

PREVALENCE OF DENTAL CARIES AMONG STUDENTS AGED 16–20 IN PARACHINAR DISTRICT KURRAM

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Abstract

Background: Dental caries is one of the most prevalent oral health problems among adolescents worldwide and remains a major public health concern in developing countries. It is a multifactorial disease influenced by dietary habits, oral hygiene practices, and microbial factors.

Objectives: Objective of the study was to determine the prevalence of dental caries among students aged 16–20 years in Parachinar, District Kurram, and to evaluate associated oral hygiene practices, dietary habits and dental care behaviors.

Material and Methods: A community-based cross-sectional study was conducted among 384 students aged 16–20 years. Data were collected using a structured questionnaire. Clinical examination was performed using the DMFT (Decayed, Missing, and Filled Teeth) index. Data were analyzed using SPSS, and descriptive statistics were applied.

Result: The prevalence of dental caries was 82.3%, with only 17.7% of participants being caries-free. The mean DMFT score was 2.42 ± 1.83 , indicating moderate caries experience. Most students reported brushing once daily, with low use of fluoride toothpaste and other oral hygiene aids. Frequent consumption of sugary foods and beverages was observed.

Conclusion: There is a high burden of dental caries among adolescents in Parachinar, likely associated with poor oral hygiene practices, high sugar intake, and limited dental care utilization. School-based oral health education and preventive strategies are recommended to improve oral health outcomes.

Introduction

Dental caries remains one of the most prevalent chronic diseases worldwide and affects individuals irrespective of age, sex, and socioeconomic background [1,2]. It is currently understood as a dynamic, multifactorial, sugar-induced and biofilm-mediated disease characterized by alternating periods of demineralization and remineralization of dental

hard tissues [3]. Cariogenic microorganisms metabolize fermentable carbohydrates and produce organic acids that reduce plaque pH. When the pH falls below the critical level of approximately 5.5, dissolution of enamel hydroxyapatite may occur, ultimately producing clinically detectable carious lesions [4,5]. The continuing global burden of untreated dental caries demonstrates that the disease remains an

important public health concern despite the availability of effective preventive strategies [6]. The development of dental caries depends on the interaction of a susceptible tooth surface, cariogenic microorganisms, fermentable carbohydrates, and time [8]. This process is modified by protective biological factors, particularly saliva, which contributes to acid neutralization and supplies calcium and phosphate required for remineralization [10]. Among modifiable behavioral factors, frequent consumption of free sugars is particularly important. The World Health Organization recommends limiting free-sugar intake to less than 10% of total daily energy intake because of its relationship with dental caries and other non-communicable diseases [12]. Oral hygiene is also important because regular tooth brushing, especially with fluoride-containing toothpaste, helps control cariogenic biofilm and increases the resistance of enamel to acid-induced demineralization [13].

Adolescence and the transition into early adulthood represent important periods for the establishment of independent dietary and oral-hygiene behaviors. Individuals between approximately 16 and 20 years of age increasingly make their own decisions regarding food intake, tooth brushing, and dental attendance. Contemporary adolescent dietary patterns commonly include frequent snacking, processed foods, carbonated beverages, energy drinks, and other sugar-containing products. Repeated exposure to fermentable carbohydrates provides cariogenic microorganisms with substrates for acid production, while acidic beverages may additionally contribute to dental erosion [29,30]. Consequently, unfavorable dietary patterns combined with inadequate oral hygiene may result in a substantial cumulative caries burden during late adolescence.

The distribution of dental caries is not uniform internationally. Many high-income countries have experienced reductions in caries associated with fluoride exposure, preventive services, and organized oral-health programs. Nevertheless, substantial inequalities persist, and the disease burden has increasingly become concentrated among socially and economically disadvantaged groups [42-44]. In low- and middle-income countries, preventive dental infrastructure is

often inadequate, and untreated disease remains common. South Asian studies have similarly demonstrated a substantial burden among children and adolescents, with differences associated with socioeconomic circumstances, sugar exposure, access to dental care, and oral-hygiene practices [46,47].

Pakistan continues to face considerable challenges in oral health. Research from major urban centers has reported substantial levels of untreated decay among school-age populations, with the decayed component frequently accounting for much of the DMFT index [51,53]. Limited preventive dental attendance, socioeconomic inequalities, low oral-health literacy, and differences in the availability of dental professionals may further contribute to disease progression. Rural communities may be particularly disadvantaged because geographic isolation, transportation difficulties, financial limitations, and shortage of preventive services can delay diagnosis and treatment [61].

Parachinar, located in District Kurram near the Afghanistan border, represents an important but comparatively understudied population. Available literature in the source material indicates limited epidemiological information concerning oral health in the newly merged tribal districts of Khyber Pakhtunkhwa. Local dietary practices, socioeconomic circumstances, access to professional dental care, oral-hygiene behavior, and environmental characteristics may differ from those of large Pakistani cities. Reliable baseline information is therefore required before appropriate school-, community-, and district-level preventive programs can be planned.

The present study was conducted to determine the prevalence and severity of dental caries among students aged 16–20 years in Parachinar, District Kurram. Dental caries was assessed using the Decayed, Missing and Filled Teeth (DMFT) index, while information on oral-hygiene practices, dietary habits, dental-care utilization, and oral-health awareness was also collected. Establishing such baseline information may help identify important behavioral gaps and provide evidence for future oral-health promotion and preventive dental programs in this underserved population.

Materials and Methods**Study Design and Setting**

A descriptive cross-sectional study was conducted among students aged 16–20 years in different areas of Parachinar, District Kurram, using a community-based approach. Data collection was undertaken from January 2026 to May 2026.

Sample Size and Sampling

The minimum required sample size was calculated using Cochran's formula for estimating a single population proportion. A 95% confidence level was selected with $Z = 1.96$, an expected proportion of 0.50 in the absence of previous local prevalence data, and a margin of error of 0.05. Based on this calculation, a total of 384 students were included in the study. A non-probability sampling technique was used to recruit participants.

Inclusion and Exclusion Criteria

Students aged 16–20 years, of either sex, with fully erupted permanent dentition, who provided informed consent and were present during data collection were included. Students undergoing active orthodontic treatment, those with systemic conditions affecting oral health, individuals with special needs or conditions preventing oral examination, students taking medications associated with reduced salivary flow, and those who refused participation were excluded.

Data Collection Procedure

Ethical approval was obtained from the institutional review board before data collection. A structured questionnaire and DMFT examination form were prepared. Clinical oral examinations were performed in designated areas using natural daylight or portable illumination. Sterilized mouth mirrors and CPI probes were used together with disposable gloves, masks, and hand sanitizers.

Dental caries was assessed according to WHO oral-health survey criteria, and the DMFT index was used because all participants had permanent dentition. A self-administered questionnaire was used to obtain information regarding demographic characteristics, tooth-brushing frequency, toothpaste type, use of mouthwash, dental floss and miswak, sugary-food consumption, dental attendance, reasons for visiting dentists, and oral-health awareness.

Statistical Analysis

Data were entered, cleaned, coded, and analyzed using IBM Statistical Package for the Social Sciences (SPSS) version 25. Categorical variables were summarized using frequencies and percentages. Dental-caries prevalence was determined as the proportion of participants with a DMFT score greater than zero. Mean DMFT and standard deviation were calculated to describe the overall caries experience of the participants. Findings were presented using tables and a selected figure.

Results

A total of 384 students participated in the study. All questionnaires were complete for the principal analyzed variables.

Table 1. Data Completeness

Variable	N
Valid participants	384
Missing	0
Total	384

Table 1 demonstrates that data from all 384 study participants were available for analysis, with no reported missing observations for the principal study variables. Complete data

improve the reliability of descriptive estimates because the percentages presented throughout the results are based on the full study sample.

Table 2. Distribution of Participants by Gender

Gender	Frequency	Percent
Male	209	54.4
Female	175	45.6
Total	384	100.0

Table 2 shows that males constituted a slightly greater proportion of the participants than females. Of the total sample, 209 participants (54.4%) were male and 175 (45.6%) were

female. The relatively balanced gender distribution indicates that both male and female students were substantially represented in the study population.

Table 3. Distribution of Participants by Age

Age (years)	Frequency	Percent
16	108	28.1
17	115	29.9
18	76	19.8
19	41	10.7
20	44	11.5
Total	384	100.0

Table 3 presents the age distribution of participants. Students aged 17 years formed the largest group, representing 29.9% of the sample, followed by 16-year-old students at 28.1%.

Participants aged 18 years represented 19.8%, while the proportions aged 19 and 20 years were comparatively smaller at 10.7% and 11.5%, respectively.

Table 4. Frequency of Tooth Brushing

Brushing frequency	Frequency	Percent
Never	14	3.6
Occasionally	63	16.4
Once daily	239	62.2
Twice daily	68	17.7
Total	384	100.0

Table 4 indicates that once-daily brushing was the most commonly reported oral-hygiene practice, accounting for 62.2% of participants. Only 17.7% reported brushing twice daily, while

16.4% brushed occasionally and 3.6% reported never brushing. These findings demonstrate that regular twice-daily brushing was relatively uncommon in the study population.

Table 5. Type of Toothpaste Used

Toothpaste type	Frequency	Percent
Fluoride-containing	127	33.1
Non-fluoride	257	66.9
Total	384	100.0

Table 5 demonstrates that approximately two-thirds of participants reported using non-fluoride toothpaste. Only 127 students (33.1%) reported using fluoride-containing toothpaste,

whereas 257 (66.9%) used non-fluoride toothpaste. This finding is important because fluoride toothpaste is an established preventive measure against dental caries.

Table 6. Use of Mouthwash

Mouthwash use	Frequency	Percent
No	297	77.3
Yes	86	22.4
Unspecified/source code	1	0.3
Total	384	100.0

Table 6 shows that mouthwash use was uncommon among the study participants. More than three-quarters of the students (77.3%) reported not using mouthwash, whereas only

22.4% reported its use. One observation represented an unexplained code in the original dataset and has therefore been retained separately without reclassification.

Table 7. Use of Dental Floss

Dental floss use	Frequency	Percent
No	279	72.7
Yes	105	27.3
Total	384	100.0

Table 7 illustrates relatively low utilization of dental floss. A total of 279 participants (72.7%) did not use dental floss, while only 105 (27.3%) reported its use. This finding suggests that

interdental cleaning was not a routine component of oral hygiene for the majority of participants.

Table 8. Use of Miswak

Miswak use	Frequency	Percent
No	298	77.6
Yes	86	22.4
Total	384	100.0

Table 8 demonstrates that the majority of participants did not use miswak. Only 86 students (22.4%) reported using miswak, whereas 298 (77.6%) did not. Thus, despite its

traditional use in some communities, miswak was not commonly reported as an oral-hygiene aid within this study sample.

Table 9. Frequency of Sugary Food or Drink Consumption

Frequency	n	Percent
Unspecified/code "0"	1	0.3
Never	26	6.8
Occasionally	130	33.9
Once daily	162	42.2
More than once daily	65	16.9
Total	384	100.0

Table 9 shows frequent consumption of sugary foods and beverages among participants. The largest group, 42.2%, consumed sugary items once daily, while 16.9% consumed them more than once daily. Only 6.8% reported never

consuming sugary foods or drinks. The findings therefore indicate regular exposure to dietary sugars among a substantial proportion of students.

Table 10. Dental Visit During the Previous 12 Months

Response	Frequency	Percent
No	297	77.3
Yes	87	22.7
Total	384	100.0

Table 10 demonstrates low utilization of dental services during the previous year. Only 87 participants (22.7%) reported visiting a dentist within the preceding 12 months, while 297

students (77.3%) had not. This pattern indicates that routine or recent professional dental attendance was uncommon among the study population.

Table 11. Main Reason for Dental Visit

Reason	Frequency	Percent
Pain	52	13.5
Treatment	29	7.6
Routine check-up	10	2.6
Never visited	293	76.3
Total	384	100.0

Table 11 further demonstrates the limited preventive use of dental services. Most participants (76.3%) reported that they had never visited a dentist. Among those who had attended, pain was a more common reason than

routine examination. Only 2.6% of participants reported visiting for a routine check-up, suggesting that dental attendance was predominantly symptom- or treatment-driven rather than preventive.

Table 12. Awareness of Dental Caries

Response	Frequency	Percent
No	237	61.7
Yes	147	38.3
Total	384	100.0

Table 12 shows that general awareness of dental caries was relatively low. A majority of participants, 61.7%, reported that they were not aware of dental caries, while only 38.3%

indicated awareness. This finding suggests an important gap in overall oral-health literacy among students.

Table 13. Belief That Brushing Prevents Dental Caries

Response	Frequency	Percent
No	52	13.5
Yes	332	86.5

Response	Frequency	Percent
Total	384	100.0

Table 13 indicates that most participants recognized the preventive importance of tooth brushing. A total of 332 students (86.5%) believed that tooth brushing could help prevent

dental caries, while 13.5% did not. This high level of specific preventive awareness contrasts with the lower overall awareness of dental caries reported in Table 12.

Table 14. Belief That Sugary Foods Increase Caries Risk

Response	Frequency	Percent
No	13	3.4
Yes	371	96.6
Total	384	100.0

Table 14 demonstrates a very high level of awareness regarding the relationship between sugary foods and dental caries. Almost all participants (96.6%) believed that sugary foods increase caries risk. However, the high frequency

of sugar consumption shown in Table 9 indicates that knowledge of the risk did not necessarily translate into healthier dietary behavior.

Table 15. Prevalence of Dental Caries

Dental-caries status	Frequency	Percent
Caries-free	68	17.7
Caries present	316	82.3
Total	384	100.0

Table 15 presents the principal outcome of the study. Dental caries was present in 316 of the 384 participants, producing an overall prevalence of 82.3%. Only 68 students (17.7%)

were free of caries. These findings demonstrate a substantial burden of dental disease among adolescents and young adults in Parachinar.

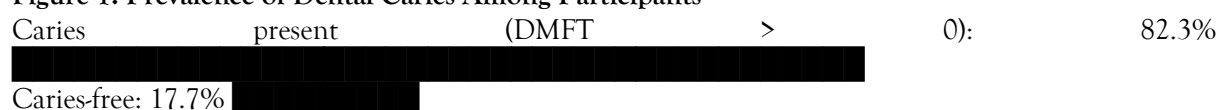
Table 16. Descriptive Statistics for DMFT Score

Variable	N	Minimum	Maximum	Mean	SD
Total DMFT score	384	0	8	2.42	1.834

Table 16 summarizes the overall dental-caries experience using the DMFT index. The mean DMFT score was 2.42 with a standard deviation of 1.834, and scores ranged from 0 to 8. These results indicate considerable variation in caries

experience among participants, while demonstrating that the average student had more than two teeth affected by decay, loss due to caries, or restoration.

Figure 1. Prevalence of Dental Caries Among Participants



The figure highlights the main finding of the investigation: more than four out of every five students examined demonstrated dental-caries experience. Among 384 participants, 316 (82.3%) had a DMFT score greater than zero and only 68 (17.7%) were caries-free. Together with the mean DMFT score of 2.42 ± 1.83 , the figure demonstrates that dental caries represents a considerable oral-health burden in the study population.

Discussion

The present study identified a high prevalence of dental caries among students aged 16–20 years in Parachinar, District Kurram. Overall, 82.3% of participants had dental-caries experience, while only 17.7% were caries-free. The mean DMFT score was 2.42 ± 1.83 . These findings indicate that dental caries constitutes a significant oral-health problem among adolescents and young adults in this population. The observed prevalence lies within the broad range reported for school-age populations in developing settings, where untreated dental disease remains widespread because of inadequate preventive infrastructure and limited access to routine dental services [66].

The high prevalence is broadly consistent with findings from South Asian populations. Studies from India and Bangladesh have demonstrated substantial caries experience among adolescents [67,68]. Although direct comparison should be undertaken cautiously because of differences in participant age, sampling methods, diagnostic thresholds, and geographical settings, these studies support the broader observation that adolescents in many South Asian communities remain at considerable risk of dental caries. Global reviews have similarly emphasized the increasing concentration of dental disease among socioeconomically disadvantaged populations despite improvements in national averages in some countries [42–44].

The caries burden recorded in the current investigation also corresponds generally with previous studies conducted in Pakistan. Research among Pakistani school-age and adolescent populations has reported high prevalence of dental decay and substantial unmet treatment need [51,53,69,72]. Differences in prevalence and DMFT between studies may arise from variations in age

distribution, urban or rural residence, socioeconomic characteristics, fluoride exposure, dietary practices, access to dental services, and diagnostic procedures. These differences reinforce the importance of obtaining local epidemiological information rather than applying estimates from large urban centers to geographically isolated districts such as Kurram.

Oral-hygiene behavior provides important context for the observed disease burden. In the present study, 62.2% of participants brushed only once daily, while just 17.7% reported brushing twice per day. An additional 16.4% brushed only occasionally, and 3.6% never brushed. Regular tooth brushing is important for plaque control, particularly when fluoride toothpaste is used [57,73]. The relatively low proportion practicing twice-daily brushing may therefore represent an important modifiable behavioral factor.

A particularly notable finding was the low reported use of fluoride toothpaste. Only 33.1% of participants reported using fluoride-containing toothpaste, whereas 66.9% reported non-fluoride toothpaste. Fluoride is well established as an effective measure for reducing enamel demineralization and enhancing remineralization of early carious lesions [13,74]. Consequently, increasing the availability and correct use of fluoride-containing toothpaste could be an important preventive strategy for this population.

Use of supplementary oral-hygiene practices was also limited. Dental floss was used by only 27.3% of participants, mouthwash by 22.4%, and miswak by 22.4%. While these measures should not replace effective tooth brushing with fluoride toothpaste, the low utilization of additional oral-hygiene practices further suggests that preventive oral self-care was relatively limited among the participating students.

Dietary habits may have contributed to the high burden of dental caries. A total of 42.2% of participants consumed sugary foods or beverages once daily, while another 16.9% reported consuming them more than once per day. Repeated exposure to fermentable carbohydrates increases the frequency of acid production by cariogenic microorganisms and can consequently promote repeated episodes of enamel demineralization. Previous systematic

evidence has established a strong relationship between sugar consumption and dental-caries development [56,75].

An important feature of the present findings is that knowledge of sugar-related caries risk appeared substantially higher than the adoption of appropriate dietary behavior. Although 96.6% of participants recognized that sugary foods increase the risk of caries, a considerable proportion still reported daily or more frequent sugar consumption. This knowledge-behavior gap suggests that awareness alone may be insufficient to achieve behavioral change. Oral-health programs may therefore need to incorporate practical dietary counseling and strategies for reducing the frequency of sugar exposure.

Professional dental-service utilization was also low. Only 22.7% of participants had visited a dentist during the previous 12 months, whereas 77.3% had not. Furthermore, only 2.6% reported routine examination as their principal reason for dental attendance. Pain was a more common reason for dental visits, indicating that professional care was primarily sought after symptoms developed rather than for preventive purposes. Similar patterns have been described in populations where financial barriers, lack of dental professionals, limited accessibility, and poor oral-health literacy influence health-seeking behavior [61].

The awareness results demonstrate an important discrepancy. Although 61.7% of students reported that they were not aware of dental caries as a condition, 86.5% understood that brushing could prevent caries and 96.6% recognized sugary foods as a risk factor. Students may therefore possess isolated pieces of preventive knowledge without understanding dental caries more comprehensively as a chronic disease process. Educational interventions should consequently emphasize not only individual preventive messages but also the biological process of caries development and the importance of early diagnosis, fluoride use, regular brushing, dietary control, and preventive dental visits.

The findings have important public-health implications for District Kurram. A caries prevalence exceeding 80%, together with inadequate oral-hygiene behaviors and low preventive dental attendance, indicates the need

for organized intervention. School- and college-based programs may provide practical platforms for oral-health education, screening, fluoride promotion, dietary counseling, and referral of affected students for professional treatment. Community-based programs could complement these activities by increasing awareness among parents and families.

This study has several strengths. A sample of 384 participants provided a substantial dataset for describing oral-health conditions in the study population. Furthermore, use of the standardized DMFT approach allowed the burden of dental caries to be quantified in a manner broadly comparable with other epidemiological investigations. The study also assessed multiple behavioral factors, including oral-hygiene habits, dietary practices, dental attendance, and awareness.

Nevertheless, several limitations should be acknowledged. Because this was a cross-sectional investigation, it was not possible to determine causal relationships between behavioral factors and dental-caries occurrence. The non-probability sampling technique may also limit generalizability to all adolescents and young adults in District Kurram. In addition, dietary, brushing, and dental-attendance variables were based on self-reported responses and may therefore have been influenced by recall or social-desirability bias. Finally, the source dataset contained an unexplained response code for mouthwash use and a numerical "0" category for sugary-food consumption. These observations should be reviewed in the original SPSS dataset or source questionnaires before final journal submission.

Despite these limitations, the present investigation provides useful baseline information on adolescent oral health in Parachinar. The combination of an 82.3% prevalence of dental caries, low twice-daily brushing, limited fluoride-toothpaste use, frequent intake of sugary foods and beverages, and low utilization of professional dental services indicates multiple areas in which preventive interventions may be beneficial.

Conclusion

The present study demonstrates that dental caries is highly prevalent among students aged 16–20 years in Parachinar, District Kurram.

Among the 384 participants examined, 82.3% had dental caries and only 17.7% were caries-free. The mean DMFT score was 2.42 ± 1.83 , with scores ranging from 0 to 8, indicating a substantial level of caries experience in the study population.

Oral-hygiene practices were generally inadequate. Most participants brushed their teeth only once daily, while fewer than one-fifth reported brushing twice daily. The use of fluoride-containing toothpaste was also limited, with approximately two-thirds reporting non-fluoride toothpaste. Supplementary oral-hygiene practices such as dental floss, mouthwash, and miswak were used by relatively small proportions of students.

Dietary habits demonstrated frequent exposure to sugary foods and beverages, with a considerable proportion consuming sugary products daily or more than once daily. Although the majority of students understood that sugar increases the risk of dental caries and that tooth brushing contributes to prevention, general awareness of dental caries remained low. This finding demonstrates a gap between specific health knowledge and broader understanding of oral disease.

Dental-service utilization was also poor. Most participants had not visited a dentist during the previous 12 months, and routine preventive dental attendance was uncommon. Dental visits were more frequently associated with pain or treatment needs, suggesting a predominantly problem-oriented pattern of dental care.

Overall, the findings indicate that dental caries represents a significant public-health concern among adolescents and young adults in Parachinar. Improved oral-health education, greater use of fluoride toothpaste, reduced dietary sugar exposure, routine dental screening, and improved accessibility of preventive dental services are required to reduce the future burden of disease in this population.

Recommendations

Based on the findings of the present study, the following recommendations are proposed:

1. School- and College-Based Oral-Health Education

Structured oral-health education programs should be introduced in schools and colleges throughout Parachinar and District Kurram.

These programs should provide students with information regarding the causes of dental caries, appropriate tooth-brushing techniques, fluoride use, dietary sugar control, and the importance of early prevention.

2. Promotion of Twice-Daily Tooth Brushing

Students should be encouraged to brush their teeth at least twice daily. Practical demonstrations of correct brushing techniques may help students translate oral-health knowledge into routine preventive behavior.

3. Promotion of Fluoride Toothpaste

The use of fluoride-containing toothpaste should be actively promoted because a large proportion of participants reported using non-fluoride toothpaste. Oral-health campaigns should explain the protective role of fluoride in preventing enamel demineralization and promoting remineralization.

4. Reduction of Sugary Food and Beverage Consumption

Students should receive dietary education concerning the relationship between frequent sugar intake and dental-caries development. Particular emphasis should be placed on reducing the frequency of sugary snacks, sweetened beverages, carbonated drinks, and other fermentable carbohydrate exposures between meals.

5. Regular Preventive Dental Check-Ups

Students should be encouraged to visit dental professionals regularly for preventive examination rather than waiting until pain or advanced disease develops. Routine dental visits may facilitate earlier detection and management of carious lesions.

6. School-Based Dental Screening

Periodic dental-screening programs should be established in schools and colleges. Students found to have untreated caries should be referred to appropriate dental facilities for further evaluation and treatment.

7. Community Oral-Health Awareness Programs

Community-based awareness campaigns should target not only adolescents but also parents and

families. Increasing household-level understanding of fluoride, oral hygiene, dietary risk factors, and preventive dental attendance may contribute to long-term improvement in oral-health behaviors.

8. Improved Dental Services in Rural and Underserved Areas

Public-health authorities should strengthen access to preventive and restorative dental services in rural and geographically isolated communities such as District Kurram. Improved availability of trained dental personnel and affordable treatment may help reduce unmet dental-treatment needs.

9. Integration of Oral Health Into Primary Healthcare

Oral-health promotion should be incorporated into existing primary-health and adolescent-health programs. General healthcare workers may also be trained to provide basic oral-health advice and appropriate referral.

10. Future Research

Further epidemiological studies should be conducted across different communities of District Kurram and other regions of Khyber Pakhtunkhwa. Future studies should consider probability-based sampling and analytical methods to investigate associations between dental caries and factors such as brushing frequency, fluoride use, sugar consumption, socioeconomic status, and dental-service utilization.

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