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Original Article

# Significant association of oral health-related quality of life with mental depression in middle-aged and older Taiwanese adults

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**KEYWORDS**
Mental depression;
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Oral health-related quality of life

**Abstract** *Background/purpose:* With the gradual aging of the population, oral health has emerged as a critical concern alongside mental well-being. This study endeavored to investigate the relationship between oral health-related quality of life (OHRQoL) and mental depression in middle-aged and older population.

*Materials and methods:* Based on the Taiwan Longitudinal Study on Aging in 2015, 7631 participants were enrolled. OHRQoL was assessed utilizing the Taiwan version of the Oral Health Impact Profile questionnaire, stratifying individuals into five categories (excellent, good, fair, poor, and very poor). The excellent OHRQoL group was regarded as the reference group. Depression status was evaluated using the 10-item Center for the Epidemiological Studies of Depression Short Form questionnaire. Descriptive statistics and Pearson's chi square test were applied to elucidate the demographic characteristics and the differences among the five OHRQoL groups, respectively. Multivariable logistic regression was applied to elucidate the association of OHRQoL with depression after controlling for confounding factors.

*Results:* After controlling for covariates such as age, sex, marital status, living status, residency status, religion, level of physical activity, and pressures arising from personal or familial

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concerns, the adjusted ORs of experiencing mental depression were 1.45 (95% CI: 1.198—1.760, $P < 0.001$), 2.25 (95% CI: 1.791—2.829, $P < 0.001$), 3.88 (95% CI: 2.730—5.525, $P < 0.001$), and 6.87 (95% CI: 3.116—15.129, $P < 0.001$) for the good, fair, poor, and very poor OHRQoL groups, respectively, which demonstrated a gradually increased relationship.
*Conclusion:* Oral health-related quality of life was negatively associated with mental depression in middle-aged and older adults.


## Introduction

The advent of modern technology has catalyzed an increase in life expectancy across numerous nations.[1] Consequently, the burgeoning population of senior citizens has underscored the imperative of addressing healthcare challenges pertinent to aging societies.[2] Implementation of age-friendly healthcare systems, exemplified by the establishment of geriatrics specialty training programs, post-acute services, and fortified connections between health and social care services, has become a focal point in several countries.[3] Among the myriad healthcare concerns confronting aging populations, oral health and mental well-being emerge as pivotal components, pivotal to the pursuit of successful and healthy aging.[4]

The oral health of elderly individuals represents a critical facet of overall well-being often marginalized on the global health agenda. Aging adults confront heightened susceptibility to oral cavity infections, precipitating significant complications that impact their quality of life, nutritional intake, and general health.[5] Predominant oral health issues among the elderly encompass dental caries, periodontal disease, and xerostomia.[6] Sustaining optimal oral health in this demographic assumes paramount importance, not only for preserving chewing function and nutritional absorption, but also for fostering a high quality of life as they age.[7] Oral health-related quality of life (OHRQoL) encapsulates a multifaceted construct encompassing physical, psychological, and social dimensions, alongside Oral Impact on Daily Performance (OIDP). This composite metric delineates individuals' perceptions regarding the influence of oral health on their overall well-being and capacity to engage in daily activities.[8] Its assessment typically entails the utilization of multifaceted questionnaires.[9] Consequently, OHRQoL serves as an invaluable instrument for gauging the ramifications of oral health conditions on individuals' quality of life, spotlighting the imperative of augmenting oral health behaviors and management to optimize overall well-being.[10]

In terms of mental health, depression in the elderly population is a significant concern globally, with prevalence rates varying across studies, ranging from 17.05% to 40.78%.[11] A plethora of factors, encompassing age, gender, religion, social deprivation, loneliness, and presence of chronic illness or poor health status, underpin geriatric depression.[12] Emerging evidence suggests a nexus between oral health-related quality of life and depression, transcending diverse populations, including the general adult population in Germany[13] and older adults in Korea.[14]

However, sparse literature has addressed individuals' depression status while adjusting for pressures stemming from personal or familial health concerns, occupational demands, financial constraints, and marital dynamics. Based on comprehensive questionnaire surveys from the Taiwan longitudinal study on aging (TLSA), the aim of this paper is to elucidate the relationship between oral health-related quality of life and depression. The goal is to promote overall well-being among meddle aged and older individuals.

## Materials and methods

### Data source

The primary data source of the present study is the Taiwan Longitudinal Study on Aging (TLSA), a comprehensive national survey conducted across multiple waves, representative of middle-aged and older adults.[15] Trained interviewers administered structured questionnaires during face-to-face home visits to collect information. The questionnaires can be divided into six domains: (a) personal information, marriage status, and residence history; (b) household structure, satisfaction with a living arrangement, and interaction with children, relatives, and others; (c) health status, health utilization, and hygiene behaviors; (d) social support and exchange; (e) work history; and (f) social participation and physical safety. The analysis focused exclusively on data from the 8th wave of the TLSA conducted in 2015, which applied a cross-sectioned design. Our participant pool included individuals ($n = 2996$) previously enrolled in earlier waves, as well as a refresh cohort ($n = 5304$) newly incorporated in this wave. In total, the study encompassed 8300 participants for analysis.

### Assessment of oral health-related quality of life (OHRQoL)

Oral health-related quality of life (OHRQoL), the key independent variable of our present study, was evaluated utilizing the Taiwan version of the Oral Health Impact Profile (OHIP-7T) questionnaire, which is a modified iteration of the self-reported OHIP-14T questionnaire.[16] Comprising 7 items, the OHIP-7T evaluates diverse dimensions of OHRQoL, capturing the frequency of oral health issues experienced over the preceding 12 months. These dimensions encompass functional limitations, physical discomfort, psychological distress, physical

impairment, psychological impairment, social constraints, and handicap. Responses to the questionnaire are graded on a 5-point Likert scale for each item, ranging from 0 (never) to 4 (almost), with higher scores denoting a more pronounced impact of oral health challenges on overall quality of life.[17] Total OHIP-7T scores are derived by summing the scores of the 7 questions, yielding a maximum score of 28. Lower OHIP-7T scores are indicative of enhanced OHRQoL.[17,18] In the current investigation, OHRQoL was stratified into five categories: excellent, good, fair, poor, and very poor. These categories were delineated based on OHIP-7T scores, with corresponding ranges of 0, 1–7, 8–14, 15–21, and 22–28, respectively.

### Assessment of mental depression

Mental depression status, the outcome variable of interest, was assessed with the 10-item Center for the Epidemiological Studies of Depression Short Form (CES-D-10) questionnaire. The CES-D-10 demonstrates comparable precision to that of the 20-item CES-D, with the Cronbach's alpha for internal consistency ranges from 0.78 to 0.87 for the TLSA sample.[19,20] The questionnaire comprises 10 items that gauge the frequency of experiencing described feelings over the past week, rated on a scale from 0 (rarely or never) to 3 (most or almost all of the time). These scores from the 10 questions are totaled to yield the CES-D-10 total score, with a maximum possible score of 30. A higher CES-D-10 score indicates a more severe level of mental depression status. Consistent with prior research, a cutoff of 10 will be utilized in this study, where a CES-D-10 score of 10 or above indicates depression.[17,21]

### Covariables

Data regarding relevant covariates were obtained through structured interviews. This encompassed demographic information, participants' lifestyle factors, and pressures stemming from personal or familial concerns. Demographic details included age categories (50–64, 65–74, 75–84, and 85+ years), sex (male and female), and marital status (married and other statuses, such as single or divorced). Participants' lifestyle factors comprised living status (living with someone and living alone), residency status (community dwellers and residents of care facilities), with or without religion, and level of physical activity (none, 1 to 2 times a week, and more than 3 times a week). Pressures arising from personal or familial concerns included health issues, work-related issues, financial situation, and marital dynamics, and interacting with family members. These factors were categorized into four levels: none, some, moderate, and severe.

### Statistical analysis

Four types of statistical analyses were carried out in this study. Descriptive statistics were utilized to describe the basic variables. The categorical variables were summarized in terms of the frequency and percentages. Pearson's chi square test was conducted to assess differences among the five OHRQoL groups. Univariable analysis was performed to investigate the association between the covariates and mental depression. Covariates with a *P*-value of 0.05 or lower were included in the multiple logistic regression analysis. Multivariable logistic regression was applied to elucidate the association between OHRQoL, which was the primary independent variable, and mental depression, after adjusting for covariates. The excellent OHRQoL group was regarded as the reference group in the present study. Odds ratios and 95% confidence intervals were reported, with statistical significance set at a *P*-value of $<0.05$. All statistical analyses were undertaken using the SPSS software version 25 (IBM Corp., Chicago, IL, USA).

### Ethical concerns

For ethical concerns, all personal identification data in the TLSA are encoded to guarantee the confidentiality of the individuals according to the data regulations of Ministry of Health and Welfare, Taiwan. This study was approved by the Institutional Review Board of Tri-Service General Hospital and obtained a formal written waiver for the need of ethics approval (TSGHIRB No: E202416018).

## Results

Figure 1 illustrates the process of selecting the sample. Individuals who did not complete the OHIP-7T and CES-D-10 questionnaires were excluded from the study. After applying the exclusion criteria, a total of 7631 participants were included in the analysis. These participants were then categorized into five groups based on their OHIP-7T scores to assess Oral health-related quality of life (OHRQoL). Table 1 presents the baseline characteristics of the participants across these five OHRQoL groups. Of the 7631 participants, 51.3% were female. In terms of age distribution, 47.6% were middle-aged adults, between 50 and 64 years old. Participants aged 65 to 74, 75 to 84, and 85 years and older accounted for 29.4%, 16.8%, and 6.2% respectively. Regarding marital status, 47.7% of the participants were married, while 17.9% reported having a religious affiliation. The vast majority (99.5%) resided in the community, and 91.4% did not live alone. The prevalence of mental depression among the participants was 13.4%.

Regarding the demographic composition across the five OHRQoL groups, as depicted in Table 1, participants categorized as having excellent OHRQoL constituted the largest proportion at 46.0%, followed by those with good OHRQoL at 37.6%. The distribution further includes individuals with fair OHRQoL (12.6%), poor OHRQoL (3.6%), and very poor OHRQoL (0.6%). While there were no significant differences in gender distribution among these groups, statistically significant variations were observed in age ($P < 0.001$), marital status ($P < 0.001$), residency status ($P = 0.032$), living arrangements ($P = 0.007$), religious affiliation ($P < 0.003$), level of physical activity ($P < 0.001$), and prevalence of depression ($P < 0.001$) among the five OHRQoL categories.

Table 2 presents the association between various factors and mental depression. The findings reveal significant associations between mental depression and several variables, including age ($P < 0.001$), sex ($P < 0.001$), marital

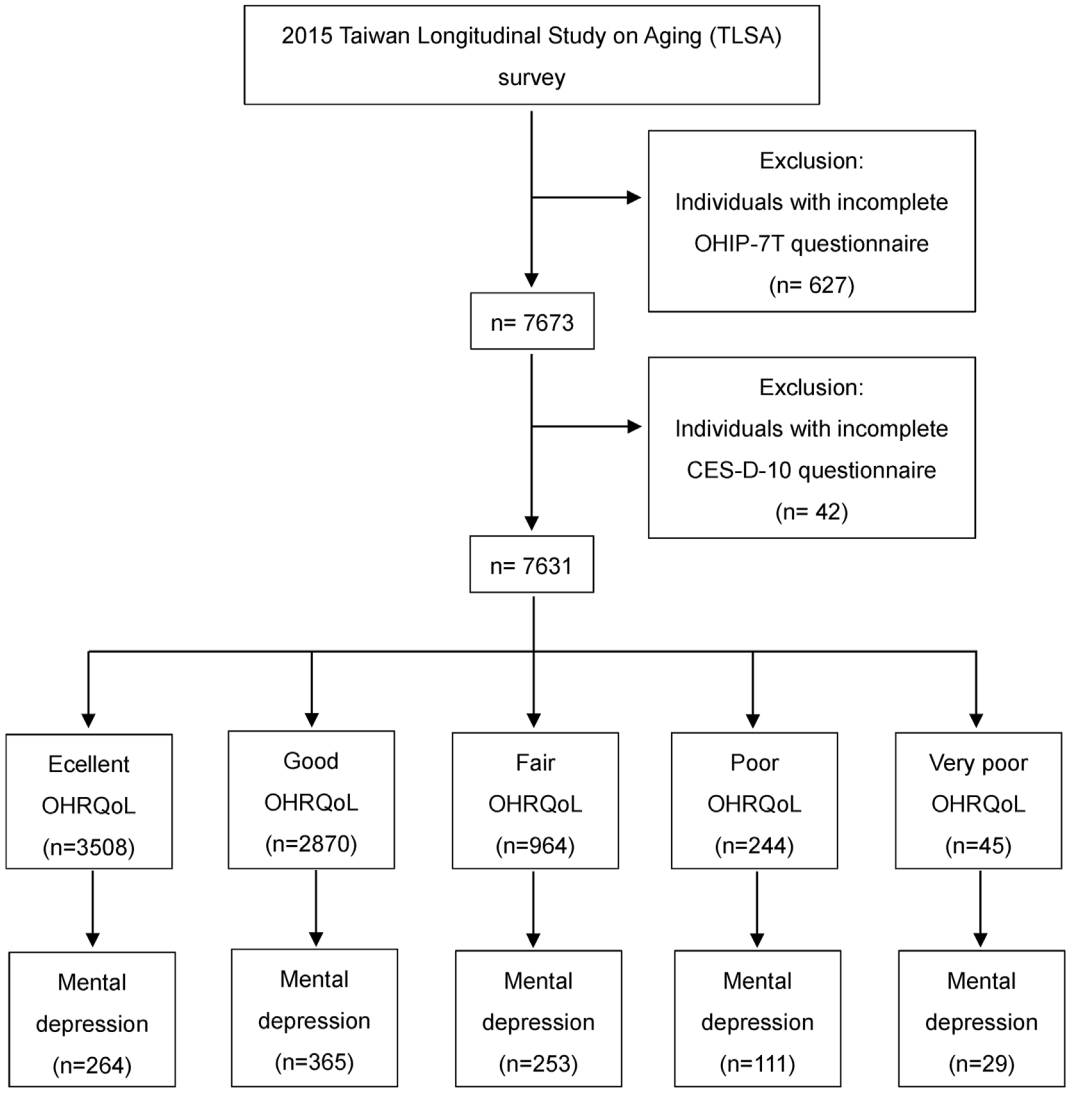


**Figure 1 The flowchart of study sample selection from 2015 Taiwan Longitudinal Study on Aging (TLSA) survey.**
[a]·CES-D-10: Center for the Epidemiological Studies of Depression Short Form questionnaire, OHRQoL: Oral health-related quality of life, OHIP-7T: Taiwan version of the Oral Health Impact Profile questionnaire, TLSA: Taiwan Longitudinal Study on Aging.

status ($P < 0.001$), residency status ($P < 0.001$), living arrangements ($P < 0.001$), religious affiliation ($P < 0.001$), level of physical activity ($P < 0.001$), as well as pressures stemming from personal or familial concerns such as health, work, finances, and marital dynamics, and interaction with family members ($P < 0.001$). Females, residents of care facilities, individuals who are single (whether due to divorce, separation, or widowhood), and those living with others exhibited significantly higher odds ratios (ORs) for experiencing mental depression. Moreover, participants without religious affiliation and those with low levels of physical activity also demonstrated higher ORs for mental depression. Furthermore, the likelihood of depression significantly increased with advancing age and with higher levels of stress arising from personal and familial issues.

Table 3 presents the outcomes of the multivariable regression analysis, depicting both the unadjusted and adjusted odds ratios (ORs) among the five categories of OHRQoL in relation to mental depression, with the excellent OHRQoL group serving as the reference category. The unadjusted ORs of acquiring mental depression were 1.79 (95% CI: 1.516—2.115, $P < 0.001$), 4.37 (95% CI: 3.614—5.291, $P < 0.001$), 10.26 (95% CI: 7.739—13.589, $P < 0.001$), and 22.27 (95% CI: 11.944—41.531, $P < 0.001$) for the groups with good, fair, poor, and very poor OHRQoL, respectively. After adjusting for age and gender in Model I, the adjusted ORs of experiencing mental depression were 1.73 (95% CI: 1.459—2.043, $P < 0.001$), 3.97 (95% CI: 3.266—4.820, $P < 0.001$), 8.32 (95% CI: 6.226—11.106, $P < 0.001$), and 20.32 (95% CI: 10.736—38.444, $P < 0.001$) for the good, fair, poor, and very poor OHRQoL groups, respectively. Moreover, after further adjustment for all covariates, the adjusted ORs of obtaining mental depression were 1.45 (95% CI: 1.198—1.760, $P < 0.001$), 2.25 (95% CI: 1.791—2.829, $P < 0.001$), 3.88 (95% CI: 2.730—5.525, $P < 0.001$), and 6.87 (95% CI: 3.116—15.129, $P < 0.001$) for the good, fair, poor, and very poor OHRQoL groups, respectively, indicating a gradually increased relationship.

**Table 1** Population characteristics in TSLA, 2015 among different oral health related quality of life (OHRQoL) groups.

| Number (Percentage) | Overall | Excellent OHRQoL | Good OHRQoL | Fair OHRQoL | Poor OHRQoL | Very poor OHRQoL | *P*-value |
|---|---|---|---|---|---|---|---|
| | 7631 (100%) | 3508 (46.0%) | 2870 (37.6%) | 964 (12.6%) | 244 (3.6%) | 45 (0.6%) | |
| **Age** | | | | | | | <0.001 |
| 50–64 | 3632 (47.6%) | 1927 (54.9%) | 1321 (46.0%) | 317 (32.9%) | 54 (22.1%) | 13 (28.9%) | |
| 65–74 | 2243 (29.4%) | 962 (27.4%) | 871 (30.3%) | 323 (33.5%) | 73 (29.9%) | 14 (31.1%) | |
| 75–84 | 1280 (16.8%) | 427 (12.2%) | 513 (17.9%) | 243 (25.2%) | 84 (34.4%) | 13 (28.9%) | |
| 85+ | 476 (6.2%) | 192 (5.5%) | 165 (5.7%) | 81 (8.4%) | 33 (13.5%) | 5 (11.1%) | |
| **Sex** | | | | | | | 0.072 |
| Male | 3716 (48.7%) | 1712 (48.8%) | 1411 (49.2%) | 476 (49.3%) | 97 (39.8%) | 20 (44.4%) | |
| Female | 3915 (51.3%) | 1796 (51.2%) | 1459 (50.8%) | 488 (50.7%) | 147 (60.2%) | 25 (55.6%) | |
| **Marital status** | | | | | | | <0.001 |
| Married | 3604 (47.7%) | 1884 (53.7%) | 1310 (45.6%) | 331 (34.3%) | 67 (27.5%) | 12 (26.7%) | |
| Single, devoice, separate, or widow | 4027 (52.3%) | 1624 (46.3%) | 1560 (54.4%) | 633 (65.7%) | 177 (72.5%) | 33 (73.3%) | |
| **Residency status** | | | | | | | 0.032 |
| Community dwellers | 7592 (99.5%) | 3439 (98.0%) | 2858 (99.6%) | 957 (99.3%) | 240 (98.4%) | 44 (97.8%) | |
| Residents of care facilities | 39 (0.5%) | 15 (2.0%) | 12 (0.4%) | 7 (0.7%) | 4 (0.6%) | 1 (2.2%) | |
| **Living status** | | | | | | | 0.007 |
| Living alone | 655 (8.6%) | 267 (7.6%) | 250 (8.7%) | 108 (11.2%) | 26 (10.7%) | 4 (8.9%) | |
| Living with someone | 6976 (91.4%) | 3241 (92.4%) | 2620 (91.3%) | 856 (88.8%) | 218 (89.3%) | 41 (91.1%) | |
| **Religion** | | | | | | | 0.003 |
| Yes | 1367 (17.9%) | 622 (17.7%) | 559 (19.5%) | 152 (15.8%) | 27 (11.1%) | 7 (15.6%) | |
| No | 6264 (82.1%) | 2886 (82.3%) | 2311 (80.5%) | 812 (84.2%) | 217 (88.9%) | 38 (84.4%) | |
| **Level of physical activity** | | | | | | | <0.001 |
| None | 2908 (38.1%) | 1208 (34.4%) | 1116 (38.9%) | 440 (45.6%) | 122 (50.0%) | 22 (48.9%) | |
| 1-2 times/week | 442 (5.8%) | 227 (6.5%) | 164 (5.7%) | 41 (4.3%) | 7 (2.9%) | 3 (6.7%) | |
| 3+ times/week | 4281 (56.1%) | 2073 (59.1%) | 1590 (55.4%) | 483 (50.1%) | 115 (47.1%) | 20 (44.4%) | |
| **Depression** | | | | | | | <0.001 |
| Yes | 1022 (13.4%) | 264 (7.5%) | 365 (12.7%) | 253 (26.2%) | 111 (45.5%) | 29 (64.4%) | |
| No | 6609 (86.6%) | 3244 (92.5%) | 2505 (87.3%) | 711 (73.8%) | 133 (54.5%) | 16 (35.6%) | |

OHRQoL: Oral health-related quality of life, OHIP-7T: Taiwan version of the Oral Health Impact Profile questionnaire, TLSA: Taiwan Longitudinal Study on Aging.

**Table 2** Univariable analysis for mental depression.

| | Depression | | OR (95% CI) | *P*-value |
|---|---|---|---|---|
| | No | Yes | | |
| Age | | | | |
| 50–64 | 3294 (49.8%) | 338 (33.1%) | Reference | |
| 65–74 | 1932 (29.2%) | 311 (32.4%) | 1.57 (1.322–1.848) | <0.001 |
| 75–84 | 1018 (15.4%) | 262 (25.6%) | 2.51 (2.103–2.991) | <0.001 |
| 85+ | 365 (5.5%) | 111 (10.9%) | 2.96 (2.331–3.768) | <0.001 |
| **Sex** | | | | |
| Male | 3345 (50.6%) | 371 (36.3%) | Reference | |
| Female | 3264 (49.4%) | 651 (63.7%) | 1.798 (1.569–2.061) | <0.001 |
| **Oral health- related quality of life (OHRQoL)** | | | | |
| Excellent (OHIP-7T = 0) | 3224 (47.8%) | 264 (25.8%) | Reference | |
| Good (OHIP-7T = 1–7) | 2505 (37.9%) | 365 (35.7%) | 1.79 (1.516–2.115) | <0.001 |
| Fair (OHIP-7T = 8–14) | 711 (10.8%) | 253 (24.8%) | 4.37 (3.614–5.291) | <0.001 |
| Poor (OHIP-7T = 15–21) | 133 (2.0%) | 111 (10.9%) | 10.26 (7.739–13.589) | <0.001 |
| Very poor (OHIP-7T = 22–28) | 16 (0.2%) | 29 (2.8%) | 22.27 (11.944–41.531) | <0.001 |
| **Marital status** | | | | |
| Single, devoice, separate, or widow | 3302 (50.0%) | 302 (29.5%) | Reference | |
| Married | 3307 (50.0%) | 720 (70.5%) | 0.42 (0.364–0.458) | <0.001 |
| **Residency status** | | | | |
| Community dwellers | 6587 (99.7%) | 1005 (98.3%) | Reference | |
| Residents of care facilities | 22 (0.3%) | 17 (0.7%) | 5.07 (2.680–9.570) | <0.001 |
| **Living status** | | | | |
| Living alone | 524 (7.9%) | 131 (12.8%) | Reference | |
| Living with someone | 6085 (92.1%) | 891 (87.2%) | 1.71 (1.392–2.094) | <0.001 |
| **Religion** | | | | |
| No | 5358 (81.1%) | 906 (88.6%) | Reference | |
| Yes | 1251 (18.9%) | 116 (11.4%) | 0.55 (0.448–0.672) | <0.001 |
| **Level of physical activity** | | | | |
| None | 2329 (35.2%) | 579 (56.7%) | Reference | |
| 1-2 times/week | 402 (6.1%) | 40 (3.9%) | 0.40 (0.286–0.561) | <0.001 |
| 3+ times/week | 3878 (58.7%) | 403 (39.4%) | 0.42 (0.364–0.479) | <0.001 |
| **Pressures arising from personal health issues** | | | | |
| None | 4430 (67.0%) | 235 (23.0%) | Reference | |
| Some | 1736 (26.3%) | 355 (34.7%) | 3.86 (3.240–4.587) | <0.001 |
| Moderate | 315 (4.7%) | 208 (20.4%) | 12.45 (10.001–15.492) | <0.001 |
| Severe | 128 (1.9%) | 224 (21.9%) | 32.99 (25.597–42.517) | <0.001 |
| **Pressures arising from personal financial situation** | | | | |
| None | 4936 (74.7%) | 396 (38.7%) | Reference | |
| Some | 1178 (17.8%) | 276 (27.0%) | 2.92 (2.473–3.449) | <0.001 |
| Moderate | 295 (4.5%) | 139 (13.6%) | 5.87 (4.685–7.363) | <0.001 |
| Severe | 200 (3.0%) | 211 (20.6%) | 13.15 (10.566–16.367) | <0.001 |
| **Pressures arising from personal work-related issues** | | | | |
| None | 5664 (85.7%) | 772 (75.5%) | Reference | |
| Some | 693 (10.5%) | 117 (11.4%) | 1.24 (1.004–1.528) | 0.046 |
| Moderate | 167 (2.5%) | 62 (6.1%) | 2.72 (2.016–3.681) | <0.001 |
| Severe | 85 (1.3%) | 71 (6.9%) | 6.13 (4.433–8.473) | <0.001 |
| **Pressures arising from interacting with family members** | | | | |
| None | 6202 (93.8%) | 773 (75.6%) | Reference | |
| Some | 358 (5.4%) | 160 (15.7%) | 3.59 (2.933–4.383) | <0.001 |
| Moderate | 38 (0.6%) | 51 (5.0%) | 10.77 (7.028–16.497) | <0.001 |
| Severe | 11 (0.2%) | 38 (3.7%) | 27.72 (14.109–54.448) | <0.001 |
| **Pressures arising from familial health issues** | | | | |
| None | 4312 (65.2%) | 458 (44.8%) | Reference | |
| Some | 1822 (27.6%) | 337 (33.0%) | 1.74 (1.497.2.025) | <0.001 |
| Moderate | 324 (4.9%) | 128 (12.5%) | 3.72 (2.967–4.663) | <0.001 |
| Severe | 151 (2.3%) | 99 (9.7%) | 6.17 (4.707–8.095) | <0.001 |
| **Pressures arising from familial financial situation** | | | | |

**Table 2** (*continued*)

| | Depression | | OR (95% CI) | *P*-value |
|---|---|---|---|---|
| | No | Yes | | |
| None | 4804 (72.7%) | 441 (43.2%) | Reference | |
| Some | 1461 (22.1%) | 343 (33.6%) | 2.56 (2.195–2.980) | <0.001 |
| Moderate | 231 (3.5%) | 128 (12.5%) | 6.04 (4.763–7.650) | <0.001 |
| Severe | 113 (1.7%) | 110 (10.8%) | 10.60 (8.014–14.031) | <0.001 |
| **Pressures arising from familial work-related issues** | | | | |
| None | 4945 (74.8%) | 510 (50.0%) | Reference | |
| Some | 1356 (20.5%) | 317 (31.0%) | 2.27 (1.946–2.640) | <0.001 |
| Moderate | 223 (3.4%) | 106 (10.4%) | 4.61 (3.595–5.909) | <0.001 |
| Severe | 85 (1.3%) | 89 (8.7%) | 10.15 (7.439–13.855) | <0.001 |
| **Pressures arising from familial marital dynamics** | | | | |
| None | 4897 (74.1%) | 586 (57.3%) | Reference | |
| Some | 1303 (19.7%) | 251 (24.6%) | 1.61 (1.372–1.889) | <0.001 |
| Moderate | 270 (4.1%) | 87 (8.5%) | 2.70 (2.084–3.480) | <0.001 |
| Severe | 139 (2.1) | 98 (9.6%) | 5.89 (4.487–7.736) | <0.001 |

OHRQoL: Oral health-related quality of life, OHIP-7T: Taiwan version of the Oral Health Impact Profile questionnaire, OR: Odds ratio, CI: Confidence interval.

**Table 3** Multivariable regression models for association between OHRQoL and mental depression.

| OHRQoL | Non-adjusted | | Model I | | Model II | |
|---|---|---|---|---|---|---|
| | OR (95%CI) | *P*-value | OR (95%CI) | *P*-value | OR (95%CI) | *P*-value |
| Excellent (OHIP-7T = 0) | Reference | | Reference | | Reference | |
| Good (OHIP-7T = 1–7) | 1.79 (1.516–2.115) | <0.001 | 1.73 (1.459–2.043) | <0.001 | 1.45 (1.198–1.760) | <0.001 |
| Fair (OHIP-7T = 8–14) | 4.37 (3.614–5.291) | <0.001 | 3.97 (3.266–4.820) | <0.001 | 2.25 (1.791–2.829) | <0.001 |
| Poor (OHIP-7T = 15–21) | 10.26 (7.739–13.589) | <0.001 | 8.32 (6.226–11.106) | <0.001 | 3.88 (2.730–5.525) | <0.001 |
| Very poor (OHIP-7T = 22–28) | 22.27 (11.944–41.531) | <0.001 | 20.32 (10.736–38.444) | <0.001 | 6.87 (3.116–15.129) | <0.001 |

Model I was adjusted by age and sex.
Model II was adjusted by age, sex, marital status, residency status, living status, religion, level of physical activity, and pressures arising from personal and familial health issues, financial situation, work-related issues, interacting with family members, and marital dynamics.
CI: Confidence interval, OHRQoL: Oral health-related quality of life, OHIP-7T: Taiwan version of the Oral Health Impact Profile questionnaire, OR: Odds ratio.

These findings underscored a significant association between declining oral health-related quality of life and increased odds of experiencing mental depression.

## Discussion

Oral health and mental well-being are critical components of aging societies.[22] Mental depression plays an important role in mental health, posing significant concerns with profound implications for the health and quality of life of middle-aged and elderly populations.[23] Research indicates that depressive symptoms in middle age can predict the development of persistent limitations in basic activities of daily living (ADL) and mobility as individuals progress into later life.[23,24] Factors contributing to depression in the elderly include a range of biological, social, and psychological elements.[25] In the present study, the prevalence of mental depression was found to be 13.4%, which is lower than the global prevalence of depression among older adults.[26] Additionally, a higher prevalence of depression was observed among females compared to males, consistent with previous research.[27] Furthermore, Table 2 illustrates that the odds ratios (ORs) for mental depression increase with age, aligning with findings from prior studies.[28] Moreover, a gradually increased relationship was observed in the ORs of depression concerning escalating levels of stress stemming from personal or familial issues, such as health concerns, work-related challenges, financial strain, marital dynamics, and familial interactions.

Dental health is intricately connected to one's general well-being and quality of life. Poor oral health can negatively impact physical, social, and mental well-being, while good oral health enables essential functions like eating, breathing, and speaking.[29] Among the 7631 individuals involved in this study, nearly half exhibited excellent oral health-related quality of life (OHRQoL). Another noteworthy observation was the decrease in the number of participants across the five OHRQoL categories as the OHRQoL deteriorated, which 83.6% of participants demonstrated excellent and good OHRQoL, however, only 4.2% of participants demonstrated poor or very poor OHHRoL (Table

1). The trend was consistent with the research conducted by Medina AM et al., in 2021.[30]

In our investigation, it was observed that individuals experiencing mental depression exhibited a notably higher prevalence of fair, poor, and very poor OHRQoL compared to those not experiencing depression (10.8%, 2.0%, and 0.2% versus 24.8%, 10.9%, and 2.8% respectively) (Table 2). Moreover, there was a clear trend of increasing odds ratios (ORs) for depression as OHRQoL declined, even after adjusting for pressures stemming from personal or familial issues, which were covariates not commonly accounted for in prior studies examining the link between OHRQoL and depression. This adjustment did not diminish the significant association between decreased OHRQoL and heightened depression risk, underscoring a robust negative correlation between OHRQoL and mental depression, signifying that mental depression correlated with a decline in oral health-related quality of life (Table 3). These findings corroborate earlier research.[14] Although our study adopted a cross-sectional design, it is noteworthy that a gradually increased relationship of ORs across five OHRQoL groups was clearly evident with high statistical significance. A cross-sectional study conducted by Hassel AJ et al., in 2011 highlighted the association between satisfactory OHRQoL and overall well-being.[31] Previous studies investigating the correlation between OHRQoL and depression in the elderly often utilized the Geriatric Oral Health Assessment Index (GOHAI) questionnaire.[14,31] According to research by Locker D et al., both the GOHAI questionnaire and the OHIP-14 questionnaire were equally effective in predicting overall psychological well-being and life satisfaction.[32] Additionally, the OHIP-7T questionnaire, a condensed version of the OHIP-14 questionnaire, has been validated in Taiwan and serves as a valuable tool for assessing oral health outcomes in the Taiwanese population.[18] Pien LC's study assessed OHRQoL using the OHIP-7T, defining poor and good OHRQoL based on a cutoff of 14 points.[17] In our current investigation, we further stratified OHIP-7T scores into five groups, anticipating the presence of a gradually increased relationship.

Numerous studies have explored possible etiologies between oral health-related quality of life (OHRQoL) and mental depression, yet the precise mechanisms remain incompletely understood. These investigations can be categorized into three main areas: oral pain and discomfort, decline in physical function, and impairment in social interactions. Oral pain and discomfort have been consistently associated with OHRQoL.[33] For instance, a study by Takiguchi T et al. conducted in Japan highlighted the connection between oral dryness, pain, and depression.[34] Choi SH reported a similar association among the Korean population.[35] Regarding physical function decline in OHRQoL, this often manifests as difficulties in chewing and speaking. A study in 2016 demonstrated a correlation between chewing resistance, pronunciation challenges, and depression.[36] Another investigation, based on the Chilean National Health Survey 2016—2017, suggested that speaking difficulties are linked to depression.[37] Furthermore, Mikami Y et al. identified a relationship between reduced oral function and decreased social engagement among older individuals.[38] This decline in social interaction may ultimately contribute to depression.[39]

There are some limitations to this study. Firstly, it was structured as a cross-sectional study, thereby lacking the capacity to establish cause-and-effect relationships between oral health-related quality of life (OHRQoL) and depression. Secondly, the definition of mental depression relied on data obtained from the CES-D-10 questionnaire, potentially limiting its validity compared to diagnoses derived from one-on-one interviews conducted by psychiatrists. Moreover, the study could not classify depression into subtypes based on CES-D-10 questionnaire. Thirdly, despite controlling for covariates, there were still unaccounted factors, such as personal habits and daily activities, that were not within the study's scope of control.

In conclusion, this study has uncovered a negative correlation between oral health-related quality of life (OHRQoL) and mental depression among middle-aged and older adults. The gradually increased relationship was notably observed in the odds ratios (ORs) of mental depression across the five OHRQoL groups. Namely, individuals with worsened OHRQoL had increased odds of experiencing mental depression. Implementing a comprehensive oral care system and promoting oral health awareness could enhance overall well-being among middle-aged and older population. Future research should focus on elucidating the underlying mechanisms linking OHRQoL and depression, as well as developing effective strategies to bolster OHRQoL in middle-aged and elderly individuals.

## Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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