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# IMPACT OF ORAL HYGIENE, DIETARY HABITS AND SOCIOECONOMIC STATUS ON DENTAL CARIES AMONG CHILDREN AGED 5-8YEARS: A QUESTIONNAIRE BASED STUDY

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## INTRODUCTION

Dental caries remains one of the most prevalent chronic diseases affecting children worldwide, with significant implications for pain, systemic health, growth, and quality of life.[1,2] While fundamentally driven by cariogenic bacteria fermenting dietary sugars, the etiology of caries is recognized as multifactorial, intricately woven with behavioral, social, and economic determinants.[3,4] This is particularly evident during the critical developmental window of ages 5 to 8 years, when children transition from primary to mixed dentition. During this period, establishing lifelong health habits is crucial, yet children are also highly susceptible to the caries-promoting effects of poor diet and inadequate oral care.

Extensive research has independently validated the roles of key risk factors. Dietary intake of free sugars, especially through frequent consumption of sugar-sweetened beverages (SSBs), candies, and sugary snacks, is a well-established primary driver of demineralization.[5,2,4] Concurrently, protective oral hygiene practices, chiefly twice-daily brushing with fluoride toothpaste, are fundamental to disrupting plaque and preventing caries.[3,6,7] However, evidence suggests a troubling disconnect; children often possess adequate knowledge of healthy practices yet fail to translate this into consistent behavior, a gap that appears more pronounced in younger age groups.[2]

Beyond individual behaviors, the socioeconomic context exerts a powerful influence on oral health outcomes. Studies consistently demonstrate that children from families with lower socioeconomic status (SES), characterized by lower parental education and income, experience a disproportionately higher burden of dental caries.[1,6,8] This inequality persists even in settings with financial barriers removed, indicating that factors such as health literacy, parenting practices, and access to healthy foods play pivotal roles.[1] Furthermore, family structure and parental employment may influence the time and resources available for supervising a child's diet and hygiene routines.

Despite the wealth of evidence on these individual factors, there is a need for more integrated assessments that simultaneously examine the interplay between oral hygiene practices, detailed dietary habits, and nuanced socioeconomic indicators within specific age groups, such as 5-8- year-olds. Many studies focus on one or two domains, or on broader age ranges, which can obscure age-specific patterns and interactions.[7,8] A holistic,

questionnaire-based approach capturing these intertwined factors can provide a clearer picture of the dominant risk profiles in a community.

Therefore, this study aims to investigate the combined impact of oral hygiene behaviors, dietary habits, and socioeconomic status on the prevalence of dental caries among children aged 5-8 years through a cross-sectional, questionnaire-based design. By employing a detailed tool that queries tool use, brushing frequency and timing, consumption patterns of key cariogenic foods and drinks, as well as family income, structure, and parental education and employment, this research seeks to identify the most significant modifiable risk factors and protective behaviors within this population. The findings are expected to inform targeted, multi-dimensional preventive strategies and educational interventions aimed at reducing the caries burden in early school-aged children.

## METHODOLOGY

Pair of 90 parent and child were selected from the OPD at the Department of Pediatrics and Preventive Dentistry of Haldia Institute of Dental Sciences and Research. Ethical approval was obtained from the Institutional Ethical Review Board. The parents were informed about the study and were asked to complete the questionnaire and a written consent from participants of the study was also obtained. Children aged 5-8 years belonging to the same parents with no systemic condition/ pathology were included in the study. Clinical examination of children had been performed by a single operator using a mirror, a probe, a portable light, and cotton pellets for isolation, to reveal the presence or absence of dental caries, missing (extracted or congenital), and filled teeth. Caries had been detected according to the WHO criteria as dmft/DMFT Index10 for primary and permanent dentition.

### Questionnaire survey

A consent form and questionnaire were sent to parents of the children. The questionnaire included the following questions.

1. Which of the tools do your child use for oral hygiene-

a. Toothbrush with toothpaste.
b. Mouthwash along with toothbrush and toothpaste.
c. All of the above.

2. Frequency of cleaning teeth in a day-

a. Thrice.
b. Twice.
c. Once.
d. After each meal.

3. How often do you think a person should visit a dentist-

a. Six monthly.
b. Yearly.
c. When the child has a problem.

4. At what time of a day, do your child brush your teeth

a. In the morning just after waking up.
b. In the morning after breakfast.
c. After lunch.
d. After dinner.
e. After every meal.

5. How often do your child change toothbrush

a. Every month.
b. Every 2-3 months.
c. Every 6 months.
d. Once in a year.
e. When bristles become damaged.

6. Frequency of sugary drinks

a. 4 times/day.
b. 1-3 times/day.
c. 4 times/week.
d. 1-3 times/week.
e. 1-3 months/month.
f. Never.

7. Frequency of taking candy, cakes, sweetened pies, biscuits

a. <2 times/week.
b. 3-6 times/week.
c. 1-6 times/day.

8. Family structure

a. Nuclear.
b. Reconstituted.
c. Single parents.

9. Family annual income

a. 1-1.5 lakhs.
b. 1.5-2 lakhs.
c. >2 lakhs.

10. Parent’s education level

I. Mother’s

a. Less than high school.
b. High school.
c. College and above.

II. Father’s

a. Less than high school.
b. High school.
c. College and above.

11. Parents working

I. Mother

a. Working.
b. Non-Working.

II. Father

a. Working.
b. Non-Working.

**Statistical Analysis**

The collected data was tabulated in a spreadsheet using Microsoft Excel 2021 and then statistical analysis was carried out using the GraphPad Prism for Windows, Version 10.1.2 (GraphPad Software, La Jolla California USA).

A Shapiro-Wilk's test and a visual inspection of the histograms, standard Q-Q plots, and box plots showed that the collected data were skewed for all the quantitative variables.

Descriptive statistics were used to report i) categorical variables in terms of frequencies and percentages & ii) quantitative variables were reported in terms of mean (central tendency) and Standard deviation (SD) (measures of dispersion). The Chi-square($\chi^2$) test was carried out to analyze the categorical variables. Parametric tests were carried out for inferential statistics. Logistic regression analysis was carried out to assess the influence of the independent variables on the occurrence of cariess to calculate the odds ratio (OR) with 95% Confidence intervals (CI). The *P* value of ≤0.05 was considered as the level of significance.

**RESULTS**

**Descriptive statistics of the quantitative variables in the study**

| | Mean±SD | Median (IQR) | Range |
|---|---|---|---|
| Child' age | 6.29±1.06 | 6(5-7) | 5-8 |
| Caregiver/Respondent' Age | 32.93±4.94 | 32.5(30-36) | 8-46 |
| DMFT | 4.4±1.86 | 4(3-6) | 1-8 |

SD:Standard deviation; IQR:Inter-quartile Range

- **Child's Age**: The mean age of children was 6.29 ± 1.06 years, with a median age of 6 years (IQR: 5–7 years) and an age range of 5–8 years.
- **Caregiver/Respondent's Age**: The mean age of caregivers/respondents was 32.93 ± 4.94 years, with a median age of 32.5 years (IQR: 30–36 years) and an age range of 8–46 years.
- **DMFT Score**: The mean DMFT score was 4.4 ± 1.86, with a median score of 4 (IQR: 3– 6) and a range of 1–8.

**Table 2: Univariate Regression analysis to analyse factors contributing to caries severity.**

| Variables | Frequency(%) | Odds Ratio (95%CI) | *P* value |
|---|---|---|---|
| **Child's Sex** | | | |
| **Female** | 46(51.1 %) | Referent | |
| **Male** | 44(48.9 %) | 1.13(0.478-2.69) | 0.777$^{NS}$ |
| **1. Which of the tools do your child use for oral hygiene** | | | |
| **a. Toothbrush with toothpaste.** | 41(45.6 %) | Referent | |
| **b. Mouthwash along with toothbrush and toothpaste.** | 23(25.6 %) | 0.946(0.31-2.88) | 0.922$^{NS}$ |
| **c. All of the above.** | 26(28.9 %) | 0.448(0.159- 1.26) | 0.128$^{NS}$ |
| **2. Frequency of cleaning teeth in a day** | | | |
| **a. Thrice.** | 8(8.9 %) | 9670000(0-Inf) | 0.991$^{NS}$ |
| **b. Twice.** | 37(41.1 %) | 0.4735(0.14401- 1.557) | 0.218$^{NS}$ |
| **c. Once.** | 27(30.0 %) | Referent | |
| **d. After each meal.** | 18(20.0 %) | 0.0455(0.00941-0.219) | < .001* |
| **3. How often do you think a person should visit a dentist** | | | |
| **a. Six monthly.** | 25(27.8 %) | Referent | |
| **b. Yearly.** | 34(37.8 %) | 6.857(2.138-21.99) | 0.001* |
| **c. When the child has a problem.** | 31(34.4 %) | 4.346(1.409-13.4) | 0.011* |
| **4. At what time of a day, do your child brush their teeth** | | | |
| **a. In the morning just after waking up.** | 58(64.4 %) | Referent | |
| **b. In the morning after breakfast.** | 6(6.7 %) | 0.762(0.1269-4.574) | 0.766$^{NS}$ |
| **c. After lunch.** | 4(4.4 %) | 16200000(0-Inf) | 0.993$^{NS}$ |
| **d. After dinner.** | 2(2.2 %) | 16200000(0-Inf) | 0.995$^{NS}$ |
| **e. After every meal.** | 20(22.2 %) | 0.163(0.0535-0.499) | 0.001* |
| **5. How often do your child change toothbrush** | | | |
| **a. Every month.** | 11(12.2 %) | Referent | |
| **b. Every 23 months.** | 31(34.4 %) | 0.536(0.13-2.21) | 0.388$^{NS}$ |
| **c. Every 6 months.** | 23(25.6 %) | 2.714(0.529-13.92) | 0.231$^{NS}$ |

| | | | |
|---|---|---|---|
| **d. Once in a year.** | 10(11.1 %) | 5.143(0.465-56.89) | 0.182$^{NS}$ |
| **e. When bristles become damaged.** | 15(16.7 %) | 0.653(0.133-3.21) | 0.6$^{NS}$ |
| **6. Frequency of sugary drinks** | | | |
| **a. 4 times/day.** | 7(7.8 %) | 1810000000000 000(0-Inf) | 0.989$^{NS}$ |
| **b. 13 times/day.** | 17(18.9 %) | 1.02e0+8(0-Inf) | 0.993$^{NS}$ |
| **c. 4 times/week.** | 20(22.2 %) | 5.20e0+7(0-Inf) | 0.993$^{NS}$ |
| **d. 13 times/week.** | 33(36.7 %) | 8.51e0+7(0-Inf) | 0.993$^{NS}$ |
| **e. 13 months/month.** | 9(10.0 %) | 8.51e0+7(0-Inf) | 0.993$^{NS}$ |
| **f. Never.** | 4(4.4 %) | Referent | |
| **7. Frequency of taking candy, cakes, sweetened pies, biscuits** | | | |
| **a. <2 times/week.** | 46(51.1 %) | Referent | |
| **b. 36 times/week.** | 32(35.6 %) | 1.03(0.411-2.57) | 0.952$^{NS}$ |
| **c. 16 times/day.** | 12(13.3 %) | 29900000(0-Inf) | 0.988$^{NS}$ |
| **8. Family structure** | | | |
| **a. Nuclear.** | 69(76.7 %) | Referent | |
| **b. Reconstituted.** | 21(23.3 %) | 1.14(0.405-3.19) | 0.808$^{NS}$ |
| **9. Family annual income** | | | |
| **a. 11.5 lakhs.** | 34(37.8 %) | Referent | |
| **b. 1.52 lakhs.** | 21(23.3 %) | 0.348(0.1001-1.211) | 0.097$^{NS}$ |
| **c. >2 lakhs.** | 35(38.9 %) | 0.202(0.0672-0.61) | 0.005* |
| **10. Parent's education level (Mother)** | | | |
| **a. Less than high school.** | 9(10.0 %) | Referent | |
| **b. High school.** | 18(20.0 %) | 0.0000000611(0-Inf) | 0.99$^{NS}$ |
| **c. College and above.** | 63(70.0 %) | 0.0000000313(0-Inf) | 0.99$^{NS}$ |
| **10. Parent's education level (Father)** | | | |
| **a. High school.** | 7(7.8%) | Referent | |
| **b. College and above.** | 83(92.2%) | 0.28(0.0321-2.43) | 0.248$^{NS}$ |
| **11. Parents working [Mother]** | | | |
| **Non-Working** | 47(52.2 %) | Referent | |
| **Working** | 43(47.8 %) | 0.871(0.367-2.07) | 0.754$^{NS}$ |

$^{NS}$:not statistically significant($P$>0.05); **: highly statistically significant($P$<0.05)

The univariate logistic regression analysis was conducted to evaluate the association of various factors with the occurrence of dental caries, categorized as low caries (DMFT score <4, referent) and high caries (DMFT score ≥4). The results are presented below, starting with the frequency and percentage distribution of each variable.

**1. Child's Sex**

Among the children, 46 (51.1%) were female, and 44 (48.9%) were male.

- Male children had slightly higher odds of caries occurrence compared to females, but the difference was not statistically significant (OR = 1.13, 95% CI: 0.478–2.69, $P$ = 0.777).

**2. Tools Used for Oral Hygiene**

- A total of 41 children (45.6%) used a toothbrush with toothpaste, serving as the reference group.
- 23 children (25.6%) used a mouthwash along with a toothbrush and toothpaste, showing slightly lower odds of caries, but this was not statistically significant (OR = 0.946, 95% CI: 0.31–2.88, $P$ = 0.922).
- 26 children (28.9%) used all of the above, which was associated with lower odds of caries (OR = 0.448, 95% CI: 0.159–1.26), though not statistically significant ($P$ = 0.128).

**3. Frequency of Cleaning Teeth**

- 8 children (8.9%) brushed their teeth thrice daily, 37 (41.1%) brushed twice daily, 27 (30.0%) brushed once daily (referent), and 18 (20.0%) brushed after each meal.
- Brushing twice daily showed reduced odds of caries (OR = 0.4735, 95% CI: 0.14401–1.557, $P$ = 0.218), but this was not statistically significant.
- Brushing after each meal was significantly associated with lower odds of caries (OR = 0.0455, 95% CI: 0.00941–0.219, $P$ < 0.001), indicating a strong protective effect.

**4. Frequency of Dental Visits**

- 25 children (27.8%) visited the dentist six monthly (referent), 34 (37.8%) visited annually, and 31

(34.4%) visited only when a problem arose.
- Annual visits were associated with significantly higher odds of caries (OR = 6.857, 95% CI: 2.138–21.99, *P* = 0.001).
- Visits only when a problem arose also increased the odds of caries (OR = 4.346, 95% CI: 1.409–13.4, *P* = 0.011).

**5. Timing of Brushing**
- The majority of children, 58 (64.4%), brushed in the morning just after waking up (referent).
- 6 children (6.7%) brushed in the morning after breakfast, 4 (4.4%) brushed after lunch, 2 (2.2%) brushed after dinner, and 20 (22.2%) brushed after every meal.
- Brushing after every meal was significantly associated with lower odds of caries (OR = 0.163, 95% CI: 0.0535–0.499, *P* = 0.001). Other brushing times did not show significant associations.

**5. Frequency of Changing Toothbrush**
- 11 children (12.2%) changed their toothbrush every month (referent).
- 31 children (34.4%) changed every 2–3 months, showing reduced odds of caries occurrence, though not statistically significant (OR = 0.536, 95% CI: 0.13–2.21, *P* = 0.388).
- 23 children (25.6%) changed every 6 months (OR = 2.714, 95% CI: 0.529– 13.92, *P* = 0.231).
- 10 children (11.1%) changed their toothbrush once a year (OR = 5.143, 95% CI: 0.465–56.89, *P* = 0.182).
- 15 children (16.7%) changed when bristles became damaged (OR = 0.653, 95% CI: 0.133–3.21, *P* = 0.600).

**6. Frequency of Sugary Drinks**
- 7 children (7.8%) consumed sugary drinks 4 times/day, 17 (18.9%) consumed 1–3 times/day, 20 (22.2%) consumed 4 times/week, 33 (36.7%) consumed 1–3 times/week, 9 (10.0%) consumed 1–3 times/month, and 4 (4.4%) never consumed sugary drinks (referent).
- None of the categories showed statistically significant associations with caries (*P* > 0.98 across all comparisons).

**7. Frequency of Consuming Sweets (Candy, Cakes, Biscuits, etc.)**
- 46 children (51.1%) consumed sweets <2 times/week (referent).
- 32 children (35.6%) consumed sweets 3–6 times/week, showing no significant association with caries (OR = 1.03, 95% CI: 0.411–2.57, *P* = 0.952).
- 12 children (13.3%) consumed sweets 1–6 times/day (OR = 29900000, 95% CI: 0–Inf, *P* = 0.988).

**8. Family Structure**
- 69 children (76.7%) belonged to nuclear families (referent), and 21 (23.3%) were from reconstituted families.
- Reconstituted families showed no significant association with caries (OR = 1.14, 95% CI: 0.405–3.19, *P* = 0.808).

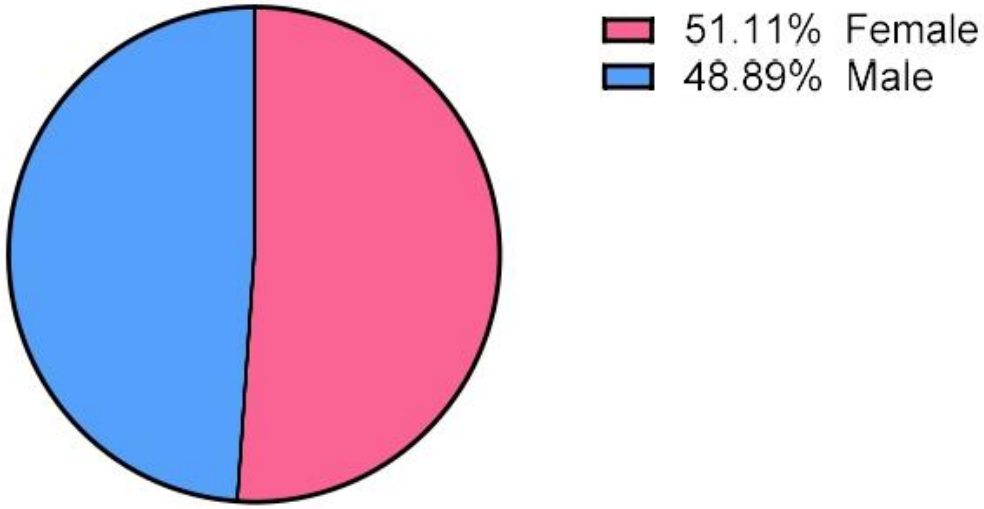
**9. Family Annual Income**
- 34 children (37.8%) had a family income of ≤1.5 lakhs/year (referent).
- 21 children (23.3%) had a family income of 1.5–2 lakhs/year, with reduced odds of caries but not statistically significant (OR = 0.348, 95% CI: 0.1001– 1.211, *P* = 0.097).
- 35 children (38.9%) had a family income >2 lakhs/year, showing significantly lower odds of caries (OR = 0.202, 95% CI: 0.0672–0.61, *P* = 0.005).

**10. Parent's Education Level (Mother)**
- 9 mothers (10.0%) had less than high school education (referent).
- 18 mothers (20.0%) had completed high school (OR = 0.0000000611, 95% CI: 0–Inf, *P* = 0.990).
- 63 mothers (70.0%) had college education or above (OR = 0.0000000313, 95% CI: 0–Inf, *P* = 0.990).
- No significant associations were observed across education levels.

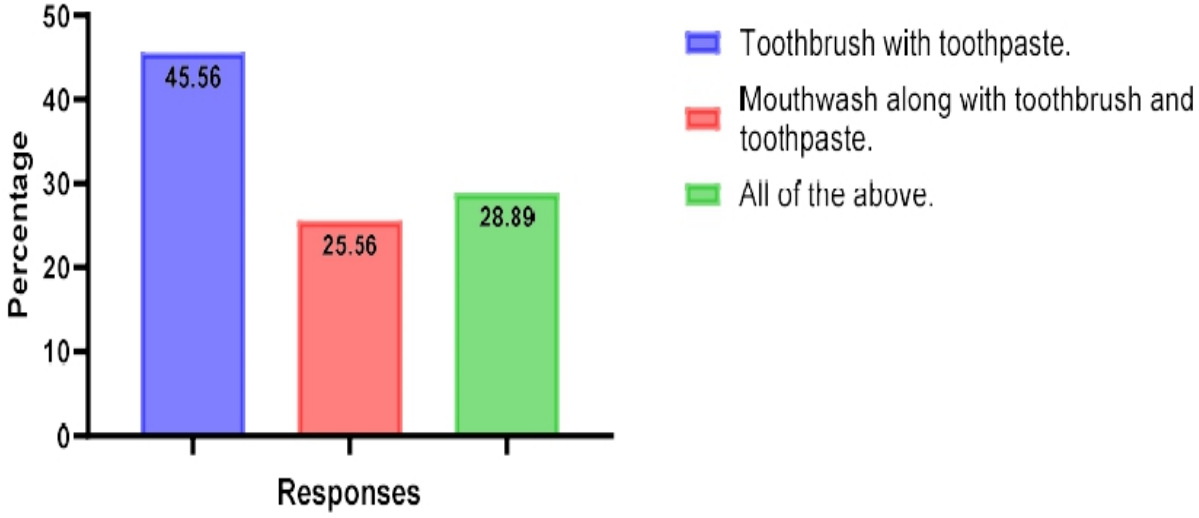
**11. Parent's Education Level (Father)**
- Among the fathers, 7 (7.8%) had a high school education, serving as the referent group, while 83 (92.2%) had education at the college level or above.
- Fathers with college-level or higher education showed lower odds of caries occurrence in their children compared to those with high school education (OR = 0.28, 95% CI: 0.0321–2.43); however, this difference was not statistically significant (*P* = 0.248).

**12. Parents Working Status (Mother)**
- 47 mothers (52.2%) were non-working (referent), and 43 (47.8%) were working.
- Working mothers showed slightly reduced odds of caries, but the association was not statistically significant (OR = 0.871, 95% CI: 0.367–2.07, *P* = 0.754).

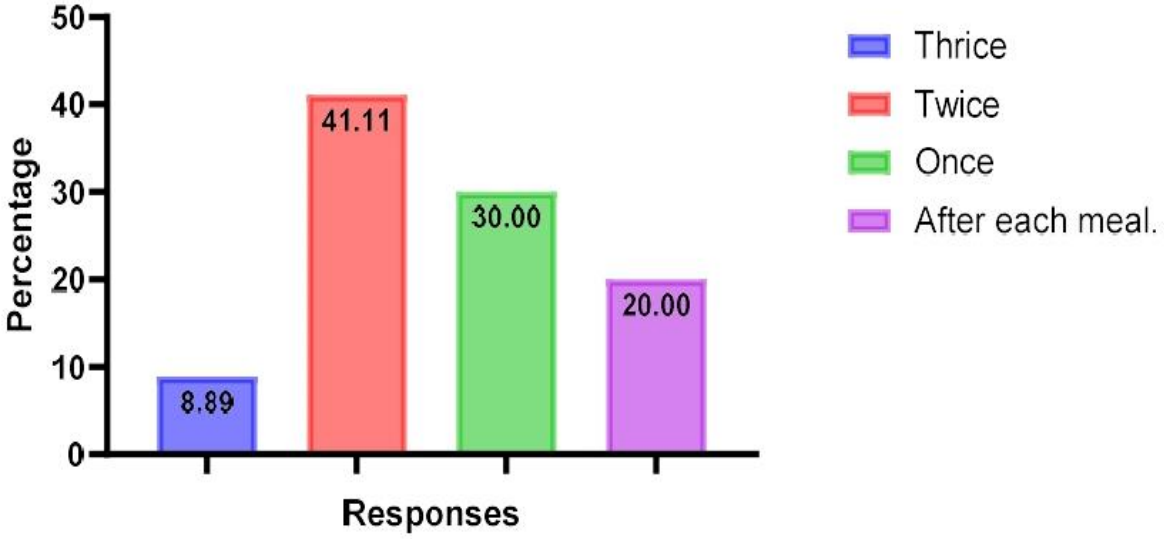
**Pie Chart: Distribution of responses for Child's Sex**



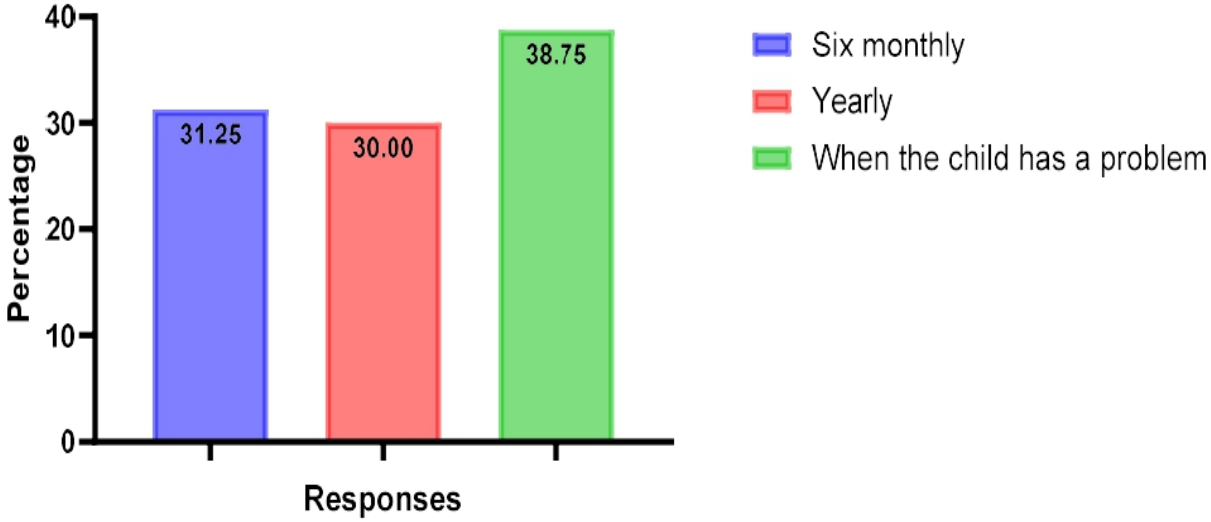

**Bar Graph: Distribution of responses for Which of the tools do your child use for oral hygiene**



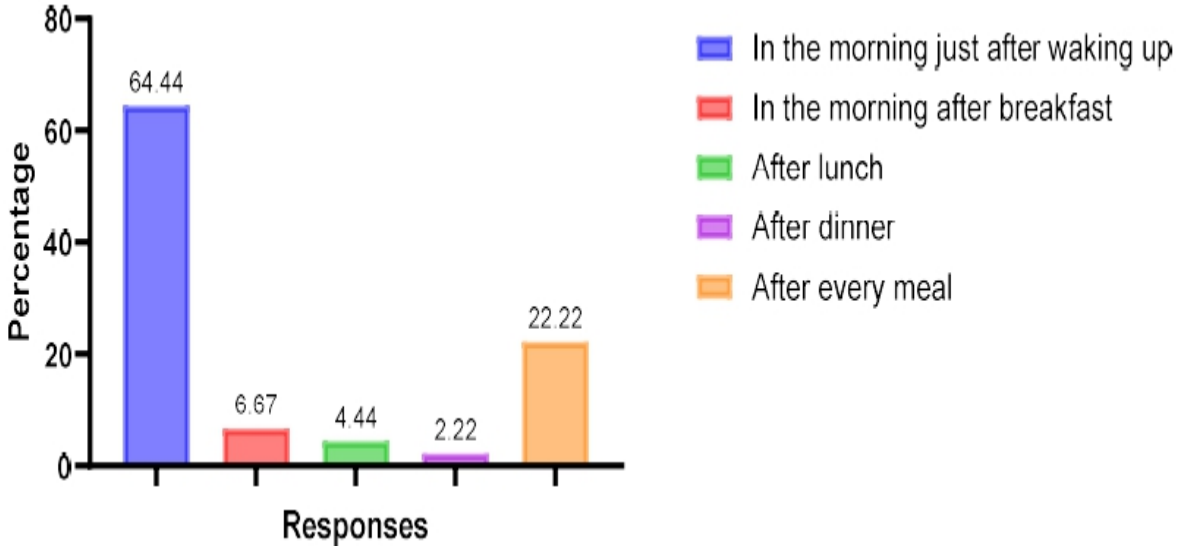

**Bar Graph: Distribution of responses for Frequency of cleaning teeth in a day**



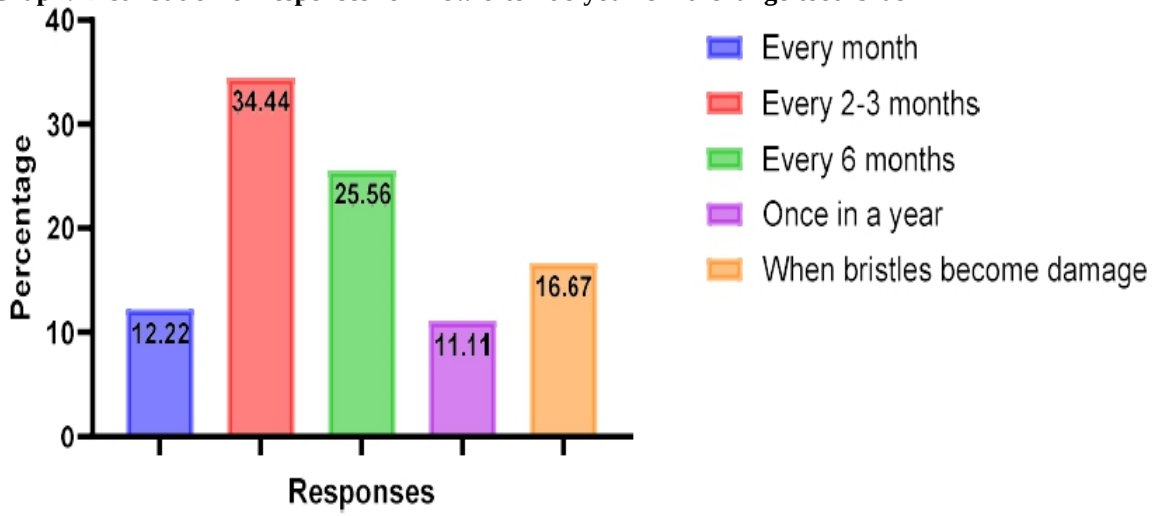
**Bar Graph: Distribution of responses for How often do you think a person should visit a dentist**



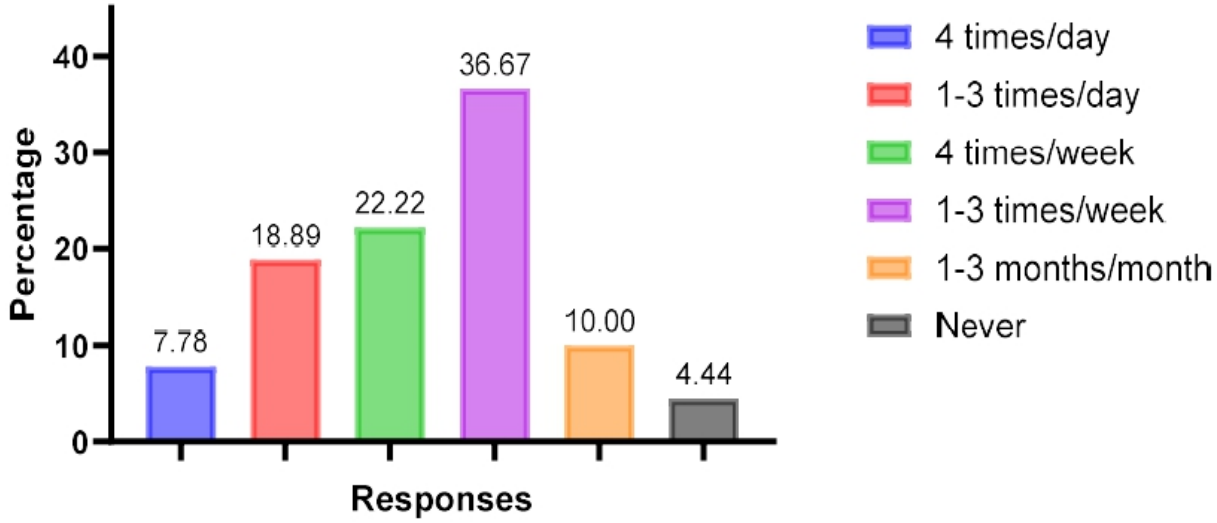

**Bar Graph: Distribution of responses for At what time of a day, do your child brush their teeth**



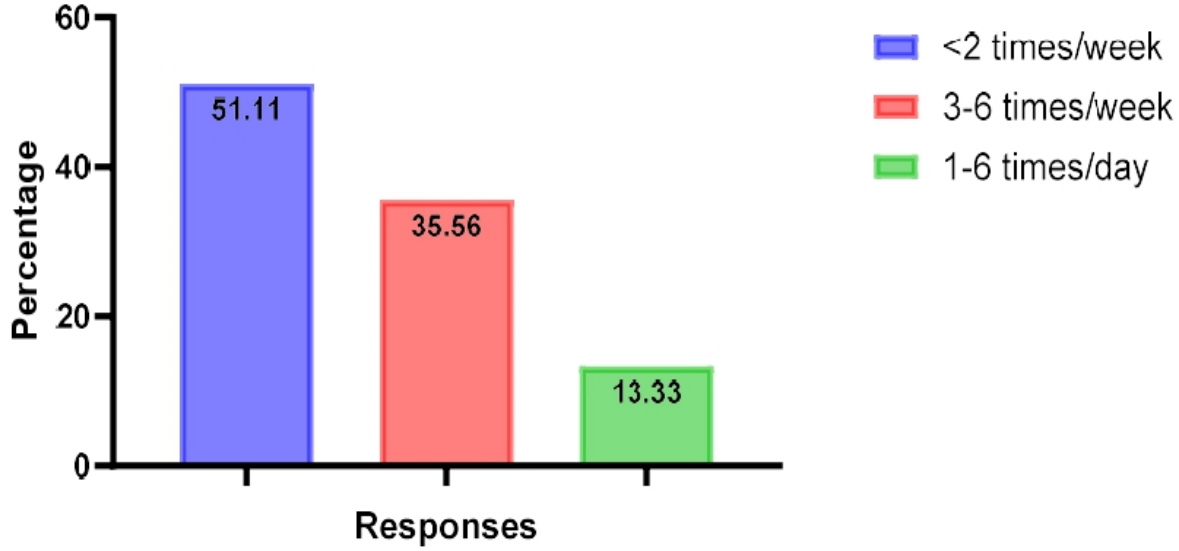

**Bar Graph: Distribution of responses for How often do your child change toothbrush**



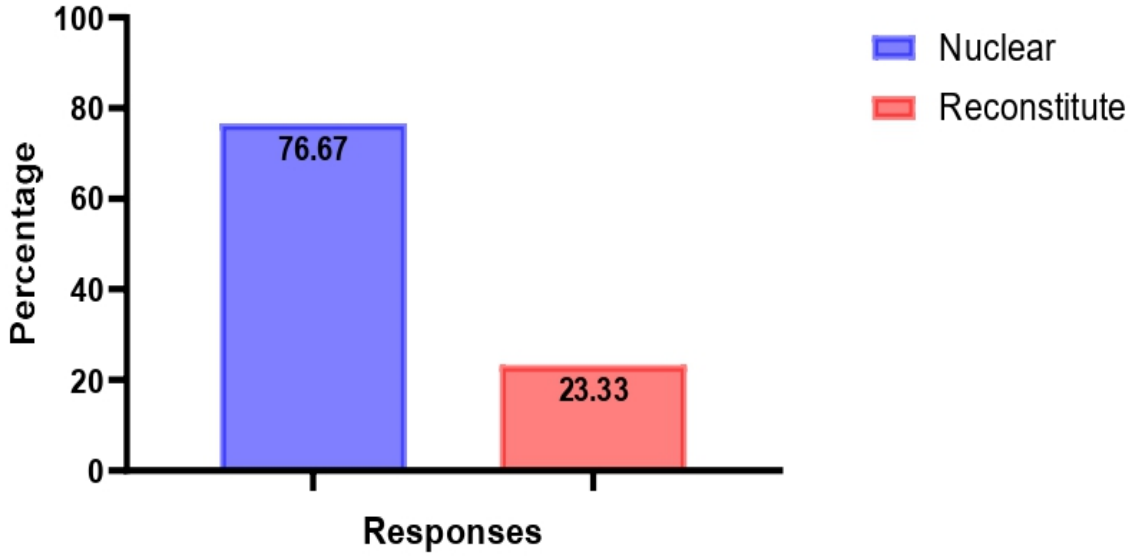
**Bar Graph: Distribution of responses for Frequency of sugary drinks**



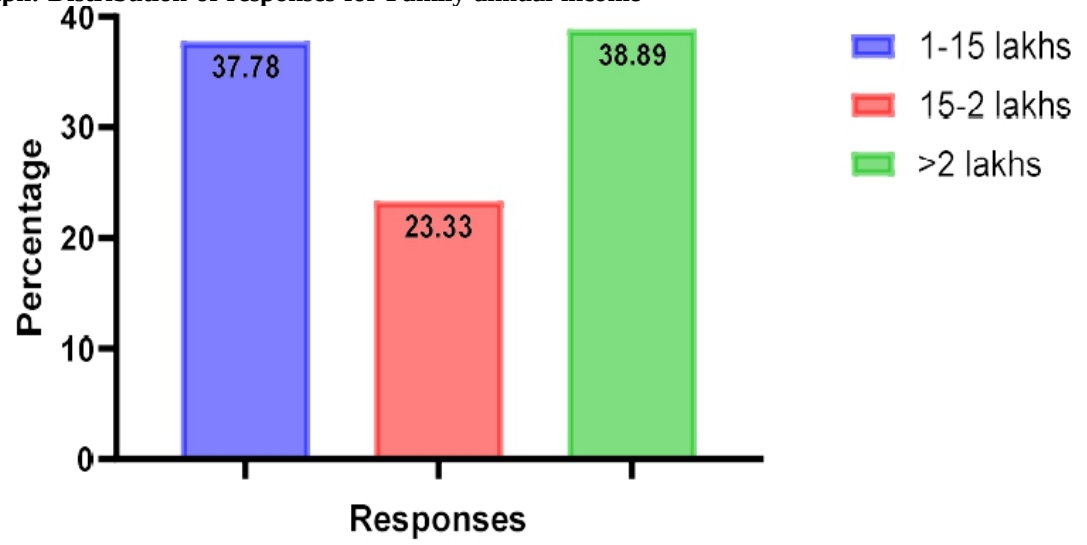

**Bar Graph: Distribution of responses for Frequency of taking candy, cakes, sweetened pies, biscuits**



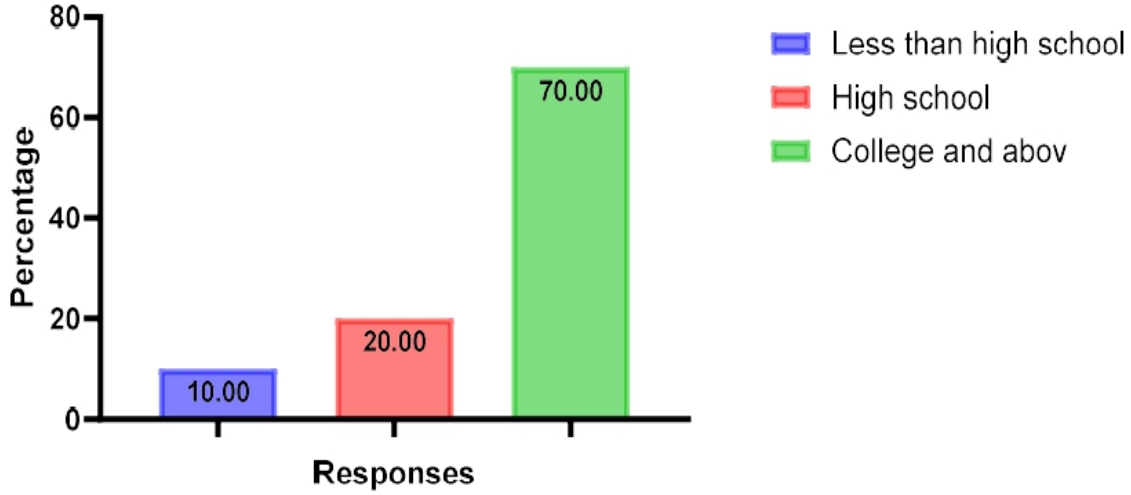

**Bar Graph: Distribution of responses for Family structure**



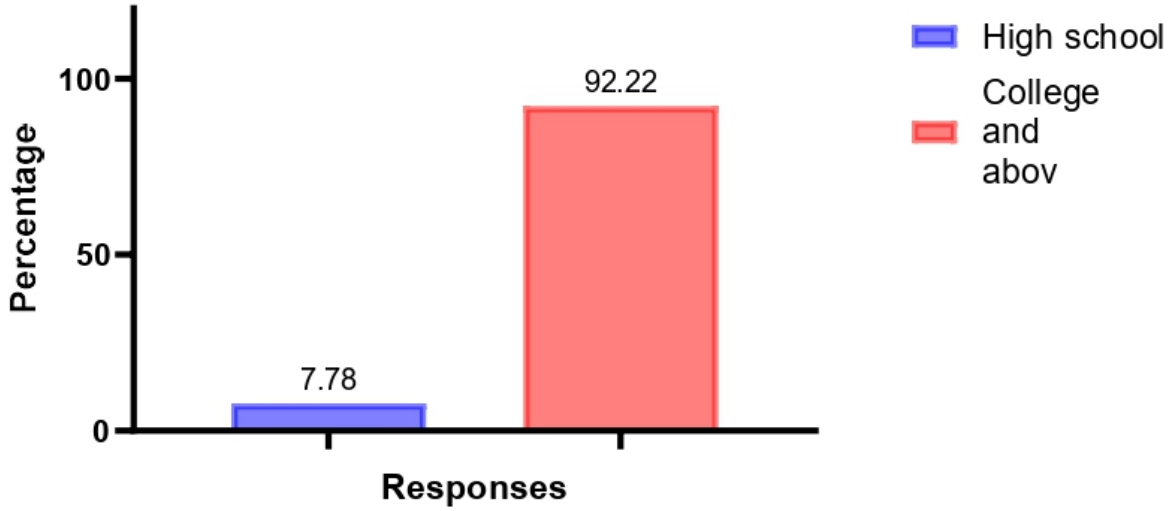
**Bar Graph: Distribution of responses for Family annual income**



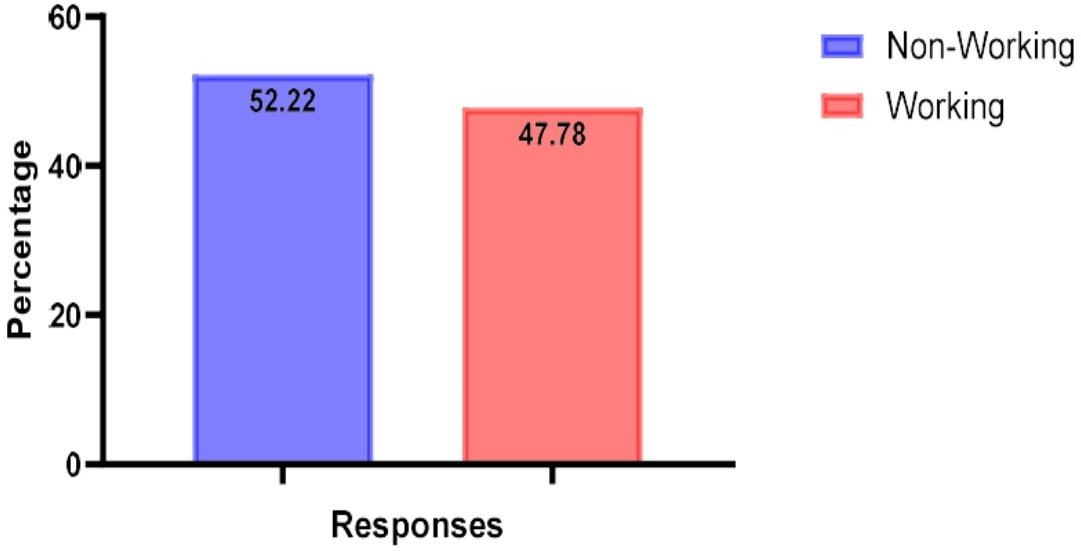

**Bar Graph: Distribution of responses for Parent's education level- [Mother's-]**



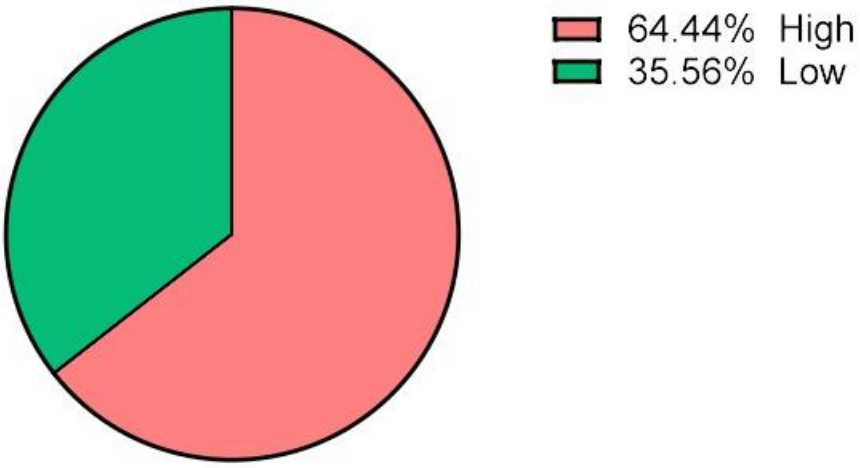

**Bar Graph: Distribution of responses for Parent's education level- [Father's-]**



**Bar Graph: Distribution of responses for Parents working- [Mother]**




**Pie Chart:DMFT Status**




## DISCUSSION

Dental caries continues to represent one of the most burdensome non-communicable diseases affecting children globally, exerting wide-ranging consequences on pain, quality of life, nutritional intake, and school performance. The present cross-sectional, questionnaire-based study sought to delineate the relative contributions of oral hygiene practices, dietary habits, and socioeconomic determinants to caries severity—measured by the dmft/DMFT index—among children aged 5 to 8 years. The mean DMFT score recorded in this cohort was 4.4 ± 1.86, a figure that underscores a moderate-to-high caries burden consistent with reports from comparable populations in developing nations. The following discussion contextualizes the principal findings within the broader epidemiological literature and examines plausible biological, behavioral, and socioeconomic mechanisms.

### *Oral Hygiene Practices and Caries Prevalence*

Among the oral hygiene variables examined, the frequency and timing of tooth brushing emerged as the most clinically significant determinants of caries severity in the present study. Children who brushed their teeth after every meal demonstrated markedly lower odds of high caries experience (OR = 0.0455; 95% CI: 0.00941–0.219; P < 0.001), while brushing after every meal in terms of timing similarly conferred significant protection (OR = 0.163; 95% CI: 0.0535–0.499; P = 0.001). These findings are in accord with the mechanistic rationale that post- meal brushing disrupts the cariogenic biofilm immediately after fermentable carbohydrate exposure, thereby attenuating acid-mediated demineralization of enamel.

This protective association aligns with the well-established evidence base for brushing frequency and dental caries. Hooley et al. (2012), in a systematic review, reported a consistent inverse association between brushing frequency and caries experience in children, particularly when fluoride toothpaste was employed.[9] Similarly, Pitts et al. (2017) affirmed that twice- daily brushing with fluoridated toothpaste constitutes a cornerstone of caries prevention.[10] The comparatively

non-significant result for twice-daily brushing alone (OR = 0.4735; P = 0.218) in the present study may reflect the relatively small sample size, which limits statistical power to detect modest effect sizes, as well as confounding from variations in brushing technique, duration, and fluoride concentration of toothpaste used—factors not captured in the questionnaire.

The predominance of morning brushing after waking up (64.4%) over post-dinner brushing in this sample is noteworthy. From a biological standpoint, nocturnal plaque accumulation in the absence of salivary flow renders bedtime brushing particularly critical for caries prevention. The low proportion of children brushing at night may contribute substantially to the observed caries burden, a pattern documented by Arora et al. (2011) who demonstrated that night-time brushing habits were significantly associated with reduced caries experience in preschool children.[11]

Regarding oral hygiene tools, children using a combination of mouthwash, toothbrush, and toothpaste showed a trend toward lower caries odds, though not statistically significant (OR = 0.448; P = 0.128). This directional finding is biologically plausible; fluoride mouthwashes serve as adjunctive remineralizing agents, and their combined use with brushing has been advocated for high-risk children. Marinho et al. (2016) demonstrated in a Cochrane review that fluoride mouthrinses significantly reduce caries in children, especially when used in addition to fluoride toothpaste.[12] The absence of statistical significance here likely reflects the limited sample size and the absence of fluoride concentration data.

The frequency of dental visits also demonstrated a highly significant association with caries severity. Children visiting the dentist only annually had substantially higher odds of high caries experience (OR = 6.857; P = 0.001), and those attending only when symptomatic—reflecting a purely reactive rather than preventive attitude—also showed elevated odds (OR = 4.346; P = 0.011), compared to children attending every six months. These findings underscore the preventive value of regular professional dental care, consistent with the policy recommendation of biannual dental examinations for children. Holt et al. (2012) emphasized that reactive patterns of dental attendance among children were strongly associated with higher caries burden, particularly in disadvantaged communities.[13] The data from the present study reflect a concerning reactive dental-seeking pattern in a substantial proportion of the cohort (34.4% attended only when a problem arose), indicative of low preventive dental awareness and possibly limited access.

***Dietary Habits and Cariogenic Exposure***

Contrary to expectations rooted in the classical Keyes triad, neither the frequency of sugary drink consumption nor the frequency of consumption of sweets, cakes, and biscuits yielded statistically significant associations with caries severity in this study (P > 0.05 across all dietary categories). This finding diverges from the considerable body of evidence implicating dietary sugars as a primary driver of dental caries. Sheiham and James (2015), in a landmark systematic review, established a dose–response relationship between free sugar intake and caries experience, with frequent consumption of sugary foods and beverages dramatically increasing caries risk.[14] Similarly, Peres et al. (2019) in the Lancet confirmed that sugar-sweetened beverage consumption is one of the most consistently identified risk factors for early childhood caries.[15]

Several explanations may account for the null findings in the present study. First, the sample size of 90 participants may be insufficient to detect the modest-to-moderate effect sizes typically reported for dietary variables in relation to caries, particularly given the wide variability in caries scores. Second, the questionnaire relied entirely on parental recall and self- reporting of a child's diet, introducing substantial social desirability bias; parents may underreport cariogenic dietary behaviors. Third, the cross-sectional design precludes the capture of lifetime dietary exposure—which is more relevant to caries development than recent frequency alone. Fourth, the absence of data on sugar quantity, viscosity, fermentability, and the context of consumption (e.g., between meals versus with meals) limits the specificity of dietary assessment. Stecksén-Blicks and Gustafsson (1986) demonstrated that the pattern and context of sugar consumption—particularly frequency between meals—was more cariogenic than total sugar intake alone.[16] A more granular dietary instrument, such as a 24-hour dietary recall or the Caries Assessment Spectrum and Treatment (CAST) tool, would enhance the detection of dietary associations in future research.

***Socioeconomic Status and Oral Health Disparities***

The socioeconomic gradient in dental caries was clearly demonstrated in this study. Children from families with an annual income exceeding INR 2 lakhs exhibited significantly lower odds of high caries experience compared to the lowest income group (OR = 0.202; 95% CI: 0.0672– 0.61; P = 0.005), representing an approximately 80% reduction in odds. This finding is consistent with the internationally recognized socioeconomic patterning of dental caries and validates the relevance of income as a determinant of oral health in the Indian pediatric context.

The social gradient in caries operates through multiple interrelated mechanisms. Higher- income families are more likely to afford and access fluoride toothpaste, professional dental services, and nutritious low-cariogenic diets. They may also demonstrate higher health literacy, more consistent oral health supervision, and greater adherence to preventive recommendations. Tellez et al. (2006) demonstrated that household income was a robust predictor of caries experience in children,

even after adjusting for dietary and behavioral variables, implying that income operates partly through material pathways independent of individual behaviors.[17]

Locker (2000) similarly argued that socioeconomic determinants of oral health function through both upstream structural factors—including income and education—and downstream behavioral mediators such as dietary habits and dental attendance.[18]

In contrast, parental education level—for both mothers and fathers—did not yield statistically significant associations with caries in this sample. While this may reflect the limited variability in the sample (70% of mothers had college-level education or above; 92.2% of fathers had college-level education or above), it may also indicate that education alone, in the absence of adequate financial resources or health system access, is insufficient to translate knowledge into effective oral health behavior. This interpretation is supported by Edelstein (2006), who highlighted that even educated parents from low-income backgrounds faced structural barriers that constrained their ability to implement preventive oral health practices.[19] The role of parental working status similarly did not reach significance (OR = 0.871; P = 0.754), suggesting that, within this sample, maternal employment per se did not adversely affect children's oral health once income and access were accounted for.

Family structure (nuclear vs. reconstituted) was also non-significant in this analysis (P = 0.808). While some studies have linked non-nuclear family structures to higher caries rates due to reduced parental supervision and dietary inconsistency, the sample in the present study contained very few reconstituted or single-parent families (23.3% reconstituted; no single- parent families), limiting the statistical power to detect such an association.

***Sex Differences in Caries Experience***

Male children showed marginally higher odds of caries compared to females (OR = 1.13; P = 0.777), but this difference was not statistically significant—a finding consistent with Joshi et al., who similarly reported no sex-based differential in caries occurrence in Indian school-aged children. While some studies have reported higher caries in girls, attributed to earlier eruption of teeth increasing cumulative caries exposure, the literature on sex differences in primary dentition caries remains inconsistent, and the present result suggests that, within this cohort, sex was not a meaningful independent predictor.

***Multifactorial Interactions and Combined Effects***

The findings of this study collectively reinforce the multifactorial etiology of dental caries. The significant associations identified—post-meal brushing, brushing timing, dental visit frequency, and family income—represent distinct but interacting pathways through which biological, behavioral, and structural determinants converge to produce differential caries outcomes. The strong association of both brushing behavior and socioeconomic variables with caries, even in a relatively small sample, underscores the principle that caries prevention requires addressing both proximal behavioral factors and upstream social determinants simultaneously. Interventions that focus exclusively on hygiene education without addressing economic access to preventive resources are unlikely to produce equitable reductions in the caries burden.

Watt and Sheiham (2012) emphasized in their salutogenic framework that oral health promotion must transcend individual behavior change and address the social, economic, and environmental conditions that shape health behaviors.[20] The data from this study, situated in an outpatient pediatric dental setting in Haldia, West Bengal, reflect a community where preventive dental awareness and access remain suboptimal, with only 27.8% of children attending dental check-ups at the recommended six-monthly interval and a majority still relying on post-symptomatic care.

***Public Health Implications***

The public health implications of these findings are considerable. The identification of post- meal brushing and regular dental visits as the most significant modifiable protective factors suggests that structured oral health education programs—delivered in schools and primary healthcare settings—should prioritize not merely the fact of brushing, but its timing, frequency, and technique. Integrating parental counseling into pediatric dental visits, with specific emphasis on post-meal brushing and the risks of irregular dental attendance, may yield meaningful reductions in caries prevalence. Furthermore, the significant income-caries gradient reinforces the need for subsidized or free preventive dental services targeting low- income families, particularly in semi-urban and peri-urban settings such as Haldia, where financial barriers to care may be pronounced.[21]

***Strengths and Limitations***

The present study possesses several methodological strengths. The use of a standardized clinical examination (WHO criteria; dmft/DMFT index) performed by a single trained operator minimizes inter-examiner variability and ensures diagnostic consistency. The multidimensional questionnaire, encompassing oral hygiene practices, dietary habits, and multiple socioeconomic indicators, allows for a holistic assessment rarely achieved in single-domain studies. The logistic regression framework, with appropriate reference group selection, enables the simultaneous examination of multiple predictors while controlling for confounding.

Nonetheless, several limitations warrant acknowledgment. The sample size of 90 child- caregiver dyads, though adequate for exploratory analyses, restricts

the statistical power to detect modest effect sizes, particularly for dietary variables. The cross-sectional design precludes causal inference, and findings reflect the caries status at one point in time rather than longitudinal exposure. Selection bias is possible, as children attending a dental outpatient department may differ systematically from the broader pediatric population in their oral health behaviors and risk profiles. Additionally, the questionnaire is subject to recall bias and social desirability bias, which may have attenuated the observed associations between dietary habits and caries. The absence of fluoride exposure data, plaque index assessment, salivary flow measurements, and detailed information on brushing technique represents further constraints on the comprehensiveness of the analysis.

***Suggestions for Future Research***

Future investigations should employ larger, population-based samples with random or stratified cluster sampling to enhance external validity and statistical power. Longitudinal designs tracking dietary exposure, brushing behavior, and caries development over time would yield more robust causal insights. The incorporation of objective dietary assessment tools, salivary cariogenic bacterial counts (e.g., Streptococcus mutans, Lactobacillus), and plaque scores would enrich the biological granularity of the analysis. Furthermore, qualitative research exploring parental perceptions, cultural dietary practices, and healthcare-seeking behaviors would complement the quantitative findings and inform contextually appropriate interventions.

## CONCLUSION

This study provides meaningful evidence that the timing and frequency of tooth brushing and regular preventive dental attendance are the most significant modifiable oral hygiene determinants of caries severity in children aged 5–8 years. The pronounced association between higher family income and lower caries experience further affirms the socioeconomic patterning of pediatric oral health in this population. Although dietary variables did not achieve statistical significance—likely reflecting methodological constraints—the directional trends align with established biological mechanisms. These findings collectively support a multi-pronged preventive approach that addresses behavioral, educational, and structural determinants of caries in early childhood.

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