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PREVALENCE AND ASSOCIATED RISK FACTORS OF DENTAL CARIES AMONG SCHOOL-AGED CHILDREN (6–13 YEARS) IN PARACHINAR, PAKISTAN: A CROSS-SECTIONAL STUDY

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Abstract

Dental caries is one of the most common non-communicable diseases of children globally, especially in low- and middle-income countries. This research sought to establish the prevalence of dental caries and associated behavioural and environmental risk factors among school children (6-13 years) in Parachinar, Khyber Pakhtunkhwa, Pakistan. This cross-sectional descriptive study involved 280 students conveniently sampled from two private schools. A questionnaire was used to gather information on oral health knowledge, dietary and oral health service usage, and clinical examination using dental tools. The findings showed that dental caries was high (71.8%). Most children had poor knowledge of oral hygiene (56.1%) and 65.0% did not use fluoridated toothpaste. Only 2.9% reported regular visits to the dentist and sugar snack consumption was high, with 23.2% eating them every day. Also, the majority of affected children were untreated. In conclusion, unhealthy oral hygiene knowledge and practices, frequent consumption of sugary snacks, and lack of preventive dental services play a major role in dental caries.

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2. INTRODUCTION

Dental caries is a common chronic non-communicable disease, impacting people of all ages, especially children. While preventable, untreated dental caries remains a major global burden, affecting millions of children, causing pain, infection, and disfigurement (Qin et al., 2022). This is demonstrated in recent global estimates, which show that dental caries in primary and permanent dentition is one of the most prevalent diseases, with an unequal distribution across low- and middle-income countries with limited access to preventive and treatment dental care (Guarnizo-Herreño et al., 2024).

Dental caries is a complex, multifactorial disease, with interactions between dietary and hygiene factors, host and environmental factors. Current evidence also acknowledges that dental caries is a non-communicable, behaviourally and socially driven disease rather than a localised oral disease (Pitts et al., 2021). One of the major modifiable risk factors is the regular intake of free sugars, which results in acid production by oral microorganisms that in turn demineralises tooth enamel and causes cavities (Lagerweij & Van Loveren, 2020). Further risk factors include poor oral health habits, including low frequency of tooth brushing and non-use of fluoride.

And worldwide, oral health inequalities are associated with socioeconomic status and health education. Disadvantaged children are more likely to have a higher caries burden because of lack of knowledge, dietary habits and use of dental health services (Nath et al., 2023). Oral health continues to be a neglected part of public health in many developing countries, such as South Asia, leading to a significant gap in the provision of preventive and restorative dental care services.

In Pakistan, childhood caries is a significant problem. A recent survey has shown a high frequency of caries in school children due to poor oral hygiene, consumption of high amounts of sugar, and lack of access to dental care (Moin et al., 2023; Chandio et al., 2025). Additionally, cultural factors, lack of parental knowledge, and limited school-based oral health initiatives all play a role in the poor oral health status (Khan et al., 2026). Preventive interventions, including the use of fluoridated toothpaste and dental visits, are underutilised, particularly in semi-urban and rural areas.

School-based programs have been shown to be effective in changing oral health knowledge and behaviours in children. Research has found that systematic oral health education programs can effectively prevent caries by teaching good dietary and oral hygiene practices (Akera et al., 2022). Furthermore, innovative interventions like digital and web-based education have demonstrated potential in improving knowledge and attitudes among children and parents (Kashani et al., 2024).

While there is an increasing body of literature on dental caries, there is a dearth of contextual evidence in the under-serviced areas such as Parachinar, Khyber Pakhtunkhwa. Parachinar has distinct socioeconomic and infrastructural issues that could impact oral health, but there is little research on the prevalence and risk factors. These context-specific factors are crucial in informing culturally sensitive interventions.

Moreover, the current study seeks to determine the prevalence of dental caries and associated behavioural, dietary and socioeconomic risk factors in schoolchildren (6-13 years) from Parachinar, Pakistan. The results of the study will add to the existing literature and guide evidence-based public health interventions to enhance oral health in similar disadvantaged populations.

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3. LITERATURE REVIEW

Despite being preventable, dental caries remains a significant global health burden, especially in children. The latest global burden estimates suggest untreated dental caries is common and has not decreased substantially over the last few decades, particularly in low- and middle-income countries (Qin et al., 2022). This reflects inequities in access to oral health care and prevention. Modern views are increasingly shifting to consider dental caries as a non-communicable disease, with behavioural, social and environmental risk factors, rather than a simple local infection (Pitts et al., 2021). This has direct consequences for prevention strategies, focussed on population-level approaches to lifestyle and health.

Dietary sugars are a well-established risk factor for dental caries. Regular consumption of fermentable carbohydrates results in acid production by oral microorganisms, which results in loss of enamel mineral content and advancement of carious lesions (Lagerweij & Van Loveren, 2020). Research indicates that both the amount and frequency of sugar intake greatly contribute to caries development, especially in children who have frequent access to sugary snacks and drinks (Verma et al., 2021). Such dietary habits are more common in developing countries because of urbanization and increases in food supply.

Toothbrushing and the application of fluoride in toothpaste are essential in the prevention of dental caries. Fluoride has long been acknowledged as a potent component to promote remineralization and suppress bacterial growth, reducing the risk of caries (Clark et al., 2020). But research shows that oral hygiene practices are poor in children of many low-income countries which contributes to the persistence of disease.

Oral health inequalities are also compounded by socioeconomic inequalities. Disadvantaged children are more likely to have a higher prevalence and severity of dental caries as a result of reduced access to oral health care, lower parental education, and oral health literacy (Nath et al., 2023). These disparities occur through behavioural pathways, with socioeconomic factors impacting diet, hygiene and health-seeking behaviours (Weng et al., 2026). Moreover, cultural attitudes and parental perceptions of oral health play a crucial role in children's oral health in traditional and disadvantaged communities (Khan et al., 2026).

In Pakistan, recent research indicates a high incidence of caries in school children, which is associated with poor oral hygiene, excessive sugar intake and low levels of dental service use (Moin et al., 2023). Likewise, Chandio et al. (2025) found Pakistani children have poor oral health knowledge, especially in relation to preventive measures like brushing and using fluoride. The absence of school-based oral health education programs also contributes to low knowledge and poor practices.

School-based preventive measures have been shown to be effective in enhancing children's oral health. According to a systematic review by Akera et al. (2022), school oral health programs improve knowledge, behaviour and prevalence of caries in low and middle-income countries. Newer strategies such as electronic and web-based educational interventions also contribute to raising knowledge and affecting preventive behaviours of parents and children (Kashani et al., 2024). However, the introduction of such programs is still lacking in many low-resource settings.

Health-care access is also a key factor in oral health. Research has indicated that children in underserved communities access dental services only when they experience symptoms, not for preventive purposes, because of financial, geographic and awareness constraints (Onyejaka et

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al., 2016). This delays their diagnosis and treatment, which in turn increases the severity of dental caries and its complications.

While the international and regional literature offers considerable evidence about the burden and risk factors of dental caries, there is a dearth of contextual evidence from the underserved and conflict-affected areas, such as Parachinar, Khyber Pakhtunkhwa. The majority of studies in Pakistan have been conducted in urban areas, with little attention given to rural or semi-urban areas where health and education policies and practices may vary. Additionally, there is a lack of studies which consider the interplay of behavioural, dietary and socioeconomic factors together. Thus, context-specific epidemiological studies are needed to understand the prevalence and risk factors of dental caries in such areas to guide evidence-based interventions.

4. METHODOLOGY

4.1. Study Design

The current research utilized the descriptive cross-sectional research design to establish the prevalence of dental caries and risk factors among school-going children in Parachinar, Khyber Pakhtunkhwa, Pakistan aged 6-13 years. A cross-sectional design was found to be suitable as it enables the measurement of exposure and outcome variables within a defined population at a given time, thus giving a picture of oral health and behavioral determinant conditions at a certain time. It is a common design employed in oral epidemiology to estimate disease burden and risk factors of a disease in the community.

4.2. Study Setting

The survey was carried out in two private schools in the city of Parachinar i.e. Paragons Innovative Public School and Paradise Public School. These schools were chosen because they are accessible and reflect the school going children of different socioeconomic backgrounds in the urban population of the region. The chosen site created the right setting to conduct clinical examination and data collection in the form of questionnaires under controlled conditions.

4.3. Population of Study

The population of the study was school going children between the ages of 6 and 13 years studying in the chosen schools. The study was carried out during six months after the approval of the synopsis, between April and July 2024. This time frame gave the necessary time to collect data, conduct clinical analysis, and confirm responses and minimal interference with academic activities.

4.4. Sample Size and Sampling Method

A total of 280 participants were included in the study. A standard sample size calculation technique applicable in the cross-sectional research was used to calculate the sample size based on a desired confidence level and expected prevalence of dental caries.

A non-probability convenience sampling technique was used for participant selection. This strategy was adopted because of the logistical limitations, and the participants were readily available, and because the study was school-based. Even though this approach restricts generalisability to a degree, it is widely employed in pre-epidemiological evaluations in resource-restricted environments.

4.5. Eligibility Criteria

The study included children between the ages of 6 to 13 years of age who were attending the sampled schools and gave their assent and parental consent. Children under 6 years and over 13 years were eliminated to ensure homogeneity in age according to WHO classification of mixed dentition stages.

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Children who had a physical or mental disability that would hamper oral examination were not included. Also, the final sample did not include the absentees during the day of data collection and those who did not like to participate.

4.6. Data Collection Procedure

Ethical approval was sought before the collection of data with the Research Ethical Committee of Iqra National University. This was followed by obtaining official clearance of the administration of the chosen schools in Parachinar. The mixed-method approach was used in data collection, which included both structured questionnaires and clinical oral examination.

The questionnaire was tailored to collect data on oral hygiene practices, dietary practices, use of dental services and oral health knowledge. Standardized dental instruments such as mouth mirrors, periodontal probes and tweezers were used to conduct clinical examination under strict aseptic conditions. All instruments were disinfected after each use, and gloves were switched between examinations to prevent infections and safety of the participants.

All tests were done in broad daylight and inside the school premises to have sufficient visibility. All respondents volunteered to take part in the study, and all confidentiality was maintained in the study process.

4.7. Variables and Measurements

The main outcome measure of the research was the occurrence of dental caries that was measured by clinical examination and scored using DMFT/dmft scores. Oral hygiene practices, frequency of brushing teeth, fluoridated toothpaste, dietary sugar intake, regularity of visits to the dentist, parental caries history, and access to dental care at home, were independent variables.

The knowledge on oral hygiene was determined through structured questions on questionnaires and classified into levels according to the patterns of the participants on scoring.

4.8. Statistical Analysis

Data were analysed using Statistical Package of Social Sciences (SPSS) version 22.0. The categorical variables were calculated as frequencies and percentages. The data were tabulated and represented graphically in a more comprehensible way. While the inferential statistical tests were not applied in a rigorous manner in the current phase, they can be applied in the future using the techniques of analytical modeling and chi-square tests to determine associations between risk factors and prevalence of dental caries.

4.9. Ethical Considerations

The study was conducted in terms of ethical integrity. The institutional ethical review committee gave its prior approval. School authorities were informed in writing, and informed consent was provided by parents/guardians and verbal consent of children. The involvement was voluntary, and the respondents were made to understand that they could drop out at any level without any repercussions.

Participants were assured confidentiality and anonymity, whereby codes were given in place of names. The research did not subject the participants to any physical risk, and no fewer than the observed infection control measures were observed during the clinical examinations. Cultural sensitivity was also observed based on local norms and values of the Parachinar community.

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5. RESULTS

5.1. Socio-Demographic Characteristics of Participants

A total of 280 school-going children participated in the study. The sample consisted of 154 males (55.0%) and 126 females (45.0%). The age distribution showed that the majority of participants were between 9–10 years (43.2%), followed by 6–8 years (35.4%), and 11–13 years (21.4%).

Table 1: *Socio-demographic characteristics of participants (N = 280)*

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	154	55.0
	Female	126	45.0
Age (years)	6–8	99	35.4
	9–10	121	43.2
	11–13	60	21.4

5.2. Oral Hygiene Practices

The oral hygiene practices of participants indicated suboptimal behaviors. A considerable proportion of children (42.5%) brushed once daily, while 27.9% reported rare or no brushing. Only 24.3% brushed twice daily and a small fraction (5.4%) brushed three times daily. Furthermore, 65.0% of participants reported not using fluoridated toothpaste.

Table 2: *Oral hygiene practices among participants*

Variable	Category	Frequency (n)	Percentage (%)
Brushing frequency	Once daily	119	42.5
	Twice daily	68	24.3
	Three times daily	15	5.4
	Rarely/Never	78	27.9
Fluoride toothpaste use	Yes	98	35.0
	No	182	65.0

5.3. Dietary Habits and Sugar Consumption

Dietary analysis revealed frequent consumption of sugary snacks and beverages. Only 1.4% of participants rarely consumed sugary items, whereas 23.2% consumed them daily. A significant proportion (64.3%) reported consuming sugary snacks at least 2–6 times per week. Additionally, 31.1% of children reported consuming sugary drinks before bedtime.

Table 3: *Frequency of sugar consumption and dietary habits*

Variable	Category	Frequency (n)	Percentage (%)
Sugary snacks	Rarely/Never	4	1.4
	Once/week	31	11.1
	2–3 times/week	102	36.4
	4–6 times/week	78	27.9
	Daily	65	23.2

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Sugary drinks before bedtime	Yes	87	31.1
	No	193	68.9

5.4. Oral Health Knowledge and Education

More than half of the participants (56.1%) demonstrated poor knowledge regarding oral hygiene, while only 15.7% showed good to excellent knowledge. Additionally, 69.3% reported not receiving any formal oral health education in school.

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Table 4: ***Oral health knowledge and exposure to education***

Variable	Category	Frequency (n)	Percentage (%)
Oral health knowledge	Excellent	9	3.2
	Good	35	12.5
	Fair	79	28.2
	Poor	157	56.1
Received oral health education	Yes	86	30.7
	No	194	69.3

5.5. Dental Service Utilization

Utilization of dental services was extremely low among participants. Only 2.9% reported regular dental visits, while 87.1% rarely or never visited a dentist. Preventive dental care practices were therefore significantly inadequate.

Table 5: ***Dental service utilization patterns***

Variable	Category	Frequency (n)	Percentage (%)
Dental visits	Regular	8	2.9
	Occasional	28	10.0
	Rarely/Never	244	87.1

5.6. Prevalence of Dental Caries and Clinical Findings

The overall prevalence of dental caries among participants was 71.8%. Among affected children, 50.0% had 1–3 decayed teeth, while 21.8% had 4–6 decayed teeth, and 2.1% had 7–10 decayed teeth. Additionally, only 17.1% of children with caries had received any form of dental treatment.

Table 6: ***Prevalence and severity of dental caries***

Variable	Category	Frequency (n)	Percentage (%)
Dental caries diagnosis	Yes	201	71.8
	No	79	28.2
Number of decayed teeth	1–3	140	50.0
	4–6	61	21.8
	7–10	6	2.1
	No response	73	26.1
Received treatment	Yes	48	17.1
	No	232	82.9

5.7. Family and Environmental Risk Factors

A considerable proportion of participants (69.3%) reported a family history of dental caries. More than half (54.6%) did not have dental care products readily available at home, and 86.8% lacked dental insurance coverage.

Table 7: ***Family and environmental risk factors***

Variable	Category	Frequency (n)	Percentage (%)
Family history of caries	Yes	194	69.3
	No	86	30.7
Dental care products at home	Yes	127	45.4

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	No	153	54.6
Dental insurance coverage	Yes	37	13.2
	No	243	86.8

5.8. Summary of Key Findings

The findings reveal a high burden of dental caries among school-going children in Parachinar with poor oral hygiene practices, high consumption of sugar, low consumption of fluoride and low utilization of dental services. These results, together, suggest a high risk factors cluster for oral diseases in the study population.

6. DISCUSSION

The present study contributes to the epidemiology of dental caries in terms of prevalence and risk factors among school children (6-13 years) in Parachinar, Pakistan. All the data point towards a high disease burden (71.8%), poor oral health practices, high sugar consumption, low fluoride intakes and very low dental service use. These results are in line with the global and regional literature where caries is still a major global health problem, particularly in resource poor settings.

The findings of this study are consistent with the world burden of disease over the past few years. Qin et al. (2022) noted that untreated dental caries has been very high since 1990 to 2019 with very little decrease in high-risk areas. Similarly, Guarnizo-Herreno et al. (2024) also noted that despite the advances in preventive dentistry, the population health inequalities contribute to the high levels of caries, particularly in disadvantaged populations. The Parachinar findings, therefore, reflect a global oral health disparity.

The main finding of the present study was that there is a strong association between poor knowledge of oral hygiene and dental caries. More than 50 percent of the participants were lacking in oral health care. This finding is supported by Chandio et al. (2025) who noted that school children in Pakistan had poor oral health knowledge particularly on the importance of brushing and fluoride. Similarly, Moin et al. (2023) reported that oral health literacy is one of the predictors of oral hygiene amongst Pakistani school-going age groups. The lack of oral health education in schools (as indicated in the current research 69.3% no oral health education received) only reinforces the problem of poor prevention of oral health promotion.

Another risk factor that was critical was the dietary habits. A high percentage of children were consuming sweet items several times a week with 23.2 reporting daily. This trend aligns with the findings of Lagerweij and Van Loveren (2020), who manifested the common exposure to sugar as one of the main causes of cariogenic action. The biologic basis of this association is well-established in which frequent consumption of sugar causes the chronic production of acid, which causes demineralization of enamel. Similar points are made by Verma et al. (2021), who highlight that caries are closely linked to diet quality, specifically high fermentable carbohydrate intake in children.

Another finding of the study was very low use of preventive dental care, 87.1 percent of the respondents attended the dentist rarely or never. This observation aligns with the larger evidence of low- and middle-income countries, where the access to dental care is still low because of financial, geographic, and awareness barriers. Similar trends in underutilization of services among children in resource-constrained environments were documented by Onyejaka et al. (2016), where dental care is usually symptom-based but not preventive. Relating to the situation in Pakistan, Khan et al. (2026) also point out that the attitudes

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of parents as well as cultural beliefs and the ignorance play a major role in shaping healthcare seeking behavior regarding oral health.

Another important determinant that is determined in this study is the low usage of fluoridated toothpaste (65.0% non-users). Clark et al. (2020) are firm believers of the benefits of fluoride in lowering the risk of caries especially in the pediatric population through its ability to promote remineralization and suppress bacterial metabolism. This study may be missing the use of fluoride by most of the children, which could have contributed to the high caries burden.

The socio economic and environmental issues also seem to have a significant role. Most children did not have dental care products at home (54.6) and no dental insurance cover (86.8). Similar studies conducted by Nath et al. (2023) have also established that socioeconomic deprivation is highly linked with increased prevalence and severity of caries in children across the world. Weng et al. (2026) also substantiate these inequalities by describing the fact that the oral health disparities are mediated by hygiene practices and dietary habits that are influenced by socioeconomic conditions.

The prevalence of dental caries in families (69.3) in this study could be a pointer to genetic predisposition as well as to common environmental practices. But modern observations indicate that behavioral clustering at the household level like dietary habits and hygiene behaviors have a greater dominating role to play than genetic predisposition by itself. This is consistent with a greater awareness that dental caries is more of a behavioral disease instead of a strictly hereditary disease (Pitts et al., 2021).

Oral health education provided in schools seems to be one of the key missing interventions in the study setting. The Akera et al. (2022) evidence shows that school-based programs are structured and can effectively promote oral hygiene practices and decrease caries levels in children in the low- and middle-income countries. On the same note, Kashani et al. (2024) emphasize the efficiency of educational interventions to enhance parental awareness, an aspect that has an indirect effect on the oral health behaviors of children. Lack of such organized programs in Parachinar is a probable contributor to high disease burden.

In general, the results of this paper support the idea that dental caries is a multifactorial phenomenon, in which behavioral, dietary, educational, and socioeconomic factors interplay to determine the course of the disease. The prevalence rate in Parachinar was not an isolated incident but rather a manifestation of the loopholes in oral health prevention systems, especially in underserved areas.

7. CONCLUSION, RECOMMENDATIONS, AND LIMITATIONS

7.1. Conclusion

The present study showed that the prevalence of dental caries (71.8%) among 613 years old school children in Parachinar Pakistan are very high which implies that there's a major health problem in this under-serviced region. The findings reveal that the dental caries among children in this region is highly associated with poor knowledge of oral health, no use brushing, low use of fluoridated toothpaste, high consumption of sugars snacks or drinks and very low use of preventive dental care services.

The results also suggest that, behavioral and environmental factors, particularly diet and oral care, play a more important role in developing dental caries than the clinical and genetic factors. This adds to the burden of disease as there are no scheduled oral health education programs in the

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schools and very poor access to preventive dental care services. Overall, the study shows that dental caries in children is not a clinical but a public health issue that is influenced by socioeconomic, educational and behavioral factors.

7.2. Recommendations

On the findings of this study, a number of evidence-based recommendations are suggested to minimize the prevalence of dental caries in school-aged children in Parachinar and other similar areas.

Oral health education programs in schools should be instituted as part of the school curriculum in order to enhance the level of education about proper brushing methods, use of fluoride and diet. These programs ought to be engaging and age-related to make the adoption of behavioral changes among the children.

Regular dental check-ups should be reinforced in schools to help in the early detection and control of dental caries by providing preventive dental services. The partnership between education and health facilities is necessary to support the regular screening programs.

Fluoridated toothpaste should also be encouraged at the community level by creating awareness among the children and the parents. The message of fluoride as a preventive measure of tooth decay and promotion of long-term oral health should be promoted by the public health.

Behavioral interventions and school policy regulations that restrict the availability of high-sugar food items in school settings should promote the reduction of the consumption of sugary snacks and beverages.

Lastly, policy makers must emphasize on the incorporation of oral health into primary healthcare and enhancing dental insurance cover or subsidized dental care services to low income families to make them more accessible and affordable.

7.3. Study Limitations

There are certain limitations to the current study which must be taken into consideration when interpreting the results. To begin with, a non-probability convenience sampling method could diminish the applicability of the outcomes to the general population of school-going children in Parachinar and the neighboring areas.

Second, the cross-sectional design limits the possibility to determine the causal relationship between identified risk factors and dental caries since the data were gathered only at one time. Determining temporal associations would be better done through longitudinal studies.

Third, oral hygiene practices and dietary habits may be recalled biased and influenced by social desirability bias, which may compromise the truthfulness of the answers. Despite the clinical examination tests conducted to confirm the caries status, behavioral variables were dependent on participant self-reporting.

Fourth, the research was confined to two privately-owned schools in an urban environment, which might not be fully applicable to children in the public schools or children in the rural environment and possibly having different socioeconomic and behavioral characteristics.

In spite of these shortcomings, the study offers good background evidence on the prevalence and determinants of dental caries in a poorly researched and underserved area in Pakistan.

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