individuals who provided informed consent and underwent eligibility assessment, 10 were deemed ineligible according to the predefined exclusion criteria: seven were in the acute or critical stage of illness, and three had Alzheimer's disease that precluded effective communication or cooperation with the assessment. The remaining 180 eligible participants were enrolled and underwent data collection. Subsequently, 12 participants were excluded from the final analysis because of incomplete assessment data. Therefore, 168 participants were included in the final analysis (Fig. 1). Specifically, missingness occurred in the GOHAI ($n = 7$), K10 ($n = 3$), and disability-related covariates ($n = 2$). A comparison between the excluded ($n = 12$) and included ($n = 168$) participants revealed no significant differences in median age, gender distribution, or disability severity, suggesting that the missing data did not introduce systematic bias.

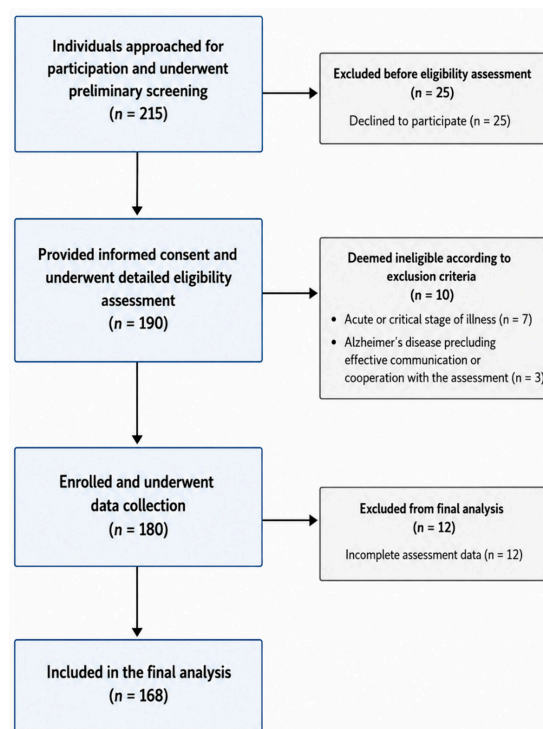


Figure 1: Flow diagram of participant selection.

The median age of the participants was 75.0 (68.0, 82.0) years. Among them, 56.5% (95/168) were male and 43.5% (73/168) were female. Nearly half of the participants had an educational level of junior high school or high school (49.4%), and the majority were married or had a partner (55.4%). With respect to clinical characteristics, 41.7% of the participants had four or more chronic comorbidities. Assessment of disability status showed that the median duration of disability was 37.0 (23.25, 51.0) months, and mild disability was the most common severity level, accounting for 54.2% (91/168) of the sample. Detailed demographic and clinical baseline characteristics of the participants are presented in Table 1.

Table 1: Baseline demographic and clinical characteristics of the study participants (N = 168).

Characteristics	Median (IQR)/n (%)
Age (years)	75.0 (68.0, 82.0)
Gender	
Female	73 (43.5%)
Male	95 (56.5%)
Education Level	
Primary School or Below	49 (29.2%)
Junior/Senior High School	83 (49.4%)
College Degree or Above	36 (21.4%)
Marital Status	
Married/Partnered	93 (55.4%)
Single/Widowed/Divorced	75 (44.6%)
Economic Status	
Poor	50 (29.8%)
General	73 (43.5%)
Good	45 (26.8%)
Number of Chronic Comorbidities	
<4	98 (58.3%)
≥4	70 (41.7%)
Disability Level	
Mild	91 (54.2%)
Moderate	48 (28.6%)
Severe	29 (17.3%)
Duration of Disability (months)	37.00 (23.25, 51.00)

3.2 Descriptive Statistics of the Main Study Variables

The median BOHSE total score was 9 (IQR: 6, 12; possible range: 0–20), and the median GOHAI total score was 30 (IQR: 26.00, 40.75; possible range: 12–60). The median K10 total score was 17 (IQR: 14.00, 23.75; possible range: 10–50), with higher K10 scores indicating greater psychological distress.

3.3 Exploratory Comparisons of Oral Health Status, OHRQoL, and Psychological Distress across Participant Characteristics

Significant differences were observed in oral health status (BOHSE total score), OHRQoL (GOHAI total score), and psychological health (K10 total score) across subgroups with different demographic and clinical characteristics (Table 2).

In terms of educational level, participants with primary school education or below had significantly higher BOHSE and K10 total scores, but a significantly lower GOHAI total score, compared with those with a college education or above (all $p < 0.05$).

Regarding marital status, the K10 total score was significantly higher in participants without a partner (single/widowed/divorced) than in those with a partner (married/partnered) ($p < 0.05$).

For economic status, participants with poor economic conditions had significantly higher BOHSE and significantly lower GOHAI scores than participants in both the general and good economic-status groups (all $p < 0.05$). For K10, participants with poor economic conditions had significantly higher scores than those with good economic conditions ($p < 0.05$), whereas the difference between the poor and general groups was not statistically significant ($p > 0.05$).

Table 2: Exploratory comparisons of oral health status, oral health-related quality of life, and psychological distress across participant characteristics.

Characteristics	n (%)	BOHSE Score	Z/H	p-Value	GOHAI Score	Z/H	p-Value	K10 Score	Z/H	p-Value
Age (years)			14.848	<0.001		9.705	0.008		2.152	0.34
<70	52 (31.0)	7.5 (5.0, 10.0)			38.00 (27.25, 46.50)			16.50 (13.00, 20.75)		
70–79	62 (36.9)	9.0 (7.0, 12.0) ^a			29.00 (25.00, 39.00) ^a			17.50 (14.00, 23.25)		
≥80	54 (32.1)	10.0 (7.0, 12.0) ^a			29.00 (25.00, 38.00) ^a			19.00 (14.00, 27.25)		
Gender			−1.179	0.24		1.339	0.18		−0.045	0.96
Female	73 (43.5)	9.0 (7.0, 12.0)			29.00 (26.00, 39.50)			17.00 (14.00, 23.50)		
Male	95 (56.5)	8.0 (5.0, 12.0)			31.00 (26.00, 43.00)			18.00 (14.00, 24.00)		
Education Level			22.199	<0.001		17.109	<0.001		19.045	<0.001
Primary School or Below	49 (29.2)	11.0 (9.0, 12.5)			27.00 (24.50, 32.00)			22.00 (15.50, 28.50)		
Junior/Senior High School	83 (49.4)	8.0 (6.0, 11.0) ^a			31.00 (25.00, 42.00) ^a			18.00 (14.00, 23.00)		
College Degree or Above	36 (21.4)	7.0 (5.0, 10.0) ^a			36.50 (30.00, 46.75) ^a			14.00 (12.00, 17.50) ^{ab}		
Marital Status			0.977	0.33		0.788	0.43		2.176	0.03
Married/Partnered	93 (55.4)	8.0 (6.0, 11.0)			30.00 (25.50, 39.50)			16.00 (13.00, 23.00)		
Single/Widowed/Divorced	75 (44.6)	9.0 (6.0, 12.0)			31.00 (26.00, 42.00)			19.00 (14.00, 24.00)		
Economic Status			25.620	<0.001		24.535	<0.001		8.592	0.01
Poor	50 (29.8)	10.0 (8.0, 13.0)			28.50 (24.75, 34.75)			19.50 (16.00, 25.00)		
General	73 (43.5)	10.0 (7.0, 12.0) ^a			29.00 (25.00, 36.50) ^a			18.00 (14.00, 24.00)		
Good	45 (26.8)	7.0 (4.5, 9.0) ^a			40.00 (32.00, 46.50) ^a			15.00 (12.00, 20.00) ^a		
Number of Chronic Comorbidities			4.178	<0.001		−2.498	0.01		2.969	0.003
<4	98 (58.3)	8.0 (5.0, 10.0)			33.50 (26.00, 43.25)			16.00 (13.00, 22.00)		
≥4	70 (41.7)	10.5 (8.0, 13.0)			28.00 (25.00, 37.00)			19.00 (16.00, 26.00)		
Disability Level			20.552	<0.001		20.970	<0.001		15.871	<0.001
Mild	91 (54.2)	7.0 (5.0, 10.0)			36.00 (28.00, 43.00)			16.00 (13.00, 20.00)		
Moderate	48 (28.6)	10.0 (8.0, 12.0) ^a			27.50 (24.00, 33.75) ^a			20.00 (16.00, 24.75) ^a		
Severe	29 (17.3)	11.0 (8.5, 13.0) ^a			26.00 (24.50, 31.50) ^a			22.00 (15.00, 27.00) ^a		
Duration of Disability (months)			−1.314	0.19		0.77	0.44		−1.618	0.11
<36	79 (47.0)	9.0 (7.0, 12.0)			30.00 (25.00, 41.00)			19.00 (14.00, 24.00)		
≥36	89 (53.0)	8.0 (5.5, 11.5)			31.00 (26.00, 40.50)			17.00 (13.00, 22.00)		

Data are presented as median (IQR). For two-group comparisons, the table reports the standardized Z statistic associated with the Mann-Whitney U test; for comparisons of three or more groups, it reports the Kruskal-Wallis H statistic. When the overall Kruskal-Wallis test was significant, pairwise comparisons were conducted using Dunn's test with Bonferroni correction. Superscript a indicates adjusted $p < 0.05$ versus the first category within the same characteristic; superscript b indicates adjusted $p < 0.05$ versus the second category. With regard to age, the BOHSE total scores in the 70–79 years group and the ≥80 years group were both significantly higher than that in the <70 years group (both $p < 0.05$), whereas the GOHAI total scores in these two older age groups were significantly lower than that in the <70 years group (both $p < 0.05$).

With respect to the number of chronic comorbidities, participants with ≥ 4 chronic diseases had significantly higher BOHSE and K10 total scores, but a significantly lower GOHAI total score, than those with < 4 chronic diseases (all $p < 0.05$).

In terms of disability severity, the BOHSE and K10 total scores in the moderately disabled group and the severely disabled group were both significantly higher than those in the mildly disabled group (both $p < 0.05$), whereas the GOHAI total scores in these two groups were both significantly lower than that in the mildly disabled group (both $p < 0.05$).

3.4 Correlation Analysis among the Main Study Variables

BOHSE total scores were negatively correlated with GOHAI total scores (Spearman's $\rho = -0.643$, $p < 0.001$) and positively correlated with K10 total scores ($\rho = 0.546$, $p < 0.001$). GOHAI total scores were negatively correlated with K10 total scores ($\rho = -0.562$, $p < 0.001$).

3.5 Cross-Sectional Indirect-Association Analysis through OHRQoL

After adjustment for age, gender, educational level, marital status, economic status, number of chronic comorbidities, disability level, and duration of disability, a path model was specified with oral health status (BOHSE total score) as X, OHRQoL (GOHAI total score) as M, and psychological distress (K10 total score) as Y (Fig. 2). The terms direct, indirect, and total association refer to statistical parameters within the fitted cross-sectional path model and do not imply temporal ordering or causality.

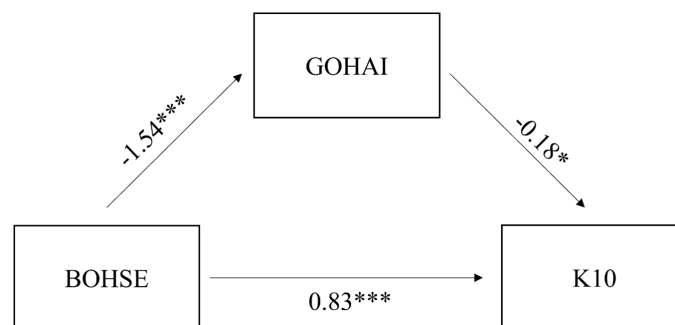


Figure 2: Path diagram of the cross-sectional direct and indirect statistical associations among oral health status, oral health-related quality of life (OHRQoL), and psychological distress in older adults with functional disability. Values are unstandardized regression coefficients (B) adjusted for age, gender, educational level, marital status, economic status, number of chronic comorbidities, disability level, and duration of disability. * $p < 0.05$; *** $p < 0.001$.

Oral health status (BOHSE) was negatively associated with OHRQoL (GOHAI) ($B = -1.54$, $p < 0.001$), and OHRQoL was negatively associated with psychological distress (K10) ($B = -0.18$, $p = 0.01$). After inclusion of GOHAI in the model, BOHSE remained positively associated with K10 ($B = 0.83$, $p < 0.001$). These coefficients represent adjusted cross-sectional associations.

Regression coefficients for the adjusted covariates are presented in Supplementary Table S1. The analysis revealed that beyond the main variables, several covariates showed significant statistical associations in the model. Specifically, disability severity was significantly associated with lower OHRQoL ($B = -1.62$, $p = 0.04$). Regarding psychological distress (K10), lower educational level ($B = -1.74$, $p = 0.02$) and being single, widowed, or divorced ($B = 2.01$, $p = 0.04$) were significant correlates. After adjustment for these covariates, the statistically significant indirect association between oral health status and psychological distress remained unchanged.

Bootstrap analysis showed a total association of 1.10 (95% CI: 0.74 to 1.46), a direct association of 0.83 (95% CI: 0.42 to 1.24), and an indirect association through OHRQoL of 0.27 (95% CI: 0.08 to 0.48) (Table 3). The indirect-to-total ratio was 24.6%.

Table 3: Decomposition of total, direct, and indirect statistical associations in the cross-sectional path model.

Effect	Effect Value	SE	LLCI	ULCI	Relative Effect (%)
Total effect	1.10	0.18	0.74	1.46	-
Direct effect	0.83	0.21	0.42	1.24	75.4%
Indirect effect	0.27	0.10	0.08	0.48	24.6%

4 Discussion

This study demonstrated that older adults with functional disability generally experience varying degrees of impaired oral health. This finding is closely related to the physiological and functional characteristics of this population. First, disability often limits the ability to perform routine oral hygiene practices, such as tooth brushing, mouth rinsing, and denture cleaning, which over time can lead to plaque accumulation, gingival inflammation, dental caries, and halitosis. Second, older adults with functional disability frequently present with multimorbidity and long-term medication use. Certain medications, including antihypertensives, diuretics, and antidepressants, may induce xerostomia, thereby impairing the protective functions of saliva—such as lubrication, buffering, and antimicrobial activity—and consequently increasing the risk of oral diseases [20,21].

Exploratory subgroup comparisons showed that GOHAI scores differed according to age, educational level, economic status, number of chronic comorbidities, and disability severity. Lower GOHAI scores were observed among older participants and those with lower educational attainment, poorer economic status, multiple chronic comorbidities, or moderate-to-severe disability [22]. Because numerous comparisons were conducted across the three study outcomes, these findings should be regarded as hypothesis-generating and should not be interpreted as evidence that these characteristics independently predict poorer OHRQoL. The GOHAI not only reflects local oral symptoms but also captures multidimensional experiences, including chewing and swallowing function, eating comfort, communication ability, self-image, and social interaction. For older adults with functional disability, oral health problems may interact synergistically with factors such as inadequate nutritional intake, increased dependence during meals, social withdrawal, and diminished self-perception, ultimately resulting in substantial deterioration in overall quality of life [23–25].

Regarding psychological distress, our findings indicate that older adults with functional disability experience a certain degree of psychological distress, with more severe problems observed among those without a partner, with lower educational attainment, poorer economic conditions, a higher burden of chronic diseases, and greater disability severity. These findings suggest that psychological distress in this population is related to multiple vulnerability factors. On the one hand, disability itself entails reduced autonomy, diminished social roles, and increased dependence on caregivers, which may contribute to feelings of helplessness and negative emotions. On the other hand, lower educational levels and poorer economic conditions may limit health literacy, access to healthcare, and social support resources, thereby amplifying the psychological impact of disease and functional impairment [26].

Correlation analysis further revealed that BOHSE scores were positively associated with K10 scores, whereas GOHAI scores were negatively associated with K10 scores, indicating that poorer oral health is associated with greater psychological distress, while better OHRQoL is associated with reduced psychological burden [27]. This relationship is further supported by recent studies in vulnerable populations. Alharbi

et al. [21] reported that physically disabled individuals commonly experience poor oral health, primarily due to limitations in performing self-care. Similarly, Hsu et al. [28] found a negative association between OHRQoL and depressive symptoms in middle-aged and older adults. Collectively, these findings reinforce the role of OHRQoL as a statistical indirect pathway linking objective oral health deficits to psychological outcomes. Oral discomfort, difficulties in chewing and swallowing, halitosis, and impaired appearance may adversely affect eating experiences, social interactions, and self-esteem, thereby exacerbating negative emotional states in older adults. Notably, because the GOHAI includes psychosocial items related to social avoidance and self-image, its content may partly overlap with the negative emotional states measured by the K10. This conceptual overlap, alongside the shared self-report nature of both scales, likely contributes to the observed strength of the indirect association.

A key finding of this study is that OHRQoL plays a statistically significant indirect pathway in the association between oral health status and psychological distress, corresponding descriptively to 24.6% of the total association [11]. This ratio is descriptive and lacks a reported confidence interval; it should not be interpreted as showing that a quarter of a causal mechanism was explained. This hierarchical relationship is consistent with the theoretical framework of Wilson and Cleary's model, which posits that objective clinical variables (biological/physical status) do not directly determine distal outcomes like psychological distress; instead, they operate through intermediate stages of functional status and OHRQoL [29,30]. Notably, the direct association between BOHSE and K10 remained significant after adjusting for OHRQoL, indicating that oral health status may also be linked to psychological distress through additional pathways beyond OHRQoL. These may include chronic inflammatory burden, pain experience, malnutrition, or increased dependency on caregivers.

The findings support further investigation of integrated oral-health and psychological approaches, but the present study did not test an intervention. Future longitudinal and randomized studies could evaluate whether oral-health treatment, denture rehabilitation, oral-hygiene education, counseling, social-engagement activities, or self-efficacy programs improve OHRQoL or psychological distress [31–33].

Several limitations should be acknowledged. First, due to the cross-sectional design, this study can only identify associations and mediation relationships, but cannot establish causal inferences. Second, the study sample was recruited using convenience sampling from a single community outpatient clinic in Nanjing over a prolonged recruitment period, which may have introduced selection bias and limited the representativeness of the sample. Therefore, the generalizability of the findings to the broader population of older adults with functional disability should be interpreted with caution. Third, GOHAI and K10 were self-reported and partly overlap in psychological content, including social avoidance, self-image, and negative emotional states; shared method variance may therefore have contributed to their association. Fourth, residual confounding remains possible because potentially relevant factors such as oral pain, number of remaining teeth, denture status, medication use, nutrition, smoking, and social support were not included in the reported model. Finally, the exclusion of participants with severe psychiatric disorders or current major depressive episodes may have restricted the range of psychological distress scores and potentially underestimated the association between oral health status and psychological distress. Future multicenter longitudinal studies are warranted to further clarify the causal pathways linking oral health to psychological outcomes and to evaluate whether targeted interventions aimed at improving OHRQoL can effectively enhance psychological distress among older adults with functional disability.

5 Conclusions

Among community-dwelling older adults with functional disability, poorer oral health was associated with greater psychological distress, and OHRQoL represented a statistically significant indirect pathway in the fitted cross-sectional model. The findings are hypothesis-generating and do not establish temporal or causal mediation. Longitudinal and intervention studies are needed before specific oral-health or psychosocial programs can be recommended as effective strategies for reducing psychological distress.

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Ethics Approval: This study was approved by the Ethics Committee of Nanjing Stomatological Hospital (No. NJSJH-2021NL-020) and was conducted in accordance with the Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. Informed consent was obtained from the participants.

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