

# **The Interplay between Rapid Mental Health Screening and Oral Health Behaviors – A Population-Based study with a Focus on Toothbrushing Frequency and Dental Attendance**

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18

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# Abstract

**Objectives:** Little is known about how major mental distresses such as depression, anxiety, and suicide impact key oral health behaviors, particularly in low- and middle-income countries (LMICs) like Iran. This study assesses whether depressive and anxious moods and suicidal ideation, rapidly screened indicators of these distresses, relate to toothbrushing frequency and dental attendance among a sample of Iranian adults.

**Methods:** This cross-sectional study used data from the Integrated and Repeated Public Health Surveillance project (May–September 2023) in southern Tehran Province, Iran. Stratified random sampling was used to survey adults aged  $\geq 18$  via telephone. A validated questionnaire assessed depressive mood, anxious mood, suicidal ideation, toothbrushing frequency, and 6-month dental attendance. A “composite mental distress” variable was also created by combining the three mental distresses. Binary logistic regression analyzed associations, adjusting for covariates.

**Results:** Among the 1,282 participants (mean age 40.1, SD = 13.3, 60.6% female), 23.5% toothbrushed twice a day and above, and 33.2% attended dental visits in the past 6 months. Moderate and high depressive mood levels, higher depressive mood scores, and higher anxious mood scores were all related to toothbrushing less than twice daily (AOR = 0.65,  $p = 0.004$ , AOR = 0.54,  $p = 0.037$ , AOR = 0.85,  $p = 0.006$ , and AOR = 0.87,  $p = 0.021$ , respectively). Moderate composite mental distress levels and higher composite mental distress scores were also related to toothbrushing less than twice daily (AOR = 0.52,  $p < 0.001$ , and AOR: 0.94,  $p = 0.019$ , respectively). None of the mental distress indicators were associated with 6-month dental attendance.

**Conclusions:** To address findings, oral healthcare providers should be trained in rapid mental health screening, provide toothbrushing support for those screened, and refer them to mental healthcare when necessary. Similarly, mental healthcare providers should be trained to recognize mental distress indicators of poor toothbrushing, promote toothbrushing among therapeutic goals, and refer patients to oral healthcare when necessary

**Keywords:** Depression; Anxiety; Suicide; Mental Health; Oral health; Dental Care; Oral Hygiene; Health Behavior; Mass Screening

## Introduction

Oral health, the ability to taste, chew, swallow, smile, speak, and express emotions without pain, discomfort, or disease in the craniofacial region [1], is an essential aspect of overall health and well-being, with strong associations to diabetes, cardiovascular and respiratory diseases, metabolic syndromes, and Alzheimer's disease [2-4]. However, the reductionist biomedical model has long separated oral health from general health, leading to higher treatment costs, more severe health inequities, and fragmented care [4, 5]. In contrast, the biopsychosocial model and integrated care frameworks emphasize that oral health is inseparable from overall well-being, reflecting shared biological, behavioral, and social determinants [6, 7]. These perspectives remain insufficiently implemented in low- and middle-income countries (LMICs), where the repercussions of neglecting oral health integration are more pronounced [8, 9]. Iran is one such country with high oral disease burden, limited financial and infrastructural resources, and poor integration of oral health within the general healthcare system [10-13].

Mental healthcare is no exception to the systemic separation from oral health. Providers in these two domains often work independently, receive little cross-disciplinary training, and have limited time or resources for collaboration [14, 15]. This disconnect is concerning, as major mental distresses, such as depression, anxiety, and suicide, can profoundly affect oral health. Depression and anxiety, which together affect over 690 million people worldwide and cost the global economy an estimated US\$1 trillion annually [16, 17], as well as suicide, which claims more than 700,000 lives each year [18], heighten vulnerability to temporomandibular disorders, xerostomia, and oral ulcerations; increase the risk of periodontal disease, dental caries, and tooth loss; and impair chewing, speech, and overall oral function [19-28].

Behavioral pathways may partly explain the associations between these mental distresses and oral health. Twice-daily toothbrushing and regular dental attendance, two key oral health behaviors, play a crucial role in preventing plaque accumulation, dental caries, periodontal disease, and tooth loss [29-31]. Several studies have reported associations between the mental

distresses of depression, anxiety, and suicide infrequent toothbrushing, and irregular dental attendance [23, 32-36]. However, the evidence remains inconsistent, as some studies have found no association or even opposite trends between these mental distresses, toothbrushing frequency, and dental attendance [22, 37-39]. Moreover, much of the existing research has focused narrowly on dental anxiety rather than broader anxiety constructs [20], treated suicide as part of composite indices instead of an independent construct [36, 40, 41], relied on outdated data [33, 42], or been conducted within specific contexts and populations, such as during the COVID-19 pandemic or among airline pilots [25, 32]. Notably, no studies to date have specifically examined the association between suicidal ideation, attempts, or behavior and dental attendance. Furthermore, Iranian adults remain largely underrepresented in this area of research.

To help bridge the divide between mental and oral healthcare and address these research gaps, timely detection of these mental distresses in oral healthcare settings is essential [14, 15, 43]. Instruments such as the Patient Health Questionnaire-9 (PHQ-9), PHQ-4, the Generalized Anxiety Disorder-7 (GAD-7), the World Health Organization Well-Being Index, and the General Health Questionnaire-28 (GHQ-28) offer efficient means of identifying mental distress in busy oral healthcare environments [44-47]. Because these tools are brief, valid, and reliable, they can effectively capture the core symptoms of each distress and flag individuals in need of referral and further assessment [44-47]. However, because rapid screening tools are primarily designed for population-level surveillance and triage, they are better suited for assessing current emotional states and thoughts rather than providing formal diagnoses. Accordingly, this study uses them to evaluate depressive and anxious moods rather than full clinical diagnoses of depression or anxiety disorders. Additionally, as suicidal ideation is an early warning sign of suicidal behavior [18], rapid screening is employed to assess this construct rather than actual suicidal behavior. Therefore, the present study examines whether the rapidly assessed mental distress indicators of depressive mood, anxious mood, and suicidal ideation are associated with toothbrushing frequency and dental attendance among a sample of Iranian adults.

## Methods

## *Ethical considerations*

This study was carried out in compliance with the Helsinki declaration. Verbal informed consent was obtained prior to study conduction, after informing participants of the study's purpose, the voluntary nature of their involvement, anonymity preservation, data confidentiality, and the estimated duration of 15–20 minutes. Ethical approval was also obtained prior to commencing the study by the Research Ethics Committee of school of medicine at Tehran University of Medical Sciences (TUMS) (ethics code: IR.TUMS.MEDICINE.REC.1400.599).

## *Study Design and Setting*

This study draws on data from the Integrated and Repeated Public Health Surveillance (IRPHS) project, a population-based telephone survey employing a cross-sectional design. The methodological process of the IRPHS is detailed in its published protocol [48]. Here, only a brief summary of the most important points is provided.

## *Target population and sampling strategy*

The IRPHS targeted adults aged 18 years and older residing in areas supervised by TUMS, which include southern Tehran city, Eslamshahr, and Shahr-e Rey. These areas represent one of three administrative regions within Tehran Province, each overseen by a separate medical university.

Stratified random sampling with probability proportional to size was used to ensure representativeness across the three TUMS-supervised strata. Sample size calculations were conducted separately for each major health indicator using the population proportion formula and 2021 Iranian STEPS data [49]. The largest required sample was 1,199 individuals, inflated to 1,332 to account for a 10% attrition rate. Within each stratum, household phone numbers were randomly selected, and one eligible adult per household was interviewed. Eligibility required the respondent to be a family member who had resided in the household for at least six months and was expected to remain for the following month.

## *Data Collection Instrument*

The IRPHS monitored key health indicators selected through expert consultation and scientific evidence. These included demographic characteristics, healthcare utilization, chronic disease prevalence, lifestyle behaviors, and mental and oral health status. A structured questionnaire was developed to capture these domains. Content validity was assessed using the Content Validity Ratio (CVR  $\geq 0.59$ ) and Content Validity Index (CVI  $\geq 0.79$ ); items falling below these

thresholds were revised or excluded. Reliability was confirmed with an agreement coefficient  $\geq 0.7$ .

### *Interviewer Training and Quality Assurance*

Interviewers with prior survey experience underwent targeted training. To ensure data integrity, pilot interviews were conducted, calls were recorded and randomly reviewed, and 10% of completed questionnaires were independently rechecked. A subset of responses was validated through face-to-face interviews and clinical assessments. Data collection occurred between May 22 and September 24, 2023. Upon completion of interviews, participants identified as at-risk were referred to local health centers for free physician consultations and informed about additional support services available within the TUMS-supervised region.

### *Study measures*

#### Outcome Variables

Toothbrushing frequency: Participants were asked a single question about how often they brush their teeth, with the response options: “Three times a day,” “Twice a day,” “Once a day,” “Once a week,” “Two to three times a week,” “Never,” and “I wear complete dentures.” Participants who wore complete dentures were excluded. For descriptive analysis, responses were grouped into three categories: “At least twice a day,” “Once a day,” and “Less than once a day.” For logistic regression, the responses were further dichotomized into a binary variable, following similar categorizations in the literature [23, 41], and aligning with international guidelines for minimum daily brushing [50]. The final categories were “Twice a day and above” and “Less than twice a day”, which combined all other responses.

Six-month dental visit attendance: Participants were asked a single question about whether they had visited a dentist in the past six months, with responses of “No” or “Yes.” The 6-month timeframe was chosen to capture dental visits for several reasons. First, previous studies have successfully used this period, as shown in a scoping review of adult dental care utilization [51]. Second, shorter recall periods, such as 6 months instead of 12, improve the accuracy of self-reported health service use [52, 53]. Finally, while salient events like hospitalizations can be remembered over longer periods, frequent routine visits are more easily forgotten, making a 6-month recall reliable [54].

#### Independent Variables

Depressive mood: Depressive mood was assessed using the two PHQ-2 questions, validated in Persian [55], asking about lack of interest in usual activities and feelings of depression or hopelessness over the past two weeks. Responses were scored from 0 ("Not at all") to 3 ("Nearly every day") and summed to create a depressive mood score (0–6), with higher scores indicating greater severity. Scores were divided into tertiles to form low (0–1), moderate (2–3), and high (4–6) depressive mood levels.

Anxious mood: Anxious mood was assessed using two questions adapted from the GAD-2 and validated in Persian [56, 57], asking how often participants felt nervous or anxious and how well they could control their worries over the past two weeks. Responses ranged from 0 ("Not at all") to 3 ("Nearly every day") and were summed to create an anxious mood score (0–6), with higher scores indicating greater anxiety. Scores were also divided into tertiles to form low (0–1), moderate (2–3), and high (4–6) anxious mood levels."

Suicidal ideation: Suicidal ideation was assessed using two questions adapted from the GHQ-28 and validated in the IRPHS [49, 58, 59], asking about feelings of hopelessness and thoughts of ending one's life over the past month. Responses ranged from 0 ("None or minimal") to 3 ("Severe") and were summed to create a suicidal ideation score (0–6), with higher scores indicating greater severity. A 1-month timeframe was used to align with the GHQ-28, match the 2-week measures for depressive and anxious mood, and improve sensitivity given the low prevalence of suicidal ideation in the sample. For analysis, scores were dichotomized into low (0–1) and high (2–6), resulting in the variables "low suicidal ideation level" and "high suicidal ideation level".

Composite mental distress: To capture the combined burden of depressive mood, anxious mood, and suicidal ideation, this study drew on similar constructs in the literature, such as "psychological distress" or "poor mental health" [23, 40, 41], to create a composite mental distress variable. Scores for depressive mood, anxious mood, and suicidal ideation were summed to generate this variable, which ranged from 0 to 18, with higher values indicating greater mental distress. The composite scores were also divided into tertiles (low, moderate, high) based on the sample distribution.

*Covariates*

Covariates for this study were selected from variables consistently adjusted for in the literature on mental health and oral health behaviors [22, 36, 60, 61]. The covariates and their response options were: age (years); sex (male, female); education level (no education [0 years], primary [1–6], secondary [7–12], higher [>12]); residential area (urban, rural); socioeconomic status (high, above average, average, below average, low); current tobacco smoking (yes, no); marital status (single, married, divorced/widowed); chronic disease status (none, one, or two or more of hypertension, diabetes, cardiovascular disease, or dyslipidemia); and health service use in the past year (yes, no).

#### *Statistical analysis*

Descriptive statistics included frequency and percentage for categorical variables. Differences in variable levels across toothbrushing frequency and 6-month dental attendance subgroups were assessed using chi-square or Fisher's exact tests, as appropriate. Analysis of variance (ANOVA) was used to compare mean scores for depressive mood, anxious mood, and suicidal ideation, and mental distress across toothbrushing and 6-month dental attendance. Binary logistic regression examined the associations between mental distress and its components (as exposures) and toothbrushing frequency and 6-month dental attendance (as outcomes). Crude logistic regression models were first conducted for each mental distress variable and outcome, followed by adjusted models controlling for the covariates. Results were reported as odds ratios (ORs), adjusted odds ratios (AORs), and 95% confidence intervals (CIs). Data analysis was performed using Stata version 17, with a significance level set at  $p < 0.05$ . Cases with missing data on outcome variables ( $n=29$ ) were excluded from analysis.

#### *AI declaration*

In preparing the present manuscript, the authors used ChatGPT (OpenAI, San Francisco, CA, USA) for assistance with text editing, including improving readability and conciseness. All content was reviewed and verified by the authors for accuracy and integrity.

## **Results**

The study included 1,282 participants, as shown in Table 1. The overall population was predominantly female (60.6%), with a mean age of 40.1 years ( $SD = 13.3$ ). Most participants (58.4%) were between 26 and 45 years old, and the largest educational subgroup (35.5%) had 7

to 12 years of schooling. The sample was predominantly urban (89.5%) and largely comprised of married individuals (78.9%). A significant portion (56.1%) reported poor SES.

The distribution of oral health behaviors varied considerably across demographic subgroups, as also shown in Table 1. Among participants who brushed their teeth twice a day and above, the vast majority were female (81.1%). A similar gender gap was observed in dental attendance within the past 6 months, with attendance highest among females (38.3%) and lowest among males (25.2%) ( $p < 0.001$ ). Age differences were also striking. The largest share of those who brushed their teeth twice a day and above was found in the 26–45 age group (66.8%), while the smallest proportion came from those over 65 years (2.7%). For 6-month dental attendance, young adults aged 18–25 represented the largest group (36.4%), whereas older adults over 65 again reported the lowest rate (8.8%) ( $p < 0.001$ ). Educational attainment also showed a gradient. Among participants who brushed their teeth twice a day and above, individuals with 7–12 years of schooling had the highest proportion (44.9%), compared with only 7.48% of those with no formal education. Similarly, for attending dental visits within 6 months, the largest proportion was seen among those with more than 12 years of schooling (43.3%), while the lowest was among individuals with no formal education (17.4%) ( $p < 0.001$ ). SES was also strongly associated with oral health behaviors. The prevalence of toothbrushing twice a day and above was lowest among those in the poor SES group (35.7%) and highest among those in the good SES group (80.9%). A comparable pattern was observed for 6-month dental visits, where only 31.2% of participants from the poor SES group attended, compared to 46.8% in the good SES group.

As shown in Table 2, toothbrushing frequency was significantly associated with depressive ( $p=0.002$ ) and anxious ( $p=0.010$ ) mood scores, with lower scores for both mental distress indicators corresponding to higher toothbrushing frequency. Participants with low depressive mood scores brushed their teeth twice a day and above had a higher prevalence (53.9%) than those with high depression scores (7.2%,  $p=0.005$ ). Similarly, low anxious mood levels were associated with a higher frequency of toothbrushing (58.1% for low anxious mood vs. 12.0% for high anxious mood,  $p=0.003$ ). Categorical analysis of composite mental distress was also associated with more frequent toothbrushing ( $p<0.001$ ), with high levels of mental distress related to lower toothbrushing frequency (50% for twice daily or more vs. 26.2% for not at all).

Suicidal ideation was not associated with toothbrushing ( $p = 0.840$ ) or dental attendance in the past 6 months ( $p = 0.458$ ). Additionally, no associations were found between 6-month dental attendance and any of the mental distress indicators (all  $p > 0.05$ ).

Figure 1 illustrates the relationship between toothbrushing twice a day and above stratified by gender and scores for (A) composite mental distress, (B) depressive mood, (C) anxious mood, and (D) suicidal ideation. A significant, negative, linear association was observed between composite mental distress score and toothbrushing frequency: as scores increased from 0 to 18, the proportion of participants twice a day and above declined, with females consistently toothbrushing twice a day and above more than males (33% vs. 18% at score 0, and 17% vs. 6% at score 18). A similar trend was evident for depressive mood scores, ranging from 0 to 6, with toothbrushing twice a day and above declining from 32% to 22% among females and from 17% to 8% among males. Anxious mood scores showed the same pattern: toothbrushing twice a day and above dropped from 33% to 19% in females and from 17% to 7% in males as scores increased. However, for suicidal ideation scores, the decline in toothbrushing twice a day and above was less pronounced and not statistically significant, with only slight reductions observed for both females (about 30% to about 27%) and males (about 14% to about 11%).

According to Table 3, after adjusting for confounders, moderate composite mental distress level, versus low, was associated with lower odds of toothbrushing twice a day and above (AOR = 0.52,  $p < 0.001$ ). Similarly, higher composite mental distress scores were related to a reduced likelihood of toothbrushing twice a day and above (AOR = 0.94,  $p = 0.019$ ). Moderate and high levels of depressive mood, as well as higher depressive mood scores, were also associated with lower odds of toothbrushing twice a day and above (AOR = 0.65,  $p = 0.004$ ; AOR = 0.54,  $p = 0.037$ ; AOR = 0.85,  $p = 0.006$ , respectively). Higher anxious mood scores showed a similar pattern (AOR = 0.87,  $p = 0.021$ ). In contrast, suicidal ideation, whether measured categorically or continuously, was not associated with toothbrushing frequency.

In unadjusted models, higher depressive and anxious mood scores increased odds of attending dental visits in the past 6 months (OR=1.19,  $p = 0.005$ , and OR=1.16,  $p = 0.016$ , respectively). However, after adjustment, these associations were no longer significant and none of the other

mental distress indicators were significantly related to 6-month dental attendance either (Table 4).

## Discussion

The present study reinforced the critical need to view mental health as inseparable from oral health by examining how indicators of mental distress, assessed using rapid mental health screening tools, relate to key oral health behaviors in the Iranian adult population. Findings revealed that higher depressive mood scores, higher anxious mood scores, and moderate and high levels of depressive mood (versus low) were associated with toothbrushing less than twice daily. Similarly, moderate levels of composite mental distress (versus low) and higher mental distress scores were related to toothbrushing less than twice daily. Interestingly, none of the explored mental distress indicators were associated with 6-month dental attendance post-adjustment.

This study has notable strengths, including a large sample, stratified random sampling proportional to size, robust questionnaire development, validated telephone surveys, and comprehensive covariate adjustment. It is also likely the first study to have explored the relationships between rapid mental health screening of depressive and anxious mood, suicidal ideation, and two key oral health behaviors, particularly among Iranian adults, addressing an important gap. Nonetheless, some limitations should be noted. The cross-sectional design precludes causal inference. Self-reported data may be affected by recall or social desirability bias, though logical timeframes and interviewer training were used to mitigate these. Telephone interviews, while cost-effective, may have excluded those without stable access. Finally, the sample, comprising mostly women aged 26–45, individuals with lower SES, and urban residents from southern Tehran province, may have introduced bias into the estimates. Women typically report better oral health behaviors, whereas lower-SES individuals often face challenges with dental attendance, and Tehran is among Iran’s more affluent provinces. Stratified random sampling and statistical adjustments were applied to address this limitation. However, the findings’ generalizability may still be affected.

The relationship observed between moderate and high levels of depressive mood, higher depressive mood scores, and toothbrushing less than twice daily is likely driven by symptoms

classically associated with depression, such as fatigue, reduced motivation, anhedonia, and impaired executive function. These symptoms can weaken the individual's ability or willingness to sustain routine self-care, thereby increasing their likelihood for inadequate toothbrushing [62-64]. This finding broadly aligns with prior studies from Korea, Australia, and a global pandemic-era survey, which demonstrated that depressive symptoms and states, whether chronic, recent, or situational, are associated with suboptimal toothbrushing behavior [25, 61, 65]. However, in contrast, a Turkish study found no associations between the presence and severity of depressive symptoms and the individual's toothbrushing behavior [66]. This discrepancy might be explained by differences in study populations, as the Turkish study included patients attending a single dental school, who likely differ in demographic characteristics and health behaviors compared to the general adult population in southern Tehran province. Additional variation potentially arises from the measures used to assess depressive symptoms, the operational definitions applied, and categorizations of toothbrushing response options. Therefore, contextual and methodological factors should be considered when investigating depressive symptoms and adult toothbrushing behavior.

Interestingly, higher anxious mood was associated with toothbrushing less than twice daily when analyzed as a continuous variable, but not when categorized. This was likely due to the greater sensitivity of the continuous scale, as converting scores into tertiles to create categorical levels may mask more subtle associations. Anxious mood may compromise toothbrushing through its associations with reduced motivation, cognitive overload, social withdrawal, or executive dysfunction, which can reduce one's capacity for self-care acts [14, 22, 34]. It can also do so through its relationships with periodontitis, oral ulcers, and bruxism, which can cause pain and thus, make the act of toothbrushing uncomfortable [67-69]. Given the scarce availability of data reporting on general anxiety symptoms and toothbrushing behavior, rather than on social phobia or dental anxiety, this finding had to be compared with findings from a Finnish study, which found that adolescents with moderate or severe generalized anxiety were less likely to toothbrush twice daily [34]. Also, a study in Luxembourg found that adolescents with higher stress were less likely to brush their teeth twice daily [70]. Despite the scarcity of directly comparable literature, contradictory findings still exist. For instance, the previously noted Australian study found no associations between toothbrushing less than twice daily and being diagnosed with anxiety disorders [65]. This discrepancy may stem from methodological differences, such as the

Australian study's use of interviews to diagnose anxiety over the past 12 months within its population birth cohort. Overall, further research is needed to clarify the relationship between anxiety and toothbrushing behavior, as well as the underlying mechanisms, in the Iranian adult population.

The association between moderate composite mental distress (versus low), higher mental distress scores, and toothbrushing less than twice daily was expected, as two components of this variable were independently related to reduced toothbrushing. These associations are likely the result of similar mechanisms proposed for the components, including co-occurrence with symptoms of anhedonia, executive dysfunction, and motivational deficits, which make engaging in self-care difficult [22, 71, 72]. Since "composite mental distress" was a variable uniquely designed for this study, direct comparisons with previous studies were challenging. Nevertheless, comparisons can be broadly drawn with constructs such as 'psychological distress' or 'poor mental health,' which in studies from the U.S., Caribbean, and Indonesia, captured the combined burden of loneliness, anxiety, suicidal thoughts or attempts, self-rated emotional health, and depression, and were associated with reduced toothbrushing frequency [23, 40, 41]. Further research is needed to clarify the relationship between composite mental distress, as defined in this study and measured using rapid screening tools, and toothbrushing behaviors

Interestingly, depressive mood, anxious mood, and composite mental distress were not associated with 6-month dental attendance in this sample, whether measured continuously or categorically. Several factors may explain this lack of association. First, the significant associations between higher depressive and anxious mood scores and lack of dental attendance in the past 6 months became non-significant after adjusting for confounders in the multivariable model. This suggests that the observed associations were largely explained by sociodemographic factors, such as sex, age, education, marital status, and SES, which were themselves significantly related to dental attendance (Table 1). Second, routine health behaviors such as daily toothbrushing may be more sensitive to short-term mental health fluctuations, whereas dental attendance might be more strongly shaped by structural and economic factors. This would be particularly relevant in Iran's LMIC context, where economic hardships are prevalent and dental visits are typically symptom-driven and largely paid out of pocket [73, 74]. Consistent with these findings, an Australian study found that depressive and anxiety symptoms were unrelated to time

since the last dental visit or visit frequency in the past 12 months [65]. In contrast, some U.S. studies reported longer gaps in dental care receipt or higher non-use of oral health services among those with poor mental health [26, 63]. This differences may partly be due to the fact that those studies used different data collection tools, variable definitions, and target populations than the present one. In addition, the U.S. is a high-income country, which contrasts with Iran's LMIC status and its previously noted challenges. Overall, depressive mood, anxious mood, and composite mental distress might offer limited insight into 6-month dental attendance among adults in southern Tehran unless structural, economic, and contextual determinants are considered.

The null associations between suicidal ideation, toothbrushing frequency, and 6-month dental visits were unexpected. Suicidal ideation often co-occurs with depressive and anxious states [75, 76], which in this study were related to greater odds of toothbrushing less than twice a day. It can also involve anhedonia, apathy, social isolation, hopelessness, and executive dysfunction [36, 77, 78], symptoms known to negatively affect oral health behaviors [14, 22]. Together, these factors suggest a potential link for suicidal ideation that was not observed. Nonetheless, several factors may account for the observed null findings. The low prevalence of suicidal ideation in the sample likely limited statistical power. The 1-month recall period for suicidal ideation may not have aligned with the habitual, long-term nature of toothbrushing, while the previously-noted economic barriers and symptom-driven dental care in Iran could have masked the associations with this behavior [74, 79]. Finally, the cultural stigma surrounding suicidal ideation in Iran may have led to underreporting of suicidal thoughts [80], further attenuating observable effects. All in all, the lack of a statistically significant relationship between suicidal ideation and oral health behaviors in this study does not imply clinical insignificance, as even mild suicidal ideation can meaningfully affect self-care and well-being and thus, warrants attention.

In conclusion, this study revealed that among southern Tehran province adults, higher scores for depressive mood, anxious mood, and composite mental distress, along with moderate and high depressive mood levels and moderate composite mental distress levels were all related to toothbrushing less than twice daily. Suicidal ideation showed no link to toothbrushing frequency, and none of the mental distress indicators were associated with 6-month dental attendance. These findings underscore the need for integrated approaches that bridge mental and oral health

services. Oral healthcare providers should be trained to identify depressive mood, anxious mood, or overall mental distress using rapid mental health screening tools, provide targeted behavioral support to promote regular toothbrushing among the individuals identified with these conditions, and refer them to mental health services when appropriate. Likewise, mental healthcare providers should be trained to view toothbrushing behavior as a correlate of depressive and anxious moods and overall mental distress, reinforce it as a therapeutic goal, and refer patients with these conditions to oral health services for behavioral counseling. Effective referral and communication pathways between oral and mental health services are essential for these strategies to succeed. Since suicidal ideation did not serve as a reliable indicator of poor toothbrushing or dental attendance in the present sample, integration efforts between mental and oral healthcare may be more impactful when focused on depressive and anxious moods. Additionally, to improve 6-month dental attendance, economic triage followed by financial and structural interventions, such as subsidized dental care or expanded insurance coverage, might be more beneficial for this sample. Considering this study's population-based design while taking into account its limitations, these recommendations can be cautiously applied to other Iranian provinces and similar LMIC contexts. Future studies should investigate whether composite mental distress is related to other oral health behaviors and identify the mechanisms underlying these associations. They should also further explore the relationship between suicidal ideation and key oral health behaviors. In addition, examining structural and economic barriers to regular dental attendance in LMIC settings and piloting rapid mental health screening tools in dental clinics could provide valuable insights into feasible, integrated care approaches. Longitudinal designs would help determine whether causal relationships exist between rapidly assessed mental distress indicators and oral health behaviors. Finally, recruiting more diverse demographic and geographic groups within Iran and other LMICs, particularly rural populations and broader age ranges, would strengthen the generalizability of findings.

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709 This table has been uploaded separately for better readability.

710 **Table 1. Toothbrushing Frequency and 6-month Dental Attendance Prevalence by**  
 711 **Sociodemographics among Tehran Province Adults (n=1282)**

712  
 713 #Healthcare center visits in the past year, \*\* Affection by any of the following diseases:  
 714 hypertension, diabetes, cardiovascular disease, or dyslipidemia  
 715

**Table 2. Associations between mental distress indicators, toothbrushing frequency, and 6-month dental attendance among Tehran Province adults (n =1282)**

This table has been uploaded separately for better readability.

\*Sum of scores for depressive mood, anxious mood, and Suicidal ideation, ranging between 0 and 18.

\*\*According to the tertile classification of the suicidal ideation score, no one was assigned to this level.

\*\*\*Calculated using Chi-square and ANOVA tests where appropriate

728 **Table 3. Mental distress indicators of toothbrushing frequency among Tehran Province**  
729 **adults (n =1282)**

| <b>Mental distress indicator</b>                      | <b>Toothbrushing twice a day and above vs. less than twice a day</b> |                |                                |                |
|-------------------------------------------------------|----------------------------------------------------------------------|----------------|--------------------------------|----------------|
| <b>Composite mental distress level</b>                | <b>OR [95%CI]</b>                                                    | <b>P value</b> | <b>AOR<sup>1</sup> [95%CI]</b> | <b>P value</b> |
| Low                                                   | Ref                                                                  |                | Ref                            |                |
| Moderate                                              | 0.52 [0.38, 0.70]                                                    | <0.001         | 0.52 [0.38, 0.72]              | <0.001         |
| High                                                  | 0.81 [0.56, 0.1.17]                                                  | 0.267          | 0.73 [0.45, 1.10]              | 0.138          |
| <b>Composite mental distress score (trend) (0-18)</b> | 0.95 [0.91, 1.01]                                                    | 0.067          | 0.94 [0.89, 0.97]              | 0.019          |
| <b>Depressive mood level</b>                          |                                                                      |                |                                |                |
| Low                                                   | Ref                                                                  |                | Ref                            |                |
| Moderate                                              | 0.66 [0.50-0.88]                                                     | 0.004          | 0.65 [0.48,0.87]               | 0.004          |
| High                                                  | 0.62 [0.37-1.03]                                                     | 0.069          | 0.54 [0.30,0.96]               | 0.037          |
| <b>Depressive mood score (trend) (0-6)</b>            | 0.87 [0.79, 0.96]                                                    | 0.010          | 0.85 [0.76, 0.95]              | 0.006          |
| <b>Anxious mood level</b>                             |                                                                      |                |                                |                |
| Low                                                   | Ref                                                                  |                | Ref                            |                |
| Moderate                                              | 0.83 [0.62-1.11]                                                     | 0.217          | 0.78 [0.56,1.07]               | 0.127          |
| High                                                  | 0.95 [0.63-1.45]                                                     | 0.847          | 0.82 [0.52,1.31]               | 0.424          |
| <b>Anxious mood score (trend) (0-6)</b>               | 0.90 [0.82,1.02]                                                     | .062           | 0.87 [0.78, 0.97]              | 0.021          |
| <b>Suicidal ideation level</b>                        |                                                                      |                |                                |                |
| Low                                                   | Ref                                                                  |                | Ref                            |                |
| High                                                  | 1.13 [0.79, 1.63]                                                    | 0.492          | 1.05 [0.70,1.57]               | 0.782          |
| <b>Suicidal ideation score (trend) (0-6)</b>          | 1.02 [0.90, 1.16]                                                    | 0.722          | 0.96 [0.83,1.11]               | 0.601          |

730 1-Adjusted for age, sex, education, residence, smoking, marital status, chronic disease status and  
731 health service reception  
732

**Table 4. Mental distress indicators of 6-month dental attendance among Tehran Province adults (n =1282)**

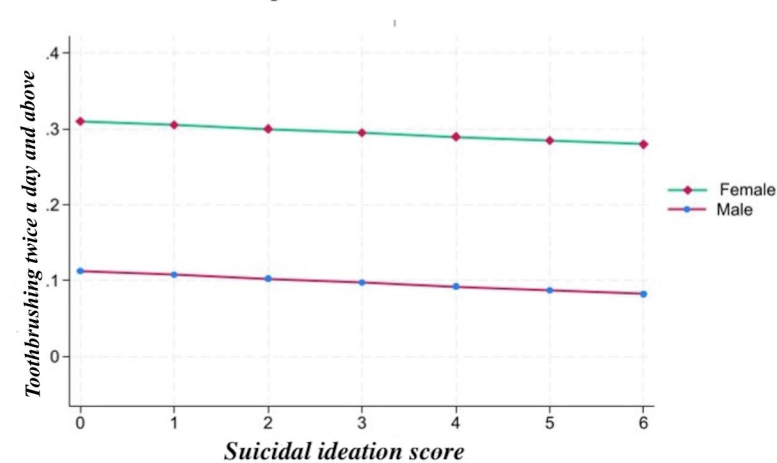
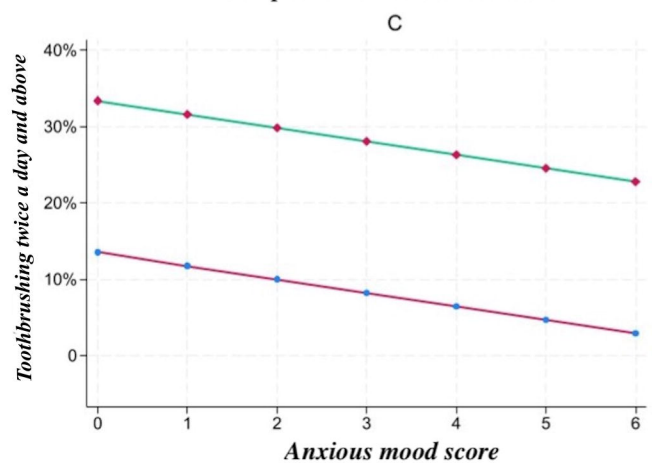
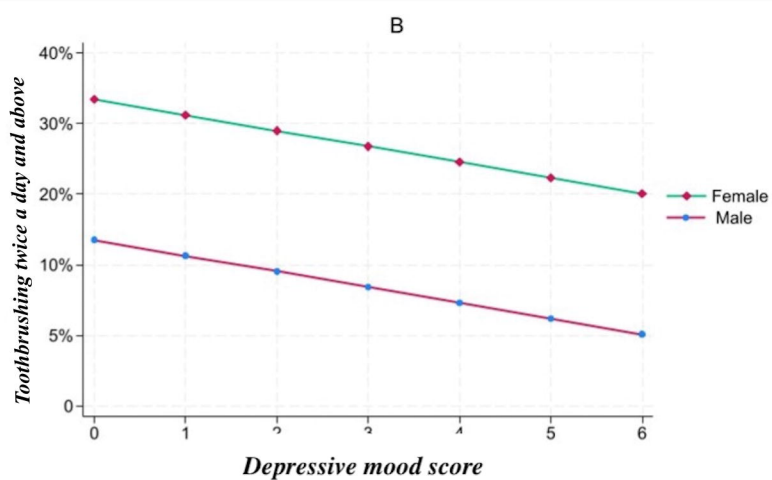
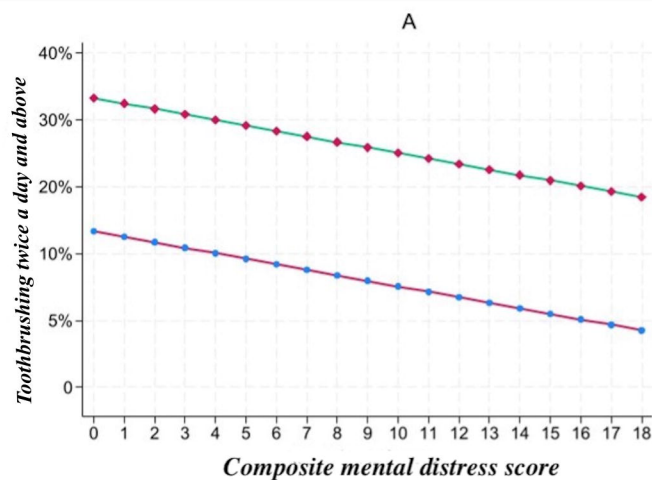
| <b>Mental distress indicator</b>             | <b>6-month dental attendance (Yes versus No)</b> |                |                                |                |
|----------------------------------------------|--------------------------------------------------|----------------|--------------------------------|----------------|
| <b>Composite mental distress level</b>       | <b>OR [95%CI]</b>                                | <b>P value</b> | <b>AOR<sup>1</sup> [95%CI]</b> | <b>P value</b> |
| Low                                          | Ref                                              |                | Ref                            |                |
| Moderate                                     | 1.25 [0.86, 1.61]                                | 0.281          | 1.15 [0.86, 1.65]              | 0.280          |
| High                                         | 1.23 [0.93,1.63]                                 | 0.133          | 1.19 [0.84,1.52]               | 0.327          |
| <b>Composite mental score (trend) (0-18)</b> | 0.97 [0.93, 1.02]                                | 0.254          | 1.02 [0.93,1.03]               | 0.203          |
| <b>Depressive mood level</b>                 |                                                  |                |                                |                |
| Low                                          | Ref                                              |                | Ref                            |                |
| Moderate                                     | 0.88 [0.69, 1.12]                                | 0.321          | 0.92 [0.7,1.18]                | 0.557          |
| High                                         | 0.75 [0.45, 1.11]                                | 0.136          | 0.73 [0.45,1.19]               | 0.212          |
| <b>Depressive mood score (0-6)</b>           | 1.19 [1.05, 1.34]                                | 0.005          |                                |                |
| <b>Anxious mood level</b>                    |                                                  |                |                                |                |
| Low                                          | Ref                                              |                | Ref                            |                |
| Moderate                                     | 0.91 [0.70, 1.17]                                | 0.479          | 0.94 [0.72, 1.24]              | 0.695          |
| High                                         | 1.01 [0.69, 1.45]                                | 0.946          | 1.10 [0.74, 1.63]              | 0.663          |
| <b>Anxious mood score (0-6)</b>              | 1.16 [1.03,1.32]                                 | 0.016          | 1.09 [0.96, 1.27]              | 0.235          |
| <b>Suicidal ideation level</b>               |                                                  |                |                                |                |
| Low                                          | Ref                                              |                | Ref                            |                |
| High                                         | 1.03 [0.87,1.23]                                 | 0.711          | 1.08[0.90,1.28]                | 0.387          |
| <b>Suicidal ideation score (0-6)</b>         | 1.0 [0.89,1.13]                                  | 0.814          | 1.06 [0.94,1.21]               | 0.309          |

1-Adjusted for age, sex, education, residence, smoking, marital status, chronic disease status and health service reception

738 **Figure 1. Frequency of toothbrushing twice a day and above across scores for: A)**  
 739 **Composite mental distress, B) Depressive mood, C) Anxious mood, and D) Suicidal ideation**

740 Note: all trends were statistically significant ( $p < 0.05$ ) except for the one concerning suicidal  
 741 ideation.

742



**Table 2. Associations between mental distress indicators, toothbrushing frequency, and 6-month dental attendance among Tehran Province adults (n =1282)**

[illegible]

|                        |                             |           |           |            |            |        |            |            |       |
|------------------------|-----------------------------|-----------|-----------|------------|------------|--------|------------|------------|-------|
|                        | <b>high</b>                 | 19 [18.4] | 20 [18.9] | 99 [12.9]  | 46 [15.7]  |        | 59 [14.0]  | 125 [14.8] |       |
| <b>Composite</b>       | <b>Poor: Number [%]</b>     | 27 [26.2] | 49 [46.2] | 289 [37.8] | 145 [50.0] |        | 122 [29.1] | 283 [33.3] |       |
| <b>mental</b>          | <b>Moderate: Number [%]</b> | 51 [49.5] | 34 [32.1] | 359 [47.0] | 92 [31.7]  | <0.001 | 114 [27.2] | 223 [26.3] | 0.358 |
| <b>distress level*</b> | <b>Good: Number [%]</b>     | 25 [24.3] | 23 [21.7] | 116 [15.2] | 53 [18.3]  |        | 183 [43.7] | 343 [40.4] |       |

\*Sum of scores for depressive mood, anxious mood, and Suicidal ideation, ranging between 0 and 18.

\*\*According to the tertile classification of the suicidal ideation score, no one was assigned to this level.

\*\*\*Calculated using Chi-square and ANOVA tests where appropriate

1 **Table 1. Toothbrushing Frequency and Dental Attendance Prevalence by Sociodemographic Factors among Tehran Province**

2 **Adults (n=1282)**

| Variable   | Variable category<br>N [%]<br>in the overall population | Tooth Brushing Frequency<br>N [%] in each subgroup |                                 |                          |                                        |         | 6-month dental attendance<br>N [%] in each subgroup |                  |         |
|------------|---------------------------------------------------------|----------------------------------------------------|---------------------------------|--------------------------|----------------------------------------|---------|-----------------------------------------------------|------------------|---------|
|            |                                                         | Not At all<br>104 [8.1]                            | Sometimes (weekly)<br>106 [8.3] | Once a day<br>771 [60.1] | Twice a day<br>and above<br>301 [23.5] | p-value | Yes<br>425 [33.2]                                   | No<br>856 [66.8] | p-value |
| Sex        | Male<br>505 [39.4]                                      | 61 [58.6]                                          | 61 [57.5]                       | 326 [42.3]               | 57 [18.9]                              | <0/001  | 127 [25.2]                                          | 377 [74.8]       | <0/001  |
|            | Female<br>777 [60.6]                                    | 43 [41.3]                                          | 45 [42.4]                       | 445 [57.7]               | 244 [81.1]                             |         | 298 [38.3]                                          | 479 [61.6]       |         |
| Age (year) | 18-25<br>154 [12.0]                                     | 6 [5.8]                                            | 12 [11.3]                       | 94 [12.19]               | 42 [13.9]                              |         | 56 [36.4]                                           | 98 [63.6]        |         |
|            | 26-45<br>749 [58.4]                                     | 18 [17.3]                                          | 65 [61.3]                       | 465 [60.3]               | 201 [66.8]                             | <0/001  | 271 [36.2]                                          | 477 [63.7]       | <0/001  |
|            | 46-65                                                   | 52 [50.0]                                          | 22 [20.7]                       | 198 [25.7]               | 50 [16.6]                              |         | 93 [28.9]                                           | 229 [71.1]       |         |

|                |                         |           |           |            |            |        |            |            |        |
|----------------|-------------------------|-----------|-----------|------------|------------|--------|------------|------------|--------|
|                | 322 [25.12]             |           |           |            |            |        |            |            |        |
|                | >65<br>57 [4.4]         | 28 [26.9] | 7 [6.6]   | 14 [1.8]   | 8 [2.7]    |        | 5 [8.77]   | 52 [91.2]  |        |
| Residency      | Urban<br>1148 [89.5]    | 88 [84.6] | 90 [84.9] | 688 [89.2] | 282 [93.7] | 0.013  | 388 [33.8] | 760 [66.2] | 0.17   |
|                | Rural<br>134 [10.4]     | 16 [15.4] | 16 [15.1] | 83 [10.8]  | 19 [6.3]   |        | 37 [27.8]  | 96 [72.2]  |        |
| Education      | 0 year<br>241 [18.9]    | 63 [60.6] | 42 [39.6] | 114 [14.8] | 22 [7.5]   |        | 42 [17.4]  | 199 [82.5] |        |
|                | 1-6 year<br>228 [17.9]  | 19 [18.3] | 21 [19.8] | 149 [19.3] | 39 [13.3]  | <0/001 | 71 [31.0]  | 158 [69]   | <0.001 |
|                | 7-12 year<br>453 [35.5] | 15 [14.4] | 28 [26.4] | 278 [36.1] | 132 [44.9] |        | 156 [34.4] | 297 [65.5] |        |
|                | 12< years<br>353 [27.7] | 7 [6.7]   | 15 [14.1] | 230 [29.8] | 101 [34.3] |        | 153 [43.3] | 200 [56.7] |        |
| Marital status | Single                  | 8 [7.7]   | 13 [12.3] | 117 [15.2] | 56 [19.0]  |        | 74 [38.1]  | 120 [61.9] | 0.005  |

|                                       |                                   |           |           |            |             |        |             |             |       |
|---------------------------------------|-----------------------------------|-----------|-----------|------------|-------------|--------|-------------|-------------|-------|
|                                       | 194 [15.2]                        |           |           |            |             |        |             |             |       |
|                                       | <b>Divorced/widow</b><br>75 [5.9] | 17 [16.3] | 8 [7.5]   | 34 [4.4]   | 16 [5.4]    | <0/001 | 13 [17.3]   | 62 [82.7]   |       |
|                                       | <b>Married</b><br>1006 [78.9]     | 79 [76.0] | 85 [80.2] | 620 [80.4] | 222 [75.5]  |        | 335 [33.3]  | 672 [66.7]  |       |
| SES                                   | <b>Poor</b><br>712 [56.1]         | 91 [87.5] | 56 [53.3] | 461 [60.0] | 104 [35.7]  | <0/001 | 222 [31.2]  | 490 [68.8]  |       |
|                                       | <b>Moderate</b><br>494 [39.0]     | 11 [10.6] | 45 [42.9] | 277 [36.1] | 161 [55.3]  |        | 170 [34.4]  | 324 [65.6]  | 0.03  |
|                                       | <b>Good</b><br>62 [4.9]           | 2 [1.9]   | 4 [3.8]   | 30 [3.91]  | 26 [80.9]   |        | 29 [46.8]   | 33 [53.2]   |       |
| <b>Health care visits<sup>#</sup></b> | <b>No</b><br>644 [50.2]           | 73 [70.2] | 40 [37.7] | 383 [49.7] | 148 [49.2]  | <0.001 | 209 [32.5]  | 434 [67.5]  | 0.607 |
|                                       | <b>Yes</b><br>638 [49.8]          | 31 [29.8] | 66 [62.3] | 388 [50.3] | 153 [50.8]  |        | 216 [33.9]  | 422 [66.1]  |       |
| <b>Smoking status<sup>1</sup></b>     | <b>No</b>                         | 74 [71.1] | 81 [76.4] | 628 [81.6] | 260 [86.38] | 0.031  | 359 [34.42] | 684 [65.58] | 0.050 |

|                                 |                                  |           |           |            |            |        |            |            |       |
|---------------------------------|----------------------------------|-----------|-----------|------------|------------|--------|------------|------------|-------|
|                                 | 1043 [81.4]                      |           |           |            |            |        |            |            |       |
|                                 | <b>Yes</b><br>238 [18.6]         | 30 [28.9] | 25 [23.6] | 142 [18.4] | 41 [13.6]  |        | 66 [27.8]  | 171 [72.1] |       |
| <b>Chronic disease status**</b> | <b>None</b><br>1044 [81.4]       | 57 [54.8] | 83 [78.3] | 650 [84.3] | 254 [84.4] |        | 348 [33.4] | 695 [66.6] |       |
|                                 | <b>One</b><br>162 [12.6]         | 13 [12.3] | 88 [11.4] | 35 [11.6]  | 13 [12.26] | <0.001 | 59 [36.4]  | 103 [63.6] | 0.144 |
|                                 | <b>Two and above</b><br>76 [5.9] | 21 [20.2] | 10 [9.4]  | 33 [4.3]   | 12 [3.99]  |        | 18 [23.7]  | 58 [76.3]  |       |

3 1-Current smoking status 3- In the past six months

4 #Healthcare center visits in the past year, \*\* Affection by any of the following diseases: hypertension, diabetes, cardiovascular

5 disease, or dyslipidemia

