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Dental Health and Oral Hygiene Behaviors among Adults with Depression Symptoms in Saudi Arabia

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ABSTRACT

Background: Oral diseases remain among the most common non-communicable conditions worldwide, imposing a significant public health and economic burden. Emerging evidence suggests an association between depressive symptoms and adverse oral health outcomes. However, data from Saudi Arabia are limited.

Objectives: The study aims to assess the relationship between depression symptoms and oral health outcomes among adults in Saudi Arabia.

Methods: A cross-sectional online survey was conducted between June and August 2020, with 655 adult participants. Data included sociodemographics, the Patient Health Questionnaire-9 to screen for depressive symptoms, and self-reported oral health outcomes. Descriptive statistics, bivariate analysis, and multivariate logistic regression analyses were performed using SAS (SAS OnDemand for Academics).

Results: Of 655 participants, 146 (22.3%) reported depression symptoms. After adjusting for sociodemographic variables and chronic disease indicators (CDIs), depressive symptoms were significantly associated with fair/poor oral health (adjusted odds ratio [aOR] = 2.97 [1.97–4.48]), oral aches (aOR = 2.08 [1.39–3.12]), dental caries (aOR = 1.75 [1.17–2.61]), and periodontal disease (aOR = 1.82 [1.20–2.76]) compared with those with no depression ($P < 0.05$). Participants with depressive symptoms were more likely to feel embarrassed about their oral health (aOR = 3.62 [2.41–5.46]) and to report difficulty at work or school (aOR = 3.06 [1.63–5.72]). Limited access to dental care within the past year was also significantly associated with depressive symptoms (aOR = 1.99 [0.34–2.96]; $P < 0.05$).

Conclusion: Adjusting for sociodemographic characteristics and CDIs, depression symptoms are associated with poor/fair oral health, mouthache, and dental caries. These findings highlight the need for integrated oral and mental health interventions and improved access to preventive dental services.

Keywords: Dental caries, depression symptoms, oral health, oral hygiene behavior, periodontal disease

Introduction

Oral diseases represent a significant public health concern, placing a substantial economic burden on governments and healthcare systems. Dental caries and periodontal disease remain among the most prevalent non-communicable diseases globally, with the World Health Organization reporting that nearly half of the world's population experiences dental caries and one in ten suffers from severe periodontal disease.[1] These conditions affect not only physical health but also social functioning, academic performance, and productivity; in the United States, oral health problems account for over thirty million lost school hours and more than forty billion dollars in economic losses annually.[2]

In Saudi Arabia, the burden of oral diseases remains notably high despite considerable investments in preventive programs, school-based oral health initiatives, and national awareness campaigns. A recent systematic review by Khan *et al*. estimated that dental caries prevalence reaches 75% in primary dentition and 67% in permanent dentition, figures that remain among the highest globally and reflect persistent challenges in preventive care, dietary patterns, and oral hygiene behaviors.[3] These rates suggest that oral diseases continue to disproportionately affect children, adolescents, and young adults across the Kingdom. Moreover, variations in oral health outcomes across regions, socioeconomic groups, and age cohorts highlight the need to examine broader determinants,

including psychosocial and behavioral factors that may contribute to oral health disparities in Saudi Arabia.[4,5]

Mental health, particularly depression, has emerged as a significant yet often overlooked determinant of oral health. The Saudi population has experienced increasing levels of psychological distress over the past decade, with depressive symptoms reported at higher rates among young adults and women groups already vulnerable to poorer oral health outcomes. National surveys and recent epidemiological studies indicate that lifestyle transitions, academic pressures, unemployment, social expectations, and rapid modernization may be contributing to the rising prevalence of depressive symptoms in the Kingdom. Depression, as defined by the American Psychiatric Association, is characterized by persistent low mood, cognitive impairment, and reduced engagement in daily activities.[6] These symptoms are closely associated with impaired self-care, inconsistent oral hygiene habits, altered dietary behaviors, disrupted sleep patterns, and reduced healthcare-seeking behaviors.[7-13]

Extensive international evidence has documented strong associations between depressive symptoms and adverse oral health outcomes, including poor oral hygiene,[14-17] increased dental caries,[17-20] periodontal inflammation,[18-21] and tooth loss.[22] These findings support a bidirectional relationship between psychological distress and oral disease, in which depression increases susceptibility to oral health deterioration, whereas oral disease itself contributes to social withdrawal, low self-esteem, and worsening mental health. However, despite the robust global literature, research exploring this relationship within Saudi Arabia is insufficient, limiting the ability to design culturally relevant and health system-appropriate interventions.

Given Saudi Arabia's distinctive demographic profile, rapid socioeconomic transitions, and shifting behavioral and lifestyle patterns, it is important to investigate how psychological factors may contribute to oral health outcomes within this context. The rising prevalence of depressive symptoms, combined with persistently high rates of dental caries and periodontal disease, suggests that psychosocial determinants may play a meaningful role in shaping oral health disparities in the Kingdom. Understanding this relationship in a population-specific context is essential for improving epidemiological knowledge, identifying high-risk groups, and guiding the development of evidence-based, integrated approaches that address both mental and oral health determinants.

Materials and Methods

A cross-sectional study using primary data was conducted through an online self-administered questionnaire. Ethical approval for this study was obtained from the institutional review board (Approval No. DRC/014FA/20), and written informed consent was obtained electronically from all participants before participation. Data were collected between 20 June and 20 August 2020. The survey link was distributed through WhatsApp and Twitter using a convenience sampling strategy, and participants were encouraged to share the link within their networks. Although the minimum sample size required for the Saudi adult population was calculated to be 385, a total of 655 adults aged 18 years and older were recruited to increase statistical power. Individuals under 18 years of age were excluded. Participants were drawn from all major regions of Saudi Arabia; however, the regional distribution was not proportional to population size due to the nature of the sampling technique.

The final questionnaire consisted of 36 items divided into three sections. The first section collected sociodemographic information, including age, gender, height, weight, region of residence, marital status, employment status, education level, and monthly household income. The second section comprised the nine items of the Patient Health Questionnaire-9 (PHQ-9) used to assess depressive symptoms. The third section included 18 items addressing oral health conditions, oral hygiene behaviors, oral health-related quality of life, access to dental care, smoking status, and the presence of chronic diseases.

Independent variable

The independent variable, depressive symptoms, was assessed using the PHQ-9, a validated nine-item instrument measuring the frequency of depressive symptoms during the preceding 2 weeks.[23-26] The PHQ-9 incorporates the depression diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, and each item is scored on a four-point scale ranging from 0 ("not at all") to 3 ("nearly every day"), yielding a total score between 0 and 27.[27] A cutoff score of ≥10 was used to indicate moderate to severe depressive symptoms, based on the established sensitivity and specificity (88% and 88%, respectively)

reported by Kroenke *et al*.[25] The validated Arabic version of the PHQ-9 was used, which has undergone translation, back-translation, cultural adaptation, and psychometric validation in Saudi populations and has demonstrated high internal consistency (Cronbach's $\alpha > 0.80$) and construct validity.[28] PHQ-9 scores were computed using SAS OnDemand for Academics, and participants were categorized as having depressive symptoms (≥10) or not (<10). The study design was adapted from previous work by Almohaimeed *et al*.[14]

Dependent variable

The dependent variable, oral health outcomes, was self-reported by participants. General oral health was measured using a widely used single-item, five-point rating scale ranging from "excellent" to "poor." Following established epidemiological practice, responses were dichotomized into "good to excellent" and "fair to poor."[29,30] Additional oral health indicators included self-reported dental pain, dental caries, and periodontal disease. Oral hygiene behaviors assessed toothbrushing habits, dental floss use, mouthwash use, and use of Miswak, a traditional oral cleaning tool derived from Salvadora persica.[31] Questions assessing oral-health-related quality of life measured feelings of embarrassment, perceived functional limitations, and difficulty at work or school due to oral conditions. Access to dental care was evaluated by asking participants about the time since their last dental visit and whether they had been unable to obtain needed dental treatment during the previous year. Those reporting barriers were asked to specify the reasons, which included COVID-19 restrictions, financial difficulties, or health-related issues.

Sociodemographic covariates included age (categorized as 18–29, 30–39, 40–49, 50–59, and ≥60 years), gender, marital status, education, employment, and income. Smoking status was classified according to standard epidemiological definitions, including having smoked at least 100 cigarettes and currently smoking, smoking every day, or smoking some days. Body mass index (BMI) was calculated from self-reported height and weight and categorized according to WHO cutoffs: ≤18.49 (underweight), 18.50–24.99 (normal), 25.00–29.99 (overweight), and ≥30 (obese). Chronic disease burden was assessed by counting the number of self-reported chronic conditions, including diabetes, hypertension, heart disease, and autoimmune disorders, and assigning a chronic disease indicator (CDI) score of 0, 1, 2, or ≥3. Although the primary aim was to evaluate the association between depressive symptoms and oral health outcomes, smoking, BMI, diabetes, and CDI were included as covariates because they are established confounders affecting both depression and oral disease.

Statistical analyses were conducted using SAS OnDemand for Academics. Descriptive statistics were used to summarize participant characteristics. Bivariate associations between depressive symptoms and study variables were assessed using Chi-square tests. Multivariable logistic regression models were then constructed to examine the adjusted associations between depressive symptoms and oral health outcomes. The models controlled for sociodemographic characteristics, smoking status, BMI, diabetes, and CDI count. Statistical significance was set at $P < 0.05$.

Results

Of the 655 participants, 146 (22.3%) exhibited depression symptoms. Regarding age groups, 202 participants were aged 40–49 years old, and 175 were aged 18–29 years. Age groups were significantly linked to depression symptoms at a $P = 0.0093$. The highest incidence of depression symptoms was observed in the 18–29 age group, at 34.93%. Across genders, 86.30% of participants with depression symptoms were female, with only 13.70% of male participants. For marital status, 32.88% of single participants and 60.27% of married participants reported having depression symptoms. By education level, 5.48% of participants with less than a high school education reported depression symptoms, with 26.71%, 59.59%, and 8.22% for those with a high school diploma, college graduate, and postgraduate degree, respectively. Regarding employment, 22.60% of participants who reported depression symptoms were students, compared with 47.95%, 26.03%, and 3.42% of participants who were employed, non-employed, and retired, respectively. Regarding family income, 14.38% of participants in the ≤5,999 Saudi Riyal (SR) group, 36.99% in the 6,000–9,999 SR group, 36.99% in the 10,000–19,999 SR group, and 11.64% in the ≥20,000 SR group reported depression symptoms. Regarding CDIs, 8.90% of participants with diabetes reported depression symptoms. Among smokers, 7.53% exhibited depression symptoms. Observing BMI, 3.42% of participants with depression symptoms were underweight, 31.51% were of normal weight, 28.77% were overweight, and 36.30% were obese [Table 1].

Table 1: Sociodemographic characteristics of participants with and without depression symptoms and chronic disease indicators

Participant characteristics	Depression symptoms					*P*-value[A,C]
	Total	Depressed		Not depressed		
	n=655	*n*=146 (22.3%)		*n*=509 (77.7%)		
Sociodemographic characteristics						
Age	*n*	*n*	%[B]	*n*	%[B]	
18–29 years old	175	51	34.93	124	24.36	0.0093
30–39 years old	171	42	28.77	129	25.34	
40–49 years old	202	41	28.08	161	31.63	
50–59 years old	94	10	6.64	84	16.50	
≥60 years old	13	2	1.37	11	2.16	
Gender						
Male	112	20	13.70	92	18.07	0.2157
Female	543	126	86.30	417	81.93	
Marital status						
Single	118	48	32.88	70	13.75	<0.0001
Married	500	88	60.27	412	80.94	
Divorced/separated	23	8	5.48	15	2.95	
Widowed	14	2	1.37	12	2.36	
Education						
Less than high school	35	8	5.48	27	5.30	0.2647
High school diploma*	146	39	26.71	107	21.02	
College graduate	395	867	59.59	308	60.51	
Postgraduate degree	79	12	8.22	67	13.16	
Employment						
Student	74	33	22.60	41	8.06	<0.0001
Employed	323	70	47.95	253	49.71	
Not employed	224	38	26.03	186	36.54	
Retired	34	5	3.42	29	5.70	
Family income**						
<5,999 SR	86	21	14.38	65	12.77	0.2220
6,000 SR–<9,999 SR	202	54	36.99	148	29.08	
10,000 SR–<19,999 SR	276	54	36.99	222	43.61	
20,000 SR or more	91	17	11.64	74	14.54	
Chronic disease indicators						
Diabetes						
Yes	72	13	8.90	59	11.59	0.3601
No	583	133	91.10	450	88.41	
Current smoking						
Yes	44	11	7.53	33	6.48	0.6547
No	611	135	92.52	476	93.52	
BMI						
Underweight (BMI≤18.49)	15	5	3.42	10	1.96	0.1511
Normal (BMI 18.5–24.99)	180	456	31.51	134	26.33	
Overweight (25–29)	237	42	28.77	195	38.31	
Obese (BMI≥30)	223	53	36.30	170	33.40	

[A]*P*-value-based on the $\chi 2$ test for categorical variables
[B]Column percentages were used
[C]Missing values were excluded
*Or equivalent
**Monthly in Saudi Riyal
BMI: Body mass index

Table 2: Association between oral health outcomes of participants with and without depression symptoms

Oral health outcomes	Total	Depression symptoms				*P*-value[A,C]
		With depression symptoms		No depression symptoms		
	n=655	*n*=146 (22.3%)		*n*=509 (77.7%)		
	n	*n* (%)[B]	%[B]	*n* (%)[B]	%[B]	
Condition of teeth and gums						
Good/very good/excellent	359	55	37.67	304	59.72	0.0001
Fair/poor	296	91	62.33	205	40.28	
Had aching in the mouth						
Yes	328	90	61.64	237	46.56	0.0013
No	327	56	38.36	272	53.44	
Dental caries						
Yes	353	93	63.70	260	51.08	0.0070
No	302	53	36.30	249	48.92	
Periodontal disease						
Yes	182	53	36.30	129	25.34	0.0092
No	473	93	63.70	380	74.66	
Felt bad/ embarrassed						
Yes	185	73	50.00	112	22.00	<0.0001
No	470	73	50.00	397	78.00	
Had difficulty with job/school						
Yes	51	24	16.44	27	5.30	<0.0001
No	604	122	83.56	482	94.70	

[A]*P*-value based on the $\chi 2$ test for categorical variables
[B]Column percentages were used
[C]Missing values were excluded

The association between oral health outcomes among individuals with and without depression symptoms is presented in Table 2. Among participants with depression symptoms, 37.67% rated their teeth and gums as good/very good/excellent, while 61.64% reported fair/poor conditions; this distribution was significantly associated with depression symptoms at a $P = 0.0001$. A mouthache was reported by 61.64% of participants with depression symptoms compared with 46.56% of those without. Similarly, dental caries was reported by 63.70% of the depression group and 51.08% of the non-depression group, while periodontal disease was reported by 36.30% and 25.34%, respectively. Half of the participants with depression symptoms reported feeling bad or embarrassed about their oral condition, and 16.44% indicated that oral health problems interfered with their job or school. Both embarrassment and functional difficulty were significantly associated with depression symptoms at $P < 0.0001$ [Table 2].

The connection between oral health outcomes, focusing on access to dental treatment, among participants with and without depressive symptoms is presented in Table 3. Regarding dentist visits, 45.89% of participants with depression symptoms reported visiting the dentist

Table 3: Association between dental care access of participants with and without depression symptoms

Oral health outcomes	Depression symptoms					*P*-value[A,C]
	Total	With depression symptoms		No depression symptoms		
	n=655	*n*=146 (22.3%)		*n*=509 (77.7%)		
	n	*n* (%)[B]	%[B]	*n* (%)[B]	%[B]	
Dental care access						
Visit dentist						
Never	17	3	2.05	14	2.75	0.3584
1 month–3 months ago	125	33	22.60	92	18.07	
More than 3 months–1 year ago	285	67	45.89	286	42.83	
More than 1 year	228	43	29.45	185	36.35	
Past year couldn't get needed dental care						
Yes	254	74	50.68	180	35.36	0.0008
No	401	72	49.32	329	64.64	
Reason for not getting the needed dental care						
Precaution protocols for COVID-19	199	49	33.59	150	29.47	0.0033
Financial reasons	55	22	15.07	33	6.48	
Health reasons	22	4	2.74	18	3.54	
Others	57	15	10.27	42	8.25	
Not applicable	322	56	38.36	266	52.26	

[A]*P*-value based on the χ^2 test for categorical variables. (Fisher's exact test for cells under 5)
[B]Column percentages were used
[C]Missing values were excluded

within the past 3 months–1 year. Moreover, not being able to access the required dental care in the past year was significantly associated with depression symptoms at a $P = 0.0008$. A total of 33.59% of participants with depression symptoms reported COVID-19 precaution protocols as the reason for not being able to access the required dental care [Table 3].

The connection between oral health outcomes focusing on oral hygiene behaviors among individuals with and without depression symptoms is presented in Table 4. A total of 52.74% of adults with depression symptoms reported brushing their teeth once a day, and 92.47% reported using toothpaste. Among participants with depression symptoms, 58.90%, 74.66%, and 65.75% did not use dental floss, Sewak, or mouthwash, respectively. Sewak use was significantly associated with depression symptoms at ($P < 0.0093$) [Table 4].

Multivariate logistic regression analysis was used to investigate the relationship between depression symptoms and tooth and gingival condition, oral ache, dental caries, periodontal disease, feeling bad or embarrassed, and difficulty with a job or school. In adjusted model, participants with depression were more likely to have fair or poor oral health (adjusted odds ratio [aOR] = 2.97 [1.97–4.48]), oral aches (aOR =2.08 [1.39–3.12]), dental caries (aOR = 1.75 [1.17–2.61]), and periodontal disease (aOR = 1.82 [1.20–2.76]) compared to those without depression symptoms at

Table 4: Association between oral hygiene behaviors of participants with and without depression symptoms

Oral health outcomes	Depression symptoms					*P*-value[A,C]
	Total	With depression symptoms		No depression symptoms		
	n=655	*n*=146 (22.3%)		*n*=509 (77.7%)		
	n	*n* (%)[B]	%[B]	*n* (%)[B]	%[B]	
Oral hygiene behaviors						
Average brushing						
Never	42	11	7.53	31	6.09	0.5957
Once a day	368	77	52.74	291	57.17	
Twice a day or more	245	58	39.73	187	36.74	
Toothpaste use						
Yes	611	135	92.47	476	93.52	0.6547
No	44	11	7.53	33	6.48	
Dental floss use						
Yes	255	60	41.10	195	38.31	0.5429
No	400	86	58.90	314	61.69	
Sewak use						
Yes	225	37	25.34	188	36.94	0.0093
No	430	109	74.66	321	63.06	
Mouthwash use						
Yes	193	50	34.25	143	28.09	0.1506
No	462	96	65.75	366	71.91	

[A]*P*-value based on the χ^2 test for categorical variables
[B]Column percentages were used
[C]Missing values were excluded

$P < 0.05$. In addition, compared with participants without depression symptoms, those with depression were more likely to feel bad or embarrassed (aOR = 3.62 [2.41–5.46]) and to experience difficulty at work or

school (aOR = 3.06 [1.63–5.72]) because of their oral health. Participants with diabetes were more likely to report fair/poor oral health (aOR = 2.10 [1.23–3.59]), oral aches (aOR = 1.94 [1.12–3.34]), and dental caries [aOR = 1.84 (1.06–3.18)] compared with those without diabetes at $P < 0.05$. Participants who were categorized as obese were more likely to report having dental caries (aOR = 3.17 [0.17–10.15]), controlling for age, gender, marital status, education, income, employment, current smoking, and diabetes [Table 5].

In the adjusted model, for dentist visits and oral hygiene practice, not receiving the required dental care was more likely among participants with depression (aOR = 1.99 [0.34–2.96]; $P < 0.05$). Regarding BMI, participants who were overweight (aOR = 3.31 [1.04–10.51]) and obese (aOR = 3.48 [1.08–11.23]) were more likely to report never brushing their teeth, while participants with a normal BMI (aOR = 3.03 [0.98–9.51]) were more likely to report Sewak use at $P < 0.05$. For the CDI count, participants with one CDI were more likely to report difficulty accessing the required dental treatment (aOR = 1.63 [1.03–2.57]; $P < 0.05$) [Table 6].

Discussion

The present study provides clear evidence that depressive symptoms are significantly associated with poorer oral health outcomes among adults in Saudi Arabia. Participants with depressive symptoms were markedly more likely to report fair-to-poor general oral health, dental pain, dental caries, and periodontal disease. These findings align with previous international research demonstrating that psychological distress is closely linked with deteriorated oral health status.[18,32,33] The consistency of these results across diverse populations underscores the robustness of the association between depression and oral disease. The demographic patterns observed, particularly the higher prevalence of depressive symptoms among women and younger adults, are consistent with earlier Saudi studies by AlHadi *et al*.[28] and Ibrahim *et al*.[34] as well as global findings by Albert[35] and Auerbach *et al*.[36] These demographic disparities are important because they identify groups potentially at greater risk for both depressive symptoms and oral health deterioration. Recognizing these patterns can help guide targeted public health interventions.

From a pathophysiological perspective, depressive symptoms may contribute to oral health decline through immune dysregulation and chronic systemic inflammation associated with the hypothalamic–pituitary–adrenal (HPA) axis disturbance, as described by Miller and Raison.[37] This inflammatory environment may accelerate periodontal breakdown and increase susceptibility to oral infections.[38] Further emphasized how chronic psychological stress amplifies pro-inflammatory cytokine activity, promoting both systemic and oral disease progression. Xerostomia associated with antidepressant use may also elevate caries risk, as noted by Saini *et al*.[39] These biological mechanisms support the plausibility of the associations observed in our study.

Behavioral factors further explain the link between depression and poorer oral health. Depression is often accompanied by reduced motivation, lack of energy, and neglect of personal hygiene, as documented by Dumitrescu.[40] While this study did not detect big differences in daily brushing or flossing frequency between groups, such findings may reflect social desirability bias or limited variability in self-reported behaviors, as suggested by Thomson.[41] However, the association with Miswak use may indicate irregularity in daily routines among individuals with depressive symptoms. Together, these results highlight that behavioral changes linked to depression can have meaningful consequences for oral health. Psychosocial factors provide an additional explanatory layer. Individuals with depressive symptoms reported higher levels of embarrassment about their oral condition and a greater impact on work or school functioning. These consequences mirror findings by Mertens *et al*.[42] and Sischo and Broder,[43] who emphasized that oral diseases can significantly diminish self-esteem and quality of life. This bidirectional relationship, where oral health affects mental health and mental health affects oral health, reinforces the need for integrated care models.

Access to dental care is another meaningful dimension of the depression and oral health relationship. Participants with depressive symptoms were more likely to report being unable to obtain needed dental care. Prior research by Andrade *et al*.[44] suggests that depression can reduce motivation to seek care, increase avoidance behaviors, and reduce adherence to scheduled visits. The timing of data collection during the COVID-19 pandemic may have further compounded these access barriers among vulnerable individuals.

The associations observed between chronic diseases, obesity, and oral health outcomes are consistent with previous research. Preshaw *et al*.[45] and Chapple *et al*.[46] have described how metabolic dysregulation, common among individuals with diabetes and obesity, contributes

Table 5: Multivariate analysis for depression and chronic disease indicators by self-reported participants' subjective perspective about oral health condition and outcomes

Predictor variable	Condition of teeth and gums		Aching in the mouth		Dental caries		Periodontal disease		Felt bad/ embarrassed[B]		Had difficulty with job/school[B]	
	Poor/ Fair (%[A])	aOR	Yes %	aOR	Yes %	aOR	Yes %	aOR	Yes %	aOR	Yes %	aOR
Depression												
No	40.28	1.00	46.56	1.00	51.08	1.00	25.34	1.00	22.00	1.00	5.30	1.00
Yes	62.33	2.97 (1.97–4.48)*	61.64	2.08 (1.39–3.12)*	63.70	1.75 (1.17–2.61)*	36.30	1.82 (1.20–2.76)*	50.00	3.62 (2.41–5.46)*	16.44	3.06 (1.63–5.72)*
Smoking												
No	45.6	1.00	51.39	1.00	54.66	1.00	28.81	1.00	28.31	1.00	8.02	1.00
Yes	38.64	1.44 (0.53–2.47)	29.55	0.73 (0.33–1.63)	43.18	1.19 (0.56–2.55)	13.64	0.44 (0.16–1.19)*	27.27	1.75 (0.72–4.22)	4.55	0.39 (0.08–1.98)
Diabetes												
No	42.71	1.00	46.56	1.00	52.14	1.00	26.07	1.00	27.27	1.00	8.06	1.00
Yes	65.28	2.10 (1.23–3.59)*	61.64	1.94 (1.12–3.34)*	68.06	1.84 (1.06–3.18)*	41.67	1.82 (1.07–3.10)*	36.11	1.42 (0.82–2.46)	5.56	0.62 (0.21–1.88)
BMI												
Underweight	53.33	1.00	46.67	1.00	33.33	1.00	20.00	1.00	40.00	1.00	13.33	1.00
Normal	35.00	0.46 (0.16–1.35)	45.00	0.93 (0.32–2.71)	45.56	1.58 (0.50–4.92)	23.89	1.48 (0.39–5.60)	22.78	0.52 (0.17–1.59)	9.04	1.52 (0.27–8.43)
Over-weight	43.46	0.60 (0.20–1.77)	44.30	0.80 (0.27–2.37)	55.27	2.74 (0.87–8.61	24.89	1.50 (0.39–5.71)	28.69	0.76 (0.25–2.33)	4.68	0.80 (0.13–4.87)
Obese	54.71	0.83 (0.28–2.50)	60.09	1.30 (0.43–3.91)	60.54	3.17 (0.99–10.15)*	34.53	2.12 (0.55–8.20)	31.39	0.81 (0.26–2.53)	9.91	1.67 (0.28–9.88)
Chronic disease indicator count												
0	40.66	1.00	45.44	1.00	50.83	1.00	23.86	1.00	25.52	1.00	8.51	1.00
1	54.43	1.31 (0.83–2.06)	59.49	1.44 (0.91–2.26)	59.49	1.11 (0.71–1.76)	34.18	1.64 (1.01–2.68)*	31.65	1.42 (0.87–2.31)	5.06	0.69 (0.27–1.74)
2	100	99.99 (0.00–99.9)	88.89	5.64 (0.66–48.13)	100	9.99 (.00.0–99.9)	100	99.9 (0.00–99.9)	100	99.9 (0.00–99.9)	0.31	0.00 (0.00–99.99)
≥3	83.33	2.81 (0.29–27.67)	100	99.99 (0.00–99.9)	83.33	2.23 (0.23–21.81)	66.67	5.19 (0.79–34.04)	50.00	2.58 (0.42–15.78)	33.33	8.34 (0.68–102.00)

[A]Row percentages were used

[B]Because of the mouth

Abbreviations: aOR: The odds ratio is adjusted for age, gender, marital status, education, income, employment, current smoking, diabetes, and BMI: Body mass index

*Significant at 0.05

Table 6: Multivariate analysis for depression and chronic disease indicators by self-reported participants' subjective perspective about dental care access and oral hygiene behaviors

Predictor variable	Visit dentist		Past year couldn't get needed dental care		Average brushing		Toothpaste use
	More than 1 year %[A]	aOR	Yes %	aOR	never %	aOR	no %
Depression							
No	36.35	1.00	35.36	1.00	6.09	1.00	6.48
Yes	29.45	1.19 (0.84–1.71)	50.68	1.99 (1.34–2.96)*	7.53	1.03 (0.70–1.51)	7.53
Smoking							
No	34.21	1.00	40.43	1.00	6.06	1.00	6.38
Yes	34.18	0.75 (0.38–1.51)	15.91	0.50 (0.19–1.31)	11.36	1.91 (0.89–4.10)	11.36
Diabetes							
No	34.82	1.00	35.36	1.00	6.00	1.00	6.35
Yes	34.72	1.23 (0.76–1.97)	50.68	1.03 (0.61–1.76)	9.72	0.87 (0.52–1.45)	9.72
BMI							
Underweight	40.00	1.00	40.00	1.00	0.00	1.00	0.00
Normal	27.22	1.87 (0.69–5.09)	37.22	0.97 (0.32–2.91)	2.78	2.48 (0.79–7.84)	2.22
Over-weight	38.40	1.18 (0.43–3.24)	40.51	1.26 (0.42–3.83)	7.59	3.31 (1.04–10.51)*	8.86
Obese	36.77	1.41 (0.43–3.93)	38.12	1.08 (0.35–3.35)	8.52	3.48 (1.08–11.23)*	8.52
Chronic disease indicator count							
0	32.57	1.00	36.31	1.00	6.85	1.00	7.26
1	41.14	0.54 (0.35–0.81)*	43.67	1.63 (1.03–2.57)*	5.06	0.92 (0.59–1.43)	5.06
2	55.56	0.42 (0.11–1.60)	66.67	3.99 (0.88–18.35)	0.00	0.70 (0.17–2.89)	00.00
≥3	16.67	2.23 (0.43–11.53)	66.67	4.57 (0.71–29.60)	16.67	1.06 (0.18–6.38)	16.67

Predictor variable	Toothpaste use	Dental floss use		Sewak use		Mouthwash use	
	aOR	no %	aOR	no %	aOR	no %	aOR
Depression							
No	1.00	61.69	1.00	63.06	1.00	71.91	1.00
Yes	1.42 (0.67–3.01)	58.90	0.78 (0.53–1.16)	74.66	1.47 (0.95–2.28)	65.75	0.80 (0.53–1.20)
Smoking							
No	1.00	60.39	1.00	65.79	1.00	70.21	1.00
Yes	0.64 (0.19–2.08)	70.45	1.21 (0.55–2.72)	63.64	0.94 (0.42–2.10)	75.00	0.98 (0.42–2.29)
Diabetes							
No	1.00	61.41	1.00	65.69	1.00	71.36	1.00
Yes	1.19 (0.48–2.95)	58.33	0.79 (0.47–1.33)	65.28	1.67 (0.95–2.95)	63.89	0.60 (0.35–1.04)
BMI							
Underweight	1.00	80.00	1.00	60.00	1.00	66.67	1.00
Normal	99.99 (0.00–99.9)	56.11	0.37 (0.18–2.65)	80.56	3.03 (0.98–9.51)*	66.11	0.83 (0.27–2.61)
Over-weight	99.99 (0.00–99.9)	54.01	1.15 (0.93–1.41)	59.07	1.72 (0.55–5.32)	70.89	0.97 (0.31–3.07)
Obese	99.99 (0.00–99.9)	71.30	0.85 (0.49–1.47)	60.99	2.23 (0.70–7.04)	73.99	11.17 (0.36–3.78)
Chronic disease indicator count							
0	1.00	59.96	1.00	67.01	1.00	71.78	1,00
1	0.21 (0.05–0.91)*	62.66	1.35 (0.84–2.17)	60.13	0.89 (0.55–1.44)	66.46	0.79 (0.49–1.29)
2	99.9 (0.00–99.9)	88.89	8.33 (0.95–73.41)	88.89	9.24 (0.94–90.72)	66.67	0.86 (0.19–3.89)
≥3	0.37 (0.02–6.19)	66.67	2.07 (0.32–13.51)	66.67	1.65 (0.24– 11.41)	83.33	2.38 (0.24–23.51)

[A]Row percentages were used

Abbreviations: aOR: The odds ratio is adjusted for age, gender, marital status, education, income, employment, current smoking, diabetes, and BMI: Body mass index

*Significant at 0.05

to periodontal inflammation. The co-occurrence of chronic disease and depressive symptoms may therefore amplify risk for oral health deterioration.

This study has several limitations. First, its cross-sectional design prevents causal inference, and longitudinal studies are needed to clarify the temporal sequence between depressive symptoms and oral health outcomes. Second, the reliance on self-reported oral health data may introduce misclassification or recall bias, although previous validation studies by Locker,[29] Reisine and Bailit,[30] and Sanders and Slade[47] support the reliability of self-rated oral health measures in population-based research. Third, depressive symptoms were assessed solely using the PHQ-9, a screening instrument administered online without face-to-face clinical evaluation. Although the PHQ-9 is well validated, the absence of a structured clinical interview may lead to under- or overestimation of true depressive disorder prevalence. Finally, convenience sampling and online

administration may limit representativeness; however, the large and geographically diverse sample enhances generalizability within the adult Saudi population.

Conclusion

Depression symptoms were found to be significantly associated with adverse oral health outcomes, including dental caries, periodontal disease, oral pain, and psychosocial consequences. Individuals with depression also reported limited access to dental care, suggesting structural barriers that may contribute to oral health inequalities. These results highlight the need to incorporate mental health considerations into dental practice and to strengthen preventive and accessible oral healthcare services. Future longitudinal research is warranted to establish causal pathways and inform evidence-based interventions.

Recommendations

Our findings have important clinical implications. Dentists should consider the impact of mental health on oral health when planning care, particularly given that many individuals with depression report difficulty accessing dental services. Increasing clinic accessibility, creating supportive environments, and emphasizing preventive measures such as fluoride and sealants may improve outcomes. Collaboration between dental practitioners and mental health professionals in developing coordinated care protocols may improve service accessibility and optimize oral health outcomes for individuals with depression.

Author's Contributions

Bayan Almohaimeed: Conceptualization, methodology, software, validation, formal analysis, investigation, data curation, writing/original draft preparation, writing-review and editing, visualization. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement

Authors agree to make data and materials supporting the results or analyses presented in this paper available upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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