

Oral health status, oral hygiene behaviors, and caries risk assessment of individuals with special needs: a two-country study (#111072)

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Oral health status, oral hygiene behaviors, and caries risk assessment of individuals with special needs: a two-country study

Consider adding a descriptive subtitle clarifying the study focus

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Background: Individuals with disabilities often experience greater challenges in managing oral diseases, including dental caries and periodontal conditions, due to functional limitations. This study aims to: (1) assess the oral health status of disabled individuals in Pakistan and Saudi Arabia, (2) evaluate their oral hygiene knowledge and behaviors, and (3) determine their caries risk using the CAMBRA protocol. **Methods:** A cross-sectional study was conducted on 189 adults and young aged 13 years and older participants with hearing, visual, or intellectual disabilities from Pakistan and Saudi Arabia between September 2023 and April 2024. The participants were recruited from the Institute of Special Education, Pakistan, and the Saudi Institute of Rehabilitation Medicine, Saudi Arabia. Intraoral examinations and bitewing radiographs assessed oral health, including DMFT², Gingival Index, Visible Plaque, and Molar alignment. A self-administered questionnaire gathered sociodemographic data and evaluated oral hygiene knowledge and behaviors. Caries risk was analyzed using the CAMBRA tool. Data were analyzed using descriptive statistics, Chi-square tests, and binary logistic regression. **Results:** The mean DMFT score was 6.30 (SD = 1.83), with a statistically significant difference between Pakistan and Saudi Arabia ($p = 0.007$). Gingival health was fair to poor in 47% of participants, while 43.4% exhibited bleeding on probing and 34.9% had visible plaque. Class III malocclusion affected approximately 30% of participants in both countries. Tooth brushing frequency showed a significant difference between the two groups ($p = 0.005$).

Most participants (76% in Pakistan, 62% in Saudi Arabia) were classified as high caries risk. Deep pits and fissures (69.4%) and frequent snacking (63.8%) were the main risk factors in Pakistan, while frequent snacking (71.6%) and heavy plaque (60.4%) were prevalent in Saudi Arabia. Saudi participants had a significantly higher likelihood of being in the high-risk group for caries (OR = 1.86, 95% CI: 0.95–3.65, $p = 0.04$). **Conclusion:** The disabled individuals in both countries face significant oral health challenges, with high caries risk and poor oral hygiene practices. Targeted preventive measures and improved dental care access are essential to addressing these disparities.

Oral health status, oral hygiene behaviors, and Caries Risk Assessment of Individuals with Special Needs: A Two-Country Study

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46 Abstract

47 **Background:** Individuals with disabilities often experience greater challenges in managing oral
 48 diseases, including dental caries and periodontal conditions, due to functional limitations. This
 49 study aims to: (1) assess the oral health status of disabled individuals in Pakistan and Saudi Arabia,
 50 (2) evaluate their oral hygiene knowledge and behaviors, and (3) determine their caries risk using
 51 the CAMBRA protocol. **Methods:** A cross-sectional study was conducted on 189 adults and young
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 61 health was fair to poor in 47% of participants, while 43.4% exhibited bleeding on probing and
 62 34.9% had visible plaque. Class III malocclusion affected approximately 30% of participants in
 63 both countries. Tooth brushing frequency showed a significant difference between the two groups
 64 ($p = 0.005$). Most participants (76% in Pakistan, 62% in Saudi Arabia) were classified as high
 65 caries risk. Deep pits and fissures (69.4%) and frequent snacking (63.8%) were the main risk
 66 factors in Pakistan, while frequent snacking (71.6%) and heavy plaque (60.4%) were prevalent in
 67 Saudi Arabia. Saudi participants had a significantly higher likelihood of being in the high-risk
 68 group for caries (OR = 1.86, 95% CI: 0.95–3.65, $p = 0.04$). **Conclusion:** The disabled individuals

in both countries face significant oral health challenges, with high caries risk and poor oral hygiene practices. Targeted preventive measures and improved dental care access are essential to addressing these disparities.

Keywords: Caries risk assessment, CAMBRA, oral health, disabled individuals, Saudi Arabia, Pakistan

Introduction:

People with disabilities, including those with intellectual, emotional, developmental, sensory, or physical impairments, represent a significant and vulnerable group in terms of health outcomes (Currie and Kahn, 2012). These conditions, such as Down syndrome, seizure disorders, hearing and vision impairments, and craniofacial anomalies, not only create functional limitations but also complicate the management of secondary health issues, including oral diseases (Alamri, 2022, Chaudhary, 2023). For instance, the chronicity of dental conditions like dental caries and periodontal diseases often exacerbates the challenges faced by individuals with disabilities, leading to an increased prevalence of oral health problems within this population (Salles et al., 2012). Studies ^{have} ~~has~~ shown that individuals with disabilities often encounter multiple barriers to accessing dental care, which contributes to significant oral health disparities compared to the general population (Salles et al., 2012, Chaudhary et al., 2019) .

This vulnerable group often faces communication difficulties, heightened anxiety, and sensory sensitivities that make traditional dental treatments challenging. Consequently, individuals with disabilities frequently require specialized care and personalized approaches to meet their unique dental needs (Desai et al., 2001, Fazal et al., 2023). Despite advancements in dental care and treatment options, oral diseases like dental caries remain a major public health issue globally.

92 Dental caries alone affect 60-90% of children and adults worldwide, and individuals with
93 disabilities are often at even higher risk (Levine and Stillman-Lowe, 2019).

94 Earlier studies have emphasized that individuals with disabilities are disproportionately affected
95 by dental caries diseases (Alamri, 2022, Chaudhary, 2023, Chaudhary et al., 2019). Therefore,
96 there is a critical need for effective caries risk assessment models tailored to this group. Assessing
97 caries risk is not only essential for managing and preventing the progression of dental caries but
98 also crucial for providing individualized, cost-effective dental care (Iqbal et al., 2022). Traditional
99 approaches to dental care, which do not take individual risk factors into account, may not be
100 suitable for disabled individuals who often require a more targeted approach. (Ref?)

101 Caries Management by Risk Assessment (CAMBRA) has emerged as an evidence-based protocol
102 aimed at identifying individuals at high risk for dental caries at the earliest possible stage (Iqbal et
103 al., 2022, Iqbal et al., 2024). This risk-based model enables dental professionals to evaluate disease
104 indicators, risk factors, and protective factors to classify individuals into low, moderate, high risk
105 categories. CAMBRA provides a systematic and minimally invasive approach to managing dental
106 caries by focusing on prevention and addressing the root causes of disease rather than simply
107 treating the symptoms (Iqbal et al., 2024). This approach is particularly beneficial for individuals
108 with disabilities, whose unique conditions may predispose them to increased caries risk. (Ref?)

109 While CAMBRA has been widely adopted in general populations, its application in individuals
110 with disabilities remains underexplored, especially in developing countries like Pakistan and also
111 in developed country like Saudi Arabia. The current literature largely focuses on caries risk in
112 general pediatric or adult populations without considering the specific challenges faced by those
113 with disabilities. Furthermore, studies exploring oral health status and caries risk in disabled

Specify
geographic context

114 individuals have often been small-scale or single-center with single specific disability, limiting the
 115 generalizability of their findings (Marshall et al., 2010, Alkhabuli et al., 2019). There is also a
 116 notable lack of comparative studies examining these issues across different countries with
 117 economic status, varying healthcare systems and socio-cultural contexts. For example, Saudi
 118 Arabia offers universal healthcare with specialized services for individuals with disabilities, while
 119 Pakistan faces challenges related to healthcare access and funding. Similarly, differences in
 120 cultural practices and health literacy further shape oral health behaviors and outcomes, making
 121 cross-country comparisons essential for understanding diverse influences on caries risk in disabled
 122 populations. The comparison between the two countries is valuable because it allows us to examine
 123 how differing levels of healthcare infrastructure, access to specialized care, and socio-cultural
 124 factors influence the oral health outcomes of disabled individuals.

Ref?

125 Thus, the objectives of this study are threefold: (1) to explore the oral health status of disabled
 126 individuals in Pakistan and Saudi Arabia, (2) to assess their oral hygiene knowledge and
 127 Behaviors, and (3) to assess their caries risk using the CAMBRA protocol. By addressing these
 128 objectives, this study aims to fill the existing gaps in the literature regarding the oral health needs
 129 of disabled individuals in these two culturally distinct countries. This research will provide
 130 valuable insights into the specific challenges faced by disabled populations in accessing oral
 131 healthcare and offer evidence-based recommendations for improving preventive dental care for
 132 this vulnerable group.

133

134 **Materials and Methods:**

This cross-sectional study was conducted in Pakistan and Saudi Arabia between September 2023 and April 2024, employing a non-probability convenience sampling technique. The study focused on disabled individuals, with participants recruited from the Institute of Special Education and Bahria College for Special Needs in Islamabad, Pakistan, and the Saudi Institute of Rehabilitation Medicine in Jouf, Saudi Arabia. The study population included teenagers, adults and young aged 13 years and older with hearing, visual, and intellectual disabilities. Participants with other types of disabilities (autism, cerebral palsy, or other neurological and developmental disorders) and those whose parents or guardians declined to consent were excluded.

The sample size for each country was calculated using data from reference studies. In Pakistan, the sample size was derived from a previous study on oral hygiene status among individuals with special needs in Karachi (Azfar et al., 2018), using a prevalence of 50%, a margin of error of 9%, and a 95% confidence level, resulting in 109 participants. For Saudi Arabia, the sample size was based on a study of hearing-impaired participants (Al-Qahtani et al., 2017), with a prevalence of 95% for dental caries, a margin of error of 4.65%, and a 95% confidence level, yielding 85 participants. The sample size for Saudi Arabia was initially estimated based on a study targeting a specific type of disability. The margins of error were selected based on population characteristics and prior studies. For Saudi Arabia, the margin of error was derived from a study focusing on a specific type of disability, which was adjusted during recruitment to include a broader range of disabilities. For Pakistan, where disability-specific data was scarce, the margin of error was designed to accommodate greater variability. This approach allowed sufficient power for within-country analyses but limited the capacity to detect cross-country differences.

But raises concerns about comparative analyses.

Ethical approval for this study was obtained from the Ethical Review Board of the School of Dentistry, Shaheed Zulfiqar Ali Bhutto Medical University, SZABMU (Ref. No. SOD/ERB/2023/156). Written informed consent was obtained from participants who were able to comprehend the purpose of the study, and from parents or guardians for minors or individuals with cognitive impairments.

All participants underwent intraoral examinations and bitewing radiographs to assess their oral health, particularly for the detection of caries. A self-administered questionnaire was also completed. Trained investigators conducted all oral examinations under standardized conditions, using appropriate lighting and equipment in a reclined chair setting. Calibration sessions were held for examiners in both countries, with three calibration sessions held separately and one final joint session conducted online to ensure consistency across countries. Inter-examiner reliability was assessed using Kappa statistics, and a Kappa value of ≥ 0.75 was required for participation in the study. Examination tools included a mouth mirror, explorer, and periodontal probe.

The Decayed, Missing, and Filled Teeth (DMFT) index was used to measure the participants' caries experience (Organization, 2013). The total number of decayed, missing, and filled teeth was recorded for each participant, with a higher DMFT score indicating a greater burden of caries. The Loe & Silness Gingival Index was used to assess gingival health (Organization, 2013). Six index teeth (molars and incisors) were examined, with each tooth's buccal, mesial, lingual, and distal surfaces scored from 0 (healthy) to 3 (severe inflammation). Participants were categorized based on their scores into four groups: Excellent (score 0), Good (0.1–1.0), Fair (1.1–2.0), and Poor (2.1–3.1). Oral hygiene was assessed by identifying visible plaque on the maxillary incisors using a periodontal probe (Organization, 2013). Plaque was recorded as either "Yes" (visible plaque

present) or "No" (no visible plaque), offering a simple yet reliable assessment of oral hygiene status. Angle's Classification of Malocclusion was used to evaluate molar alignment, categorizing participants into Class I (normal), Class II (distocclusion), or Class III (mesiocclusion) (Dewey, 1915). The relationship between the mesiobuccal cusp of the maxillary first molar and the buccal groove of the mandibular first molar was assessed.

After the intraoral examination, participants completed a 17-item self-administered questionnaire.

For those with visual impairments or comprehension difficulties, questions and response options were read aloud by the research team or school staff. The questionnaire, adapted from Tadin et al.

(2022) (Tadin et al., 2022), To ensure its relevance and appropriateness for our study objectives and target population, we conducted a thorough review and validation process in both countries.

An expert panel consisting of three members—an Assistant Professors of Operative Dentistry, an Assistant Professor of Epidemiology, and a specialist in special care dentistry in Pakistan and almost similar panel in Saudi Arabia reviewed the questionnaire items. Their feedback was

incorporated into the final version of the questionnaire. The questionnaire was divided into two sections: 1) Sociodemographic Information: Including age, gender, parental education, occupation, and length of employment. 2) Oral Hygiene Knowledge and Behaviors: Assessing knowledge of tooth brushing practices, oral health's impact on general health, the effects of carbonated drinks and sugary foods, and the sources of oral health information. It also evaluated behaviors like brushing frequency, duration, toothpaste type, dental visits, and independence in tooth brushing. Clarify questionnaire validation process.

Caries risk was assessed using a customized Caries Management by Risk Assessment (CAMBRA) tool, evaluating eight risk factors, protective factors, and disease indicators (Iqbal et al., 2024).

The CAMBRA protocol has been validated and successfully implemented in both Pakistan and Saudi Arabia in previous studies (Iqbal et al., 2022, Iqbal et al., 2024). Participants were classified into low, moderate, or high-risk groups based on factors such as plaque presence, fluoride use, dental care history, and salivary function. Some risk factors (e.g., bacterial counts) were excluded due to financial and logistical constraints.

Descriptive statistics were computed to summarize the data, with frequency distributions for categorical variables. Chi-square tests were used to assess the association between oral health indicators and sociodemographic factors. Binary logistic regression analysis was employed to explore relationships between caries risk categories and sociodemographic variables. All statistical analyses were performed using IBM SPSS (version 25.0), with a significance level set at $p < 0.05$.

Results

A total of 189 participants with disabilities were included in the study, with 108 participants from Pakistan and 81 from Saudi Arabia. The majority of the participants were male (61.9%) and aged between 13–16 years (66.1%). The distribution of participants based on disability was as follows: Intellectual Disability/Down syndrome (48.1%), hearing loss (38.1%), and blindness (13.8%). Most of the participants' parents had a school-level education (70.4%) and had more than 11 years of working experience (71.4%). The caries risk assessment indicated that the majority of participants in both countries were classified as having a high risk of caries, with 75.9% in Pakistan and 61.7% in Saudi Arabia (Table 1).

** Add missing demographic data.*

The mean DMFT score for the participants was 6.30 (SD = 1.83). A statistically significant difference was found between the DMFT scores of participants from Pakistan and Saudi Arabia ($p = 0.007$) (Table 2). 47% of participants exhibited fair to poor gingival health, with 43.4% showing bleeding on probing, and 34.9% having visible plaque. Molar alignment was primarily in Class I Angle classification for 55.6% of Pakistani participants and 60.5% of Saudi participants, though approximately 30% of participants in both countries had Class III malocclusion. The majority of participants (76%) in Pakistan and (62%) in Saudi Arabia were found to be in the ‘High’ caries risk category.

** Include between-group statistical comparisons*

The oral health behaviors and knowledge results are presented in Table 3. The only behavior that showed a statistically significant difference between Pakistani and Saudi participants was the frequency of tooth brushing ($p = 0.005$). Notably, 34.6% of participants from Saudi Arabia brushed their teeth twice daily, compared to 13.0% in Pakistan. 97% of the participants reported using a toothbrush for cleaning their teeth, and 58% brushed their teeth in the morning. However, 57% of participants were unaware of the type of toothpaste they should use, and 54% had not visited a dentist in the past year. Additionally, 37% of participants could not brush their teeth independently. Regarding oral health knowledge, 59% of participants believed that oral health affects general health, 70.4% recognized the importance of proper tooth brushing in maintaining oral hygiene, and 77.2% understood that sugary/sticky foods can damage teeth. However, only 50.8% were aware that carbonated drinks have adverse effects on teeth. The main source of information on maintaining oral health was parents (63%), and 57.1% of participants affirmed that their primary caregiver or school-teacher educated them about oral health and maintenance.

** Reorganize behavioral data presentation!*

Most participants in both countries had one or more disease indicators, with the most common being visible cavities (Pakistan = 98.1%, Saudi Arabia = 98.7%) and radiographic approximal enamel lesions (Pakistan = 88.8%, Saudi Arabia = 83.9%). The most common risk factor in Pakistan was deep pits and fissures (69.4%), followed by frequent snacking (63.8%). In Saudi Arabia, the most common risk factor was frequent snacking (71.6%), followed by visible heavy plaque (60.4%). The most frequently reported protective factor was the use of fluoridated toothpaste at least once daily (Pakistan = 68.5%, Saudi Arabia = 77.7%) (Table 4).

In the logistic regression analysis, adjusting for country and other sociodemographic factors, being from Saudi Arabia was significantly associated with a higher likelihood of participants being in the high-risk group for caries. Disabled participants from Saudi Arabia were 1.86 times more likely to be in the high-risk group compared to those from Pakistan (OR = 1.86, 95% CI: 0.95–3.65, $p = 0.04$) (Table 5). Other all sociodemographic variables were not significantly associated with caries risk categories.

Discussion:

The findings of this study highlight significant oral health challenges among disabled individuals in Pakistan and Saudi Arabia, with a particular focus on caries risk, oral hygiene behaviors, and gingival health. This study contributes to the growing body of literature indicating that individuals with disabilities face disproportionate risks for oral diseases due to a combination of biological, behavioral, and systemic factors.

266 The high prevalence of dental caries in both populations, with 75.9% of participants in Pakistan
 267 and 61.7% in Saudi Arabia classified as high-risk, similar to findings from previous studies on
 268 disabled individuals worldwide. For instance, a study by Shyama et al. (2013) in Kuwait found
 269 similarly elevated caries rates in disabled population, where 80% were classified as high caries
 270 risk (Shyama et al., 2001).⁹ This is consistent with broader research showing that individuals with
 271 disabilities tend to have higher caries risk than their non-disabled counterparts due to difficulties
 272 in maintaining oral hygiene and accessing dental care.

273 Moreover, the mean DMFT score of 6.30 found in this study aligns with prior research from other
 274 countries. For example, Al Habashneh et al. (2012) reported DMFT scores ranging between 5.5
 275 and 7.1 in disabled populations in Jordan (Al Habashneh et al., 2012). The statistically significant
 276 difference in DMFT scores between Pakistan and Saudi Arabia ($p = 0.007$) may be attributable to
 277 differences in public health policies, dietary habits, or access to fluoridated water. The high
 278 prevalence of deep pits and fissures as risk factors in Pakistan (69.4%) and frequent snacking in
 279 Saudi Arabia (71.6%) further underscores the need for targeted preventive strategies specific to
 280 each country's risk profile. *Strengthen comparison with literature*

281 The poor oral hygiene practices among disabled individuals in both countries are concerning, with
 282 47% of participants exhibiting fair to poor gingival health, 43.4% presenting with bleeding on
 283 probing, and 34.9% showing visible plaque. These findings are consistent with previous studies
 284 that have highlighted the challenges faced by disabled individuals in maintaining good oral
 285 hygiene. Studies in Brazil and India also reported poor oral hygiene and gingival health among
 286 individuals with intellectual and developmental disabilities (Braúna et al., 2016, Makkar et al.,
 287 2019, Mehta et al., 2015). The significant difference in tooth brushing frequency between Saudi

** Lack of critical analysis of findings*

and Pakistani participants ($p = 0.005$) suggests that cultural or educational factors may play a role in oral hygiene behaviors. Saudi participants, who brushed more frequently, may benefit from more accessible health education campaigns or greater parental involvement. However, despite higher brushing frequency, the caries risk remained high, emphasizing that brushing alone is insufficient without addressing other factors like diet, fluoride use, and regular dental visits.

The lack of knowledge regarding toothpaste type (57%) and irregular dental visits (54% had not seen a dentist in the past year) further complicates efforts to improve oral health in this population. Similar knowledge gaps have been reported in other studies on disabled individuals, particularly in developing countries where oral health education is often inadequate (Al-Sufyani et al., 2014, Chu et al., 2008, Anwar et al., 2022). This highlights the critical need for improved oral health education programs that are tailored to the needs of disabled individuals and their caregivers.

The use of the CAMBRA protocol in this study offers valuable insights into caries risk management for disabled populations. CAMBRA's focus on both risk and protective factors enables a more nuanced understanding of caries risk in this vulnerable group. For example, the use of fluoridated toothpaste, a key protective factor, was higher in Saudi participants (77.7%) compared to Pakistani participants (68.5%), which may explain the slightly lower caries risk in the Saudi cohort. However, the high prevalence of disease indicators, such as visible cavities (98.1% in Pakistan and 98.7% in Saudi Arabia), underscores the need for earlier interventions and more aggressive preventive measures. The logistic regression analysis revealed that being from Saudi Arabia was significantly associated with higher odds of being in the high-risk caries group compared to being from Pakistan ($OR = 1.86$, $p = 0.04$). This finding could be influenced by a combination of dietary habits, cultural differences, and healthcare access. Saudi Arabia's higher

310 consumption of sugary snacks and beverages, as identified in previous studies, could be a
311 contributing factor (Alsubaie, 2017, Chaudhary et al., 2024, Khattak et al., 2022).

312 The results of this study have important implications for dental practitioners and public health
313 policymakers. First, the findings of this study suggest that dental professionals in both Pakistan
314 and Saudi Arabia may face challenges in effectively addressing the oral health needs of disabled
315 individuals. While the study did not directly assess training gaps, it underscores the importance of
316 improving education and care models for this population. Based on these observations and
317 supported by existing literature, there is a clear recommendation for specialized training for dental
318 professionals to better manage the oral health needs of individuals with disabilities (Alamri, 2022,
319 Lim et al., 2022). Second, public health policies should prioritize access to preventive dental care
320 for disabled individuals, including regular dental check-ups, fluoride treatments, and dietary
321 counseling. The disparities in oral health outcomes between Pakistan and Saudi Arabia indicate
322 that country-specific interventions are needed (Chaudhary et al., 2024). For example, Saudi Arabia
323 might benefit from policies that limit the consumption of sugary foods and drinks, while Pakistan
324 could focus on improving access to fluoridated water and oral health education.

325 This study has several limitations that warrant consideration. The non-probability convenience
326 sampling method limits the generalizability of the findings. The separate sample size estimations
327 and recruitment strategies for Pakistan and Saudi Arabia allowed for detailed insights into each
328 country's oral health status among disabled populations. However, this approach does not facilitate
329 robust cross-country comparisons. This limitation highlights the need for future research to use
330 pooled sample size calculations and effect size-based estimations to ensure adequate power for
331 comparative analyses

Detail study limitation comprehensively

Moreover, while the CAMBRA protocol provides a useful framework for assessing caries risk, the exclusion of certain risk factors (e.g., bacterial counts, salivary flow) due to logistical constraints may have limited the comprehensiveness of the risk assessment. Future research should aim to include these additional factors and explore longitudinal outcomes to better understand the effectiveness of CAMBRA in preventing caries progression in disabled populations.

Conclusion

This study underscores the significant oral health challenges faced by disabled individuals in both Pakistan and Saudi Arabia, with high levels of caries risk, poor oral hygiene, and gingival health being prevalent across both populations. The findings indicate that disabled individuals in both countries are disproportionately affected by dental caries and poor oral hygiene practices. Saudi participants were found to have a slightly lower caries burden, potentially due to greater use of fluoridated toothpaste, yet their overall caries risk remained high, possibly due to lifestyle factors such as frequent snacking. In Pakistan, deep pits and fissures were a predominant risk factor, indicating the need for preventive measures such as sealants and fluoride application. These findings highlight the critical need for tailored oral health education programs, improved access to preventive dental care, and specialized training for dental professionals to better serve disabled populations.

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Table 1(on next page)

Sociodemographic characteristics of the participants

1 **Table 1.** Sociodemographic characteristics of the participants

Characteristics	Pakistan N (%)	Saudi Arabia N (%)	Total N (%)
	108 (57.1)	81 (42.9)	189
Age			
13-16	70 (64.8)	55 (67.9)	125 (66.1)
17-26	32 (29.6)	21 (25.9)	53 (28.0)
>27	6 (5.6)	5 (6.2)	11 (5.8)
Gender			
Male	68 (63.0)	49 (60.5)	117 (61.9)
Female	40 (37.0)	32 (39.5)	72 (38.1)
Education of parents			
No-formal	2 (1.9)	2 (2.5)	4 (2.1)
School	74 (68.5)	59 (72.8)	133 (70.4)
College	20 (18.5)	13 (16.0)	33 (17.5)
University	12 (11.1)	7 (8.6)	19 (10.1)
Occupation of parents			
Labor	6 (5.6)	3 (3.7)	9 (4.8)
Government	14 (13.0)	9 (11.1)	23 (12.2)
Professional	36 (33.3)	27 (33.3)	63 (33.3)
Other	52 (48.1)	42 (51.9)	94 (49.7)
Length of Employment (years)			
<5	19 (17.6)	8 (9.9)	27 (14.3)
5-10	17 (15.7)	10 (12.3)	27 (14.3)
11-15	44 (40.7)	38 (46.9)	82 (43.4)
>16	28 (25.9)	25 (30.9)	53 (28.0)
Disability of individuals			
Hearing loss	36 (33.3)	36 (44.4)	72 (38.1)
Blind	16 (14.8)	10 (12.3)	26 (13.8)
Intellectual Disability (ID)/Down Syndrome	56 (51.9)	35 (43.2)	91 (48.1)
Caries assessment			
Low	0	0	
Moderate	26 (24.1)	31 (38.3)	57 (30.2)
High	82 (75.9)	50 (61.7)	132 (69.8)

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Table 2(on next page)

The summary of the DMFT, Gingival Index, Bleeding gums, visible plaque and molar classification of the participants in Pakistan and Saudi Arabia

1 **Table 2.** The summary of the DMFT, Gingival Index, Bleeding gums, visible plaque and molar
2 classification of the participants in Pakistan and Saudi Arabia

Oral Health Status	Pakistan N (%)	Saudi Arabia N (%)	Total N (%)	P-value
DMFT Mean (SD)	6.61 (1.81)	5.89 (1.78)	6.30 (1.83)	0.007
Gingival Index				0.548
Excellent	9 (8.3)	11 (13.6)	20 (10.6)	
Good	46 (42.6)	35 (43.2)	81 (42.9)	
Fair	36 (33.3)	21 (25.9)	57 (30.2)	
Poor	17 (15.7)	14 (17.3)	31 (16.4)	
Bleeding				0.582
Yes	45 (41.7)	37 (45.7)	82 (43.4)	
No	63 (58.3)	44 (54.3)	107 (56.6)	
Visible plaque				0.826
Yes	37 (34.3)	29 (35.8)	66 (34.9)	
No	71 (65.7)	52 (64.2)	123 (65.1)	
Molar Class				0.760
Class I	60 (55.6)	49 (60.5)	109 (57.7)	
Class II	15 (13.9)	9 (11.1)	24 (12.7)	
Class III	33 (30.6)	23 (28.4)	56 (29.6)	

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Table 3(on next page)

The summary of Oral health behaviors and knowledge among participants of Pakistan and Saudi Arabia

1 **Table 3.** The summary of Oral health behaviors and knowledge among participants of Pakistan
2 and Saudi Arabia.

Oral health behaviors and knowledge	Total N (%)	Pakistan N (%)	Saudi Arabia N (%)	P-Value
How many times do you brush your teeth?				0.005
Once a day	127 (67.2)	82 (75.9)	45 (55.6)	
Twice	42 (22.2)	14 (13.0)	28 (34.6)	
Thrice	11 (5.8)	6 (5.6)	5 (6.2)	
Do not brush	9 (4.8)	6 (5.6)	3 (3.7)	
Do you think oral health has an effect on general health?				0.468
Yes	111 (58.7)	61 (56.5)	50 (61.7)	
No	78 (41.3)	47 (43.5)	31 (38.3)	
Do you think proper tooth brushing helps in maintaining oral hygiene?				0.748
Yes	133 (70.4)	75 (69.4)	58 (71.6)	
No	56 (29.6)	33 (30.6)	23 (28.4)	
Do you think carbonated drinks have adverse effects on teeth?				0.401
Yes	93 (49.2)	56 (51.9)	37 (45.7)	
No	96 (50.8)	52 (48.1)	44 (54.3)	
Do you think sugary/sticky food items can damage teeth?				0.394
Yes	146 (77.2)	81 (75.0)	65 (80.2)	
No	43 (22.8)	27 (25.0)	16 (19.8)	
Do you know how should teeth be cleaned?				0.392
Finger	5 (2.6)	4 (3.7)	1 (1.2)	
Stick	0	0	0	
Tooth-brush	183 (96.8)	103 (95.4)	80 (98.8)	
Charcoal	1 (0.5)	1 (0.9)	0	
How long should you clean your teeth?				0.485
Less than a minute	20 (10.6)	14 (13.0)	6 (7.4)	
2 min	103 (54.5)	55 (50.9)	48 (59.3)	
5 min	36 (19.0)	20 (18.5)	16 (19.8)	
I don't know	30 (15.9)	19 (17.6)	11 (13.6)	
Which type of toothpaste should be used?				0.175
Fluoride containing	77 (40.7)	38 (35.2)	39 (48.1)	
Without fluoride	4 (2.1)	3 (2.8)	1 (1.2)	
I don't know	108 (57.1)	67 (62.0)	41 (50.6)	
What do you know is the ideal time for brushing your teeth?				0.860
In the morning	111 (58.7)	64 (59.3)	47 (58.0)	
At night	51 (27.0)	27 (25.0)	24 (29.6)	
After every meal	19 (10.1)	12 (11.1)	7 (8.6)	
All of the above	8 (10.1)	5 (4.6)	3 (3.7)	
Did your primary care giver or school-teacher educate you regarding oral health and maintenance?				0.161
Yes				

No	108 (57.1) 81 (42.9)	57 (52.8) 51 (47.2)	51 (63.0) 30 (37.0)	
Have you been to a dentist during the past years?				0.613
Yes	87 (46.0)	48 (44.4)	39 (48.1)	
No	102 (54.0)	60 (55.6)	42 (51.9)	
From where did you get information on how to keep your mouth clean?				0.128
Parents	119 (63.0)	73 (67.6)	46 (56.8)	
Teacher	70 (37.0)	35 (32.4)	35 (43.2)	
Are you able to brush independently?				1.00
Yes	119 (63.0)	68 (63.0)	51 (63.0)	
No	70 (37.0)	40 (37.0)	30 (37.0)	

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Table 4(on next page)

Distribution according to disease indicators, risk, and protective factors among participants of Pakistan and Saudi Arabia

1 **Table 4.** Distribution according to disease indicators, risk, and protective factors among
2 participants of Pakistan and Saudi Arabia

Disease Indicators	Pakistan N (%)	Saudi Arabia N (%)
Visible cavities or radiographic penetration of the dentin	106 (98.1)	80 (98.7)
Radiographic approximal enamel lesions (not in dentin)	96 (88.8)	68 (83.9)
White spots on smooth surfaces	67 (62.0)	59 (72.8)
Restorations in last three years	52 (48.1)	61 (75.3)
Risk Factors		
Visible heavy plaque on teeth	37 (34.2)	49 (60.4)
Frequent snack (> 3 __ daily between meals)	69 (63.8)	58 (71.6)
Deep pits and fissures	75 (69.4)	44 (54.3)
Recreational drug use	2 (1.8)	0
Inadequate saliva flow by observation	56 (51.8)	35 (43.2)
Saliva reducing factors (medications/radiation/systemic)	61 (56.4)	37 (45.6)
Exposed roots	31 (28.7)	20 (24.6)
Orthodontic appliances	23 (21.2)	38 (46.9)
Protective Factors		
Home/work/school is a fluoridated community	26 (24.0)	54 (66.6)
Fluoride toothpaste at least once daily	74 (68.5)	63 (77.7)
Fluoride toothpaste at least 2 __ daily	13 (12.0)	30 (37.0)
Fluoride mouth rinse (0.05% NaF) daily	15 (13.8)	25 (30.8)
Fluoride varnish in last six months	5 (4.6)	12 (14.8)
Chlorhexidine prescribed/used one week each of last six months	3 (2.7)	7 (8.6)
Xylitol gum/lozenges 4 __ daily last six months	4 (3.7)	6 (7.4)
Calcium and phosphate paste during last six months	3 (2.7)	4 (4.9)

- Add statistical comparisons and include odd ratios

Table 5(on next page)

Binary logistic regression of the analysis to explore relationships between caries risk categories and sociodemographic variables

Table 5. Binary logistic regression of the analysis to explore relationships between caries risk categories and sociodemographic variables.

Predictor Variable	Coefficient (β)	Odds Ratio (OR)	95% CI for OR	P-value
Age (ref.: 13-16 years)				
17-26	-0.59	0.55	0.12, 2.45	0.43
>27	-0.11	0.89	0.17, 4.59	0.89
Gender (ref.: Male)				
Female	0.47	1.60	0.80, 3.22	0.18
Education of parents (ref.: No formal)				
School	-21.9	0.00	0	0.99
College	-0.26	0.76	0.18, 3.17	0.71
University	-0.17	0.84	0.18, 3.79	0.82
Occupation of parents (ref.: Labor)				
Government	19.855	419.7	0	0.99
Professional	0.21	1.24	0.42, 3.61	0.69
Other	-0.008	0.99	0.40, 2.43	0.98
Length of Employment (yrs) (ref.: <5)				
5-10	-0.49	0.61	0.17, 2.09	0.43
11-15	-0.73	0.48	0.14, 1.55	0.22
>16	-0.20	0.81	0.32, 2.04	0.66
Disability of individuals children (ref.: Hearing loss)				
Blind	-0.6	0.52	0.24, 1.11	0.09
Intellectual Disability (ID)/Down Syndrome	0.90	2.47	0.58, 10.4	0.21
Country (ref.: Pakistan)				
Saudi Arabia	0.67	1.86	0.95, 3.65	0.04

3
4 -Add model fit statistics