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Dental Anxiety, Oral Health Behavior Neglect, and Unmet Restorative Treatment Need: A Cross-Sectional Mediation Analysis

Abstract
Dental anxiety is an important factor in poor oral hygiene behaviours, delayed dental attendance and higher restorative treatment demands. This study evaluated the association between dental anxiety and oral health behaviour neglect and the unmet need for restorative treatment in community-dwelling adults. A cross-sectional study was carried out in the community with 450 adult samples obtained by purposive sampling. Adults ≥18 years who had at least one natural tooth were eligible. Dental anxiety was measured by the Modified Dental Anxiety Scale (MDAS) and oral health behavior and unmet restorative treatment need by self-reported validated indicators. G*Power analysis was used to determine sample size. IBM SPSS Statistics and bootstrapped structural equation modelling were used to analyze the data, controlling for age, sex, education and income. The study revealed moderate dental anxiety, oral health behavior neglect, and unmet restorative treatment need among the study participants. All variables were found to be significantly positively correlated ($r = .48–.57$, $p < .001$). The indirect effect of oral health behavior neglect on unmet dental restorative treatment need was significant ($\beta = .20$, $p < .001$) in a mediation analysis performed. Behavioral neglect and need for restorative treatment were negatively related to higher education and income. The structural model fit very well (CFI = .964, RMSEA = .043). Dental anxiety is a factor in oral health behavior neglect and unmet restorative treatment needs and so anxiety-focused interventions are important to extend the scope of preventive dental care and oral health outcomes.

Introduction

Dental diseases are a great burden of disease in the world and one of the top ten most prevalent non-communicable diseases [1]. According to world health organization (WHO), around 3.5 billion individuals suffer from oral disease around the world with untreated dental caries in permanent teeth being the most common health problem in the world [2]. Despite the developments in preventive dentistry, there are still billions of people suffering from untreated caries, especially in the low- and middle-income countries [3, 4]. Dental fear is the apprehension, fear, stress or nervousness related to dental environments, dental activities or expectations of receiving dental care. [5]. Dental anxiety may make some people skip routine checkups, put off going to the dentist and only visit when they have serious symptoms [6, 7]. This avoidance behavior establishes a vicious circle in which poor oral health leads to more fear and anxiety about dental treatment [8]. Piechal et al. (2026) study highlighted psychological and behavioral effects of dental fear involve poor oral hygiene, lack of regular dental visits and lack of preventive care [9]. Additionally, oral health problems can lead to social embartarassment, lower self-esteem, and overall poor well-being, making it crucial to address dental concerns and their anxiety to obtain optimal oral health results [10, 11].

Oral health behavior neglect is the lack of adherence to recommended oral hygiene care and preventive dental behaviors that are key for good oral health [12, 13]. This encompasses routine dental visits, minimizing sugar intake, interdental cleaning, and regular toothbrushing with fluoride toothpaste [14]. World Health Organization (WHO) acknowledges that poor oral hygiene and lack of use of preventive dental services are a significant contributor to the dental caries and periodontal disease [15]. People who do not take these preventive actions may be at higher risk for more advanced oral disease, leading to more restorative treatment requirements and lower oral health results [16]. Research by Peric & Tadin (2024) mentioned that individuals who experience high levels of dental anxiety often delay or cancel routine dentist visits because of a fear of pain, discomfort, or bad experiences in the dentist's clinic [17]. This avoidance is frequently associated with a delayed diagnosis and treatment of oral diseases, which can result in a minor dental problem turning into a more serious condition [18]. Moreover, Alenezi & Aldokhayel (2022) study evidence has shown that dental fear is significantly related to low attendance at the dentist, use of emergency based dental care as opposed to preventative care [19]. This forms a circle that further contributes to anxiety and avoidance behaviours, further building up of unmet restorative treatment needs and negatively influencing the overall quality of life [20].

Fear of dental treatment has been consistently shown to be a major determinant of unmet needs for restorative care [21]. People who suffer from dental phobia tend to avoid routine dental care because they are afraid of pain, needles, dental tools or because they have bad past experiences [22]. This avoidance behavior leads to a decrease in preventive care, early diagnosis and timely treatment of dental issues. While, Calladine et al. (2022) discussed that lots of patients are worried and only visit the dentist when the problem is serious, making treatment more complex and costly, and requiring more dentistry [23]. When left untreated, early carious lesions that can be treated with simple restorations or preventive care can progress to deep caries, pulpal involvement, infection, and ultimately to tooth loss [24]. Persic Bukmir et al.(2022) studies have demonstrated that it is associated with a worse dental health status and increased untreated dental diseases [25]. Untreated caries, tooth loss, and huge restoration requirements were more prevalent among anxious individuals than in those that regularly went to dental appointments [26]. This association underscores dental anxiety as a key area to alleviate in the context of preventive oral health care and minimize treatment needs for dentitions.

Although dental anxiety has received more focus as a dental health issue, there are still a number of research gaps. Empirical evidence of the role of oral health behavior neglect between dental anxiety and unmet oral health care needs for restorative treatment is lacking [27]. Furthermore, there is a lack of research on the impact of dental fear on preventive dental visits and treatment-seeking practices, vital components of good oral health [19]. Previous research tends to examine dental anxiety, dental self-care or the need for dental restoration individually, which limits the understanding of both the effects and the interaction [28]. Moreover, limited population-based studies have evaluated the effects of dental anxiety on untreated dental caries and restorative care use in various populations [26]. Addressing these gaps helps to better understand behavioral barriers to oral health services and development of specific interventions to mitigate unmet restorative treatment needs. This study is unique in being able to analyze the dental anxiety, neglect of oral health behavior, and the need for restorative dental treatment within a single analytical framework. This study examines the interrelationships and potential behavioral pathways that may exist among these factors, as opposed to other studies that examined each factor independently. From a practical standpoint, the results could assist dental practitioners in the identification of factors that may be linked to dental attendance anxiety and better management strategies for patients as well as encourage preventive dental visits. Theoretically, the study would add to oral health behavior literature by offering proof of the importance of psychological factors on self-care practices and treatment utilization. This study aimed to assess the relationship between dental anxiety,

neglect of oral health behavior, and the need for restorative treatment.

2 Methodology

2.1 Study Design

This study utilized a cross-sectional design to explore the cross-sectional associations between dental anxiety and oral health behaviour neglect in relation to the unmet restorative treatment need at one time point. Cross-sectional designs are appropriate for examining associations and prevalence between psychobehavioural and clinical variables in large community samples, without the large resource costs associated with a longitudinal follow-up. The location was deliberately chosen to be community-based rather than clinical-based to minimize referral bias and to capture a more representative range of anxiety levels and dental care-seeking behaviors more representative of the general population.

2.2 Inclusion and exclusion criteria

Inclusion criteria were community-dwelling adults (18 years or older) with at least one natural tooth and able to read and understand the study questionnaire and to give informed consent to participate. Furthermore, all scales concerning dental anxiety, oral health behaviors, and needed restoration of dental treatment were completed by the participants. Patients were ineligible for the study if they were cognitively impaired, had severe psychiatric disease, were edentulous (complete tooth loss) or were undergoing extensive dental or orthodontic treatment that would impact oral health behaviours or access to treatment. Individuals who did not respond to questionnaires and individuals who did not provide information on some of the key study variables were also excluded from the analyses.

2.3 Study setting

Participants were obtained from the community, such as residential neighborhood, community center, educational institution, and public gathering areas. A purposive sampling technique was used to identify adults that met the eligibility criteria. Information about the aims of the study and the procedures was given in person to potential participants. Recruitment continued until a sufficient sample size for adequate representation of diverse sociodemographic groups was obtained.

2.4 Study Population and Sampling

This cross-sectional study used purposive sampling to recruit a total of 450 adults living in the community. The G*Power 3.1 software was used for conducting an a priori power analysis to calculate the sample size. With a medium effect size ($f^2 = 0.15$), $\alpha = 0.05$ (significance level), and 80% statistical power, the researchers estimated that they needed at least 289 participants. 450 participants were recruited to enhance the statistical power and potential incomplete responses. Adults (18 years old and older) living in the community were eligible to participate. The recruitment process took place in various community environments such as residential neighborhoods, community health centers, and community gathering places to try to diversify the sample and increase generalizability of findings.

2.5 Measurement Instruments

Dental anxiety was assessed by the widely validated Modified Dental Anxiety Scale (MDAS), which consisted of five items. MDAS has high internal consistency and cross-cultural validity in a variety of adult populations around the world. Each item is rated on a five-point Likert scale and the range of total scores is from 5 to 25. The higher the score, the more dental anxiety respondents show. Oral health behaviour was treated as a composite mediating construct consisting of three different types of behaviour. These consisted of brushing teeth, cleaning between the teeth, and the pattern of dental visits. Two complementary self-reported measures of unmet restorative treatment need were used. The first captured care-seeking delay was the delay in seeking required dental care that was reported by the participants. The second measured self-rated oral health status, using a standardised single item global rating scale. Combined, these measures gave an overall and clinically useful measure of burden of restorative treatment in the community sample.

2.6 Statistical Analysis

The analysis of the data was done using IBM SPSS Statistics. Sociodemographic characteristics and study variables were summarized using descriptive statistics. To quantify the extent of bivariate relationships between dental anxiety, oral health behavior neglect, and bivariate relationships were examined using Pearson correlation analysis. A bootstrapped structural equation modelling approach was used for mediation analysis to estimate the effects, direct, indirect, and total. The covariates were included age, sex, educational level and income level. Educational and income level were also included in the analyses as moderators. The χ^2/df, CFI, TLI, RMSEA, and SRMR were used to assess model adequacy. A p value of $< .05$ was considered to be statistically significant.

2.7 Ethical Considerations

All procedures performed in accordance with the Declaration of Helsinki. All participants gave written informed consent prior to enrolment. Complete anonymity and a voluntary participation were ensured, as well as the possibility of withdrawing from the study at any time without negative repercussions. No personally identifiable information was recorded and therefore, all data recorded was kept confidential throughout the study.

3 Results

3.1 Descriptive analysis

A total of 450 people 41.8 ± 14.2 years of age participated in the study. Most participants were aged 30–44 years (31.1%), followed by 45–59 years (27.8%). Males accounted for 47.8% of the study population (n = 215) while females accounted for 52.2% (n = 235). Most respondents were

middle income (46.7%) and held college/University degrees (42.2%). The mean dental anxiety score was 13.9 ± 5.4, defining participants' level of dental anxiety as moderate. The mean scores for the oral health behavior and unmet restorative treatment need were moderate for both, at 8.6 ± 3.1 and 6.2 ± 2.7 respectively, demonstrated (Table 1).

Table 1: Descriptive analysis

Variable	Category	n (%)
Total Sample		450 (100)
Age (years)	18–29	105 (23.3)
	30–44	140 (31.1)
	45–59	125 (27.8)
	≥60	80 (17.8)
Sex	Male	215 (47.8)
	Female	235 (52.2)
Educational Attainment	Primary or less	55 (12.2)
	Secondary	145 (32.2)
	College/University	190 (42.2)
	Postgraduate	60 (13.4)
Monthly Household Income	Low	145 (32.2)
	Middle	210 (46.7)
	High	95 (21.1)
Dental Visit Pattern	Regular (every 6–12 months)	125 (27.8)
	Only when symptomatic	225 (50.0)
	No dental visit in >2 years	100 (22.2%)

Mean age = 41.8 ± 14.2 years, Dental anxiety score = 13.9 ± 5.4, Oral health behavior neglect score = 8.6 ± 3.1, Unmet restorative treatment need score = 6.2 ± 2.7

3.2 Study variables and categorization

Participants' scores on the main study variables demonstrated moderate scores in descriptive statistics. The overall mean dental anxiety score was 13.9 ± 5.4 (range 5-25) and the overall score was moderate. Within defined categorizations, 27.8% of participants (n = 125) were categorized as low dental anxiety, 45.6% of participants (n = 205) as moderate dental anxiety and 26.7% of participants (n = 120) as high dental anxiety (Supplementary Table 1-2). The mean oral health behavior neglect score was 8.6 ± 3.1 (range: 0–15), with 42.2% (n = 190) demonstrating moderate neglect and 26.7% (n = 120) high neglect. Similarly, the mean score of unmet treatment needs for restorations was 6.2 ± 2.7 (range 0–12); and 44.4% (n = 200) had moderate treatment needs, while 26.7% (n = 120) had high unmet treatment needs for restorations.

3.3 Correlation analysis

The findings indicated that all the studied variables were significantly and positively correlated. Oral health behaviour neglect was moderately correlated with dental anxiety ($r = .48$, $p < .001$), such that a higher dental anxiety score was associated with higher levels of oral health behaviour neglect and lower level of routine dental visits. The correlation was greatest for the oral health behavior neglect and unmet restorative treatment need ($r = .57$, $p < .001$). Also, there was a positive correlation between dental anxiety and unmet restorative need for treatment ($r = .52$, $p < .001$) (Table 2).

Table 2: Correlations Among Main Study Variables

Variable	1	2	3
1. Dental anxiety	1.00		
2. Oral health behavior neglect	.48**	1.00	
3. Unmet restorative treatment need	.52**	.57**	1.00

3.4 Direct and Mediation Effects

Dental anxiety significantly predicted unmet restorative treatment need (β = .52, SE = .04, 95% CI: .44–.60, $p < .001$) and oral health behavior neglect (β = .48, SE = .05, 95% CI: .39–.57, $p < .001$). Unmet restorative need (β = .42, SE = .04, 95% CI: .34 - .50, $p < .001$) also was strongly associated with behavior neglect and was the variable that contributed most to the burden of restorative treatment (Table 3).

Table 3: Direct Effects

Pathway	β	SE	95% Bootstrap CI	p-value
Dental anxiety → Unmet restorative need	.52	.04	.44 to .60	< .001
Dental anxiety → Behavior neglect	.48	.05	.39 to .57	< .001
Behavior neglect → Unmet restorative need	.42	.04	.34 to .50	< .001
Direct effect	.32	.05	.23 to .41	< .001
Indirect effect	.20	.03	.14 to .27	< .001
Total effect	.52	.04	.44 to .60	< .001

The mediation analysis indicated that the association between dental anxiety and unmet restorative treatment need was partially mediated by the oral health behavior neglect. The total effect was significant (β = .52, p < .001), and decreased but remained significant after inclusion of the mediator (β = .32, p < .001). The indirect effect via behavior neglect was also high (β = .20, SE = .03, 95% CI: .14- .27, p < .001), suggesting partial mediation (Table 4).

Table 4: Mediation analysis

Effect	β	SE	95% Bootstrap CI	p-value
Total effect: Dental anxiety → Unmet restorative need	.52	.04	.44 to .60	< .001
Direct effect: Dental anxiety → Unmet restorative need	.32	.05	.23 to .41	< .001
Indirect effect: Dental anxiety → Behavior neglect → Unmet restorative need	.20	.03	.14 to .27	< .001

3.5 Covariate effects

The covariate analysis revealed that age was a significant factor (β = .11, p = .021) but not sex (β = .05, p = .248) in unmet need for restorative treatment. Those with a higher education had lower levels of oral health behaviour neglect (β = −.23, p < .001) and lower levels of unmet restorative need (β = −.17, p = .006). As was the case for behavior neglect, higher income was linked to lower levels of unmet restorative need (β = −.15, p = .011) and behavior neglect (β = −.19, p = .002). Low education (β = .14, p < .001) and low income (β = .12, p = .002) strengthened the anxiety–neglect pathway (Table 5).

Table 5: Effects of Sociodemographic Covariates on the Mediation Model

Covariate	Outcome Path	β	p-value
Age	Unmet restorative treatment need	.11	.021
Sex	Unmet restorative treatment need	.05	.248
Educational attainment	Oral health behavior neglect	-.23	< .001
Income level	Oral health behavior neglect	-.19	.002
Educational attainment	Unmet restorative treatment need	-.17	.006
Income level	Unmet restorative treatment need	-.15	.011
Moderation of Anxiety → Behavior Neglect Pathway			
Interaction Term	β	95% CI	p-value
Dental Anxiety × Low Education	.14	.07 to .22	< .001
Dental Anxiety × Low Income	.12	.05 to .20	.002

3.6 Model fit

The findings evaluate the fit of the model by comparing its value of χ^2/df with the recommended value of 3.0: χ^2/df is 1.84, which indicates a good model fit. Tucker–Lewis Index (TLI = .951) and the Comparative Fit Index (CFI = .964) were both higher than the recommended .90 suggesting excellent fit. Additionally, the RMSEA (.043) and the SRMR (.038) were lower than .05, also marking good model fit and supporting proposed mediation model (Table 6).

Table 6: Model fit

Fit Index	Recommended Value	Interpretation
χ^2/df	1.84	Good fit
CFI	.964	Excellent fit
TLI	.951	Excellent fit
RMSEA	.043	Good fit
SRMR	.038	Good fit

3.7 Internal Consistency Reliability Test

The Internal consistency of the Dental Anxiety Scale was high (Cronbach's α = 0.88) and the mean score was very low (13.9 ± 5.4) indicating that they were consistent in measuring Dental Anxiety. The Oral Health Behavior Neglect Scale also had good internal consistency (Cronbach's α = 0.81), with an acceptable mean score of 8.6 ± 3.1. The mean score of the Unmet Restorative Treatment Need measure was 6.2 ± 2.7 but no Cronbach's alpha was computed since it was not measured on the basis of multi-item scale (Supplementary Table 3).

4 Discussion

This study explored the association among dental anxiety, oral health behavior neglect and unmet need for restorative treatment in community-dwelling adults. The results suggest that dental anxiety, neglect of oral health behavior, and dental need for restorative treatment are common concerns among community-dwelling adults that can occur as part of a larger psychobehavioural framework. This pattern corresponds with previous studies which relate anxiety to oral health behaviors, such as diminished use of preventive oral health care and diminished participation in recommended oral hygiene behaviors. Gbadebo et al. (2025) found that people with high levels of dental anxiety are more likely to delay routine dental check-ups and wait until the pain is severe to attend, which leads to a greater risk of oral disease being untreated [29]. Likewise, Alfadhli et al. (2026) study revealed that anxiety-related avoidance behaviors are associated with less optimal maintenance of oral health and less use of preventive dental services [30]. The results also corroborate evidence that poor oral health practices have been linked to higher restorative treatment burden. Patients who don't make it to the dentist regularly and don't practice good oral hygiene have a higher risk of the disease worsening, thus requiring more treatment. The findings were consistent with the findings of Gustafsson et al. (2020) who found that dental fear is a strong predictor of non-attending to the dentist and seeking emergency care [31]. Moreover, as reported by Enright & Enright (2021), the anxious persons often have less optimal oral health status and higher prevalence of untreated dental problems [32]. These findings strengthen the current evidence of the role of psychological factors in influencing oral health behaviours and treatment utilisation patterns, underscoring the need to address anxiety-related barriers to better oral health outcomes.

The results of the correlation analysis also showed that the significant positive relationships found between dental anxiety and oral health behavior neglect. A relationship between dental anxiety and the neglect of oral health behavior was observed, confirming that individuals with a high dental anxiety are more likely to postpone routine dental visits and subject to a lack of regularly recommend oral health behaviors. This was also noted by Winkler et al., (2023) who stated that dental fear engenders avoidance behaviours, which in turn can adversely affect oral health care-seeking [33]. Eric et al. (2025) found that patients' anxiety is associated with postponing dentist visits for preventive care, thereby increasing the risk for the progression of oral disease [34]. The direct effect analysis also highlighted that dental anxiety is a significant independent predictor of ORTN and OHBN. This finding aligns with the previous evidence that avoidance of dental care due to fear is associated with delayed diagnosis and treatment and thus with a higher burden of restorative treatment [35]. In addition, there is a strong relationship between oral health behavior neglect and unmet restorative treatment need, which is consistent with previous research that poor oral hygiene. However, Bogale et al. (2021) illustrated that lack of dental care attendance are important factors in the presence of untreated caries and restorative treatment needs [36]. Additional evidence of mediation analysis indicated that oral health behaviour neglect was a significant mediator between dental anxiety and restorative treatment burden. This finding aligns with Chan et al. (2023) study that the cognitive-behavioural theories which suggest that anxiety affects oral health outcomes indirectly via avoidance and self-care behaviours [37]. In addition, the moderation analysis showed that these relationships might be stronger among people with lower levels of education and income, indicating they might be more susceptible to the behavioral outcomes of dental anxiety. Together the findings indicate the intricate relationship between psychosocial, psychological, and behavioral factors and oral health-related treatment demands.

The results of the moderation analysis give significant insights into the factors associated with the neglect of oral health behaviors and the need for restorative treatment that is not met. This finding of an association between age and level of restorative treatment burden is consistent with earlier Ruiz et al. (2023) reports that show that greater restorative treatment requirements are linked with greater lifetime exposure to oral disease and delay in treatment among older individuals [38]. However, in contrast, the lack of a sex effect is consistent

with the results of other studies, which indicate that behavioral and socioeconomic factors have a

stronger association with oral health outcomes. This was also seen in the covariate analysis where educational level and income were also protective. In addition, King et al. (2023) study mentioned that individuals with more education tend to have more oral health literacy, engage in preventive behaviors, and use dental services appropriately [39]. Likewise, increased income has been consistently linked with dental access and fewer unmet dental treatment needs [40]. These results contribute to a larger framework that considers

the social determinants of health, and socioeconomic status as an important determinant of oral health. Based on the moderation analysis, the negative effect of dental anxiety on oral health behavior might be stronger in socioeconomically disadvantaged population. Studies by Shahid et al. (2021), Othman et al. (2025) and Subih et al. (2025) found that a low level of education and income can have a more profound impact on dental fear as it restricts access to coping resources and preventive dental care [41,42,43]. This means that anxiety-related avoidance behaviors might be exacerbated in vulnerable groups [44]. The findings indicate the intricate relationship between psychosocial, psychological, and behavioral factors and oral health-related treatment demands.

4.1 Strengths and limitations

The study was based on a bootstrapped SEM methodology which allowed for the estimation of direct and indirect mediation pathways simultaneously. Moreover, the recruitment in several community locations added to the sample heterogeneity and to generalisability beyond clinic-based samples. The cross-sectional design does not allow causal inferences to be drawn regarding the links between dental anxiety, behavioural neglect, and need for restorative treatment. The use of self-reported measures of oral health behaviours and treatment need brings into the study the risk of recall and social desirability bias. The use of purposive sampling may result in findings that are not applicable to other national or international populations due to lack of representativeness.

5 Conclusion

The study results showed that dental anxiety is significantly related to oral health behavior neglect and unmet restorative treatment need for community dwelling adults. General dental anxiety was associated with poorer oral hygiene and less regular dental attendance and increased dental treatment burden for restorative treatment. The results from the mediation analysis indicated that oral health behavior neglect partially mediated the relationship between dental anxiety and unmet restorative treatment need, which suggests an important behavioral pathway between dental anxiety and oral health outcomes. The results highlight the importance of combined psychological and behavioral interventions to enhance oral health behaviors, encourage preventive dental visits, and decrease the unmet needs for restorative dental

treatment.

5.1 Recommendations

Longitudinal designs should be used in future research to address the directionality and causality of the relationships among dental anxiety, behavioural neglect, and restorative treatment need. Psychobehavioural training is needed to build competencies in clinicians to allow for recognition and management of anxiety-induced treatment avoidance in patients in restorative dental curricula. Behaviours counselling interventions addressing anxiety-induced avoidance, especially among the less educated and less affluent members of the population should be introduced to the community oral health programmes. Researchers should design and test culturally appropriate anxiety management programs in various community contexts to increase the generalisability of the outcomes of psychobehavioural interventions for anxiety across various populations worldwide.

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Appendix

Supplementary Files

Supplementary Table 1: Descriptive Statistics of Main Study Variables

Variable	Possible Range	Mean (SD)	Minimum	Maximum
Dental Anxiety Score	5–25	13.9 (5.4)	5	25
Oral Health Behavior Neglect Score	0–15	8.6 (3.1)	0	15
Unmet Restorative Treatment Need Score	0–12	6.2 (2.7)	0	12

Supplementary Table 2: Categorization

Variable	Category	n (%)
Dental Anxiety	Low	125 (27.8)
	Moderate	205 (45.6)
	High	120 (26.7)
Oral Health Behavior Neglect	Low	140 (31.1)
	Moderate	190 (42.2)
	High	120 (26.7)
Unmet Restorative Treatment Need	Low	130 (28.9)
	Moderate	200 (44.4)
	High	120 (26.7)

Supplementary Table 3. Internal Consistency Reliability of Study Measures

Measure	Mean (SD)	Cronbach's α
Dental Anxiety	13.9 (5.4)	0.88
Oral Health Behavior Neglect	8.6 (3.1)	0.81
Unmet Restorative Treatment Need*	6.2 (2.7)	N/A