



Screen dependency and first permanent molar caries experience among 6 to 8 year old children: A comparative cross-sectional study

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ABSTRACT

Background: Excessive digital screen exposure is a growing pediatric health concern, yet its impact on early permanent molar decay remains unclear. This study evaluated the relationship between daily screen time and first permanent molar caries experience in 6- to 8-year-old children. **Methods:** In this comparative cross-sectional study, 140 children aged 6 to 8 years were assigned to Group 1 (≤ 2 hours/day, $n = 70$) or Group 2 (> 2 hours/day, $n = 70$). Parent questionnaires and clinical examinations recorded Decayed, Missing, and Filled Teeth scores for first permanent molars per World Health Organization guidelines. Mann-Whitney U and Chi-square tests compared groups, with Spearman correlation evaluating screen duration against caries severity ($\alpha = 0.05$).

Results: Baseline parameters showed no significant differences between Group 1 and Group 2 in age, gender distribution, or socioeconomic status. Group 2 demonstrated significantly higher molar caries scores (1.93 ± 1.17 ; median: 2.00, interquartile range: 2.00) than Group 1 (1.33 ± 1.19 ; median: 1.00, interquartile range: 2.00). Daily screen duration positively correlated with caries experience (Spearman correlation coefficient = 0.646, $p < 0.05$).

Conclusion: Daily screen exposure exceeding two hours is significantly associated with increased first permanent molar caries severity in young children. Integrating digital screen habit screening into routine pediatric dental risk assessments is recommended.

INTRODUCTION

In recent years, the rapid proliferation of digital media devices—including smartphones, tablets, televisions, and gaming consoles—has led to an alarming rise in screen dependency among pediatric populations worldwide (1). Excessive daily screen viewing is increasingly recognized as a major modifiable behavioral determinant that negatively impacts children's oral health routines and physical well-being (2). In pediatric dentistry, the age bracket of 6 to 8 years represents a uniquely critical developmental milestone characterized by the eruption of the First Permanent Molars (FPMs) (3). As the cornerstone of the permanent dentition, newly erupted FPMs possess deep occlusal pits and fissures, incomplete post-eruptive enamel mineralization, and prominent positions in the dental arch, rendering them exceptionally vulnerable to rapid carious breakdown during early mixed dentition (4).

Current evidence and health guidelines from international pediatric organizations recommend restricting recreational digital screen exposure to no more than two hours per day for school-aged children (4,5). Substantial literature indicates that exceeding this baseline threshold (>2 hours/day) is associated with compromised oral health outcomes, including elevated Decayed, Missing, and Filled Teeth (DMFT) scores, higher plaque and gingival inflammation indices, and increased frequency of consuming sugar-sweetened beverages and cariogenic snacks while viewing screens (5-7). Proposed mechanisms linking excessive screen exposure to dental caries include prolonged intraoral food pouching during distracted eating (8), nocturnal oral hygiene omission, altered salivary flow rates and amylase activity (9), and dietary sugar intake mediating caries incidence and quality of life (10). However, notable controversies and variations persist across existing literature; while several observational studies document robust direct correlations between screen time and caries burden, others report weak or non-significant associations with early non-cavitated lesions or note marked variances across device types, age cohorts, and socioeconomic strata (6,11).

Despite the growing body of literature on digital media habits and pediatric health, a significant knowledge gap remains regarding the specific impact of screen dependency on distinct permanent tooth types during early childhood (2). The majority of prior investigations have relied on composite caries metrics (such as overall DMFT or primary dentition deft) evaluated across broad, heterogeneous age cohorts ranging from preschool toddlers to older

adolescents, thereby masking tooth-specific vulnerability patterns (5,7,11). Specifically, there is a lack of focused evidence examining whether daily screen time exposure directly correlates with caries experience in newly erupted First Permanent Molars among 6-8-year-old children, who are transitioning into independent dietary choices and digital device habits (3). Addressing this unmet need is crucial for establishing targeted preventive strategies and early risk assessment protocols in pediatric dental practice. Therefore, the present study aimed to assess the relationship between daily screen time exposure and dental caries experience (DMFT) in the first permanent molars among children aged 6 to 8 years. Furthermore, our investigation sought to compare FPM caries experience between children with non-excessive baseline exposure (≤ 2 hours/day) and those with excessive screen exposure (>2 hours/day). We hypothesized that children with excessive daily screen time (>2 hours/day) would exhibit significantly higher DMFT scores in their first permanent molars compared to those with non-excessive screen exposure, demonstrating a direct positive correlation between daily screen duration and FPM caries severity.

MATERIALS AND METHODS

Study design and setting:

The present study was designed as a comparative cross-sectional investigation. The study was conducted in a Pediatric dental clinic at Hazaribag, Jharkhand, India. Data collection and clinical dental examinations were executed over a year operational timeframe spanning from June 1, 2025, to May 31, 2026.

Ethical approval and consent:

Prior to study initiation, ethical clearance was granted by the Institutional Ethics Committee (IEC). Prior to enrollment, the objectives, procedures, and voluntary nature of the study were explained to the parents or legal guardians. Written informed consent was obtained from all participating parents/guardians, and written assent was obtained from participating children aged 7 years and older.

Participant selection criteria:

Participants were recruited from pediatric patients attending the dental clinic during the study timeframe based on the following pre-defined criteria:

Inclusion criteria:

- Children aged 6 to 8 years

- Presence of all four fully erupted First Permanent Molars (FPMs; Federation Dentaire Internationale [FDI] teeth 16, 26, 36, and 46).
- Ability of parents or legal guardians to comprehend and complete the interviewer-administered questionnaire.
- Provision of written parental informed consent and child assent (for children ≥ 7 years).

Exclusion criteria:

- Children with systemic illnesses, congenital anomalies, physical/developmental disabilities, or cognitive impairments.
- History of long-term systemic medication known to alter salivary flow rates or mineral density.
- Ongoing fixed orthodontic therapy or presence of extensive intraoral appliance therapy.
- Presence of hypoplastic enamel defects, fluorosis, or molar-incisor hypomineralization (MIH) affecting the FPMs.
- FPMs missing due to non-carious etiologies (e.g., trauma, surgical extraction, developmental agenesis).
- Uncooperative behavior precluding a complete and safe clinical dental examination.

Sample size calculation:

The sample size was estimated a priori using G*Power software (version 3.1.9.7, Franz Faul, Universität Kiel, Germany) (12). The calculation was based on a two-tailed Mann-Whitney U test comparing the primary continuous outcome measure-carries experience in first permanent molars-between two independent screen exposure groups. Setting a significance level (α) of 0.05 (5%), a desired statistical power ($1 - \beta$) of 0.80 (80%), a medium Cohen's effect size (d) of 0.50, and an allocation ratio of 1:1, the minimum required sample size was determined to be 67 children per group (total $n = 134$). To compensate for potential non-response or incomplete parent-reported questionnaire data, 70 children were enrolled per group, yielding a final analytical sample size of 140 participants ($n = 140$).

Study protocol:

Participants were categorized into two comparative exposure cohorts based on parent-reported cumulative daily screen exposure duration across all digital media devices (television, smartphones, tablets, computers, and gaming consoles):

Group 1 (Non-excessive /Baseline exposure): Cumulative daily screen viewing ≤ 2 hours per day, aligning with national and international pediatric media guidelines (5).

Group 2 (Excessive exposure): Cumulative daily screen viewing > 2 hours per day.

Questionnaire administration:

A structured, pre-tested, interviewer-administered questionnaire was completed by parents/guardians during the initial clinic visit. The instrument captured demographic profiles (child's age and sex), socioeconomic status (SES, evaluated via the Modified Kuppaswamy Socioeconomic Scale) (13) and digital device usage patterns.

Clinical examination protocol:

Oral health examinations were conducted in a standardized dental operatory under artificial light with the participant seated in a dental chair. Dental caries was recorded across all four FPMs (teeth 16, 26, 36, and 46) by a single trained examiner using plane mouth mirrors and World Health Organization (WHO) Community Periodontal Index (CPI) ball-ended probes, adhering strictly to WHO basic oral health survey criteria (14). To evaluate intra-examiner reliability, duplicate examinations were conducted on 10% of the sample prior to study commencement, yielding a high level of consistency ($\kappa > 0.85$).

Statistical analysis:

Statistical analysis was conducted using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA). Data normality was evaluated using the Shapiro-Wilk test, which demonstrated that continuous variables (age and DMFT scores) significantly deviated from a normal distribution ($p < 0.05$). Consequently, non-parametric statistical methods were employed. Descriptive statistics were expressed as mean $\pm$ standard deviation (SD), median with interquartile range (IQR), and minimum-maximum range for continuous variables, while categorical data were presented as absolute frequencies (n) and percentages (%). Comparative analyses between the two screen exposure groups were executed using the Mann-Whitney U test for non-parametric continuous metrics (age, DMFT) and the Chi-square test (χ^2) for categorical variables (sex distribution, SES class). The association between continuous daily screen time duration (hours/day) and FPM DMFT scores was evaluated using the Spearman rank correlation coefficient (r_s) (15). All

statistical tests were two-tailed, and the significance threshold was set at $p < 0.05$.

RESULTS

In Group 1 (≤ 2 hours/day), the mean age was 6.90 ± 0.71 years (median: 7.00; IQR: 1.00; range: 6.00–8.00), while in Group 2 (> 2 hours/day), the mean age was 6.99 ± 0.73 years (median: 7.00; IQR: 2.00; range: 6.00–8.00). The Mann–Whitney U test indicated no statistically significant difference in age between the two groups ($U = 2296.000$, $P > 0.05$) (table 1).

In Group 1 (≤ 2 hours/day), 37 participants (52.86%) were male and 33 (47.14%) were female. In Group 2 (> 2 hours/day), 39 participants (55.71%) were male and 31 (44.29%) were female. The chi-square test revealed no statistically significant difference in gender distribution between the two groups ($\chi^2 = 0.115$, $df = 1$, $P > 0.05$) (table 2).

In Group 1 (≤ 2 hours/day), 21 participants (30.00%) belonged to the upper class, 26 (37.14%) to upper middle, and 23 (32.86%) to lower middle socioeconomic status, with no participants in the upper lower or lower classes. In Group 2 (> 2 hours/day), 20 participants (28.57%) were in the upper class, 21 (30.00%) in upper middle, and 29 (41.43%) in lower middle class, with none in the upper lower or lower classes. The chi-square test indicated no statistically significant difference in socioeconomic status distribution between the two groups ($\chi^2 = 1.249$, $df = 2$, $P > 0.05$) (table 3).

In Group 1 (≤ 2 hours/day), the mean DMFT was 1.33 ± 1.19 (median: 1.00; IQR: 2.00; range: 0.00–4.00), while in Group 2 (> 2 hours/day), the mean DMFT was 1.93 ± 1.17 (median: 2.00; IQR: 2.00; range: 0.00–4.00). The Mann–Whitney U test revealed a statistically significant difference in caries experience between the two groups ($U = 1755.000$, $P < 0.05$), with higher DMFT values observed in children with greater screen exposure (table 4).

A statistically significant, moderate positive correlation was observed between daily screen exposure duration and caries experience (DMFT) in first permanent molars ($r_s = 0.646$, < 0.05) (figure 1).

DISCUSSION

The current investigation demonstrated that daily digital screen time exposure exceeding two hours per day is significantly associated with an elevated dental caries experience in newly erupted First Permanent Molars (FPMs) among children aged 6 to 8 years. Addressing our primary research objective, our cohort demonstrated that children in the excessive screen exposure group (> 2 hours/day) experienced a statistically significant increase in FPM

Decayed, Missing, and Filled Teeth (DMFT) scores compared to those with non-excessive baseline exposure (≤ 2 hours/day) (median DMFT: 2.00 vs. 1.00; $P < 0.05$). Furthermore, a statistically significant, moderate-to-strong positive correlation ($r_s = 0.646$, $P < 0.05$) was established between cumulative daily screen duration and FPM caries burden. Importantly, these primary outcomes were observed in comparative cohorts that exhibited no statistically significant baseline differences regarding age, sex distribution, or Kuppuswamy socioeconomic status, confirming that daily screen time operates as an independent behavioral risk indicator for early permanent molar decay during the mixed dentition transition. The positive association between excessive digital media exposure and heightened caries experience observed in the present study strongly corroborates a growing body of pediatric literature (1,4). Specifically, our findings align with previous cross-sectional evaluations reporting significantly higher overall DMFT/deft scores, plaque indices, and gingival inflammation among school-aged children spending two or more hours daily on digital devices (2,5). Similarly, hospital-based studies in pediatric cohorts have linked excessive screen time during weekends and mealtimes to an increased prevalence of cavitated carious lesions (6,8), while nationwide epidemiological surveys in adolescents confirm a direct link between prolonged smartphone viewing and reported caries symptoms (7). However, our investigation presents a novel contribution to the literature by specifically isolating newly erupted First Permanent Molars within a narrow developmental age window (6–8 years). In contrast, most prior studies evaluated composite caries scores across broad, heterogeneous age samples (ranging from 3 to 14 years) without differentiating tooth type or eruptive status (3,5,6). Notably, our results contrast with those of Kalaivanan et al. (11), who reported a weak, non-significant correlation ($r = -0.042$) between problematic screen exposure and early childhood caries severity in primary molars among preschool children. This discrepancy can be methodologically attributed to differences in diagnostic index thresholds (ICDAS-II vs. WHO DMFT), target dentition (deciduous vs. permanent), and sample age (preschoolers aged 36–71 months vs. school children aged 6–8 years). Furthermore, while large-scale population surveys noted that online media usage lost statistical significance after adjusting for health behaviors (16), our clinically evaluated cohort demonstrated an independent, robust correlation between daily screen hours and FPM caries severity.

Several behavioral and physiological mechanisms explain the observed relationship between screen dependency and FPM caries destruction. Behaviorally, prolonged screen immersion fosters distracted eating and intraoral food pouching, wherein children unconsciously retain cariogenic food boluses in the buccal vestibule and occlusal fissures for extended durations (5,8). Newly erupted FPMs possess deep, narrow occlusal pits and immature, incompletely mineralized enamel, making them exceptionally susceptible to rapid acid demineralization when exposed to prolonged carbohydrate stagnation (4). Furthermore, digital device exposure frequently coincides with ad-libitum consumption of sugar-sweetened beverages and snacks driven by targeted media advertisements (1,10). Physiologically, prolonged screen exposure—particularly near bedtime—triggers sympathetic nervous system arousal and circadian rhythm disruption, resulting in reduced unstimulated salivary flow rates, elevated salivary amylase, and altered inflammatory responses (3,9,17). Decreased salivary clearance and reduced buffering capacity compromise enamel remineralization, thereby accelerating carious breakdown in vulnerable erupting permanent teeth.

These findings carry significant implications for clinical pediatric dentistry and public health policy. Given that first permanent molars serve as the anatomical and functional foundation of the permanent dentition, preventing their early carious breakdown is paramount. Clinicians should routinely incorporate digital screen habit screening into pediatric caries risk assessment protocols (2). Identifying children with daily screen time exceeding two hours should prompt early preventive interventions, including the application of pit and fissure sealants and professional topical fluoride varnish during the 6-8-year eruptive window. Furthermore, chairside anticipatory guidance must emphasize “device-free mealtimes” to prevent distracted eating and food pouching, alongside “screen-free bedtimes” to avoid late-night snacking and nocturnal toothbrushing omission (3,8).

Strengths and limitations: The current investigation possesses several key methodological strengths, including the isolation of a homogenous 6-8-year-old cohort to evaluate newly erupted FPMs, the execution of clinical examinations by a single calibrated examiner using validated WHO criteria with high intra-examiner reliability, and the statistical comparability of baseline demographic and socioeconomic parameters across exposure groups. Conversely, certain limitations warrant

consideration. First, the cross-sectional design precludes establishing definitive temporal causality between screen exposure and caries initiation. Second, screen time data relied on parental recall, which may be vulnerable to reporting bias. Third, the study was conducted at a single center, which may limit direct generalizability to non-clinical rural populations. Fourth, direct biochemical assays of salivary flow and microbial load were not performed. These limitations were partially mitigated by employing a standardized, interviewer-administered media questionnaire and adjusting for major potential confounders.

Conclusion

In conclusion, daily screen exposure exceeding two hours per day is strongly associated with an increased caries experience in first permanent molars among 6-8-year-old children. Daily screen time represents a major modifiable behavioral determinant of pediatric oral disease. Future research should prioritize multi-center longitudinal cohort studies tracking children from FPM eruption through complete root development. Incorporating objective device-tracking applications, detailed dietary logging, and salivary biochemical profiling (such as salivary flow rates, pH, and *Streptococcus mutans* levels) will further elucidate the precise causal pathways and validate targeted behavioral interventions.

DECLARATIONS

Funding: No funding sources

Ethics Approval: Ethical clearance was granted by the Institutional Ethics Committee (IEC) prior to study initiation.

Patient Consent: Written informed consent was obtained from all participating parents/guardians, and written assent was obtained from participating children aged 7 years and older.

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Table 1: Comparison of age between study groups based on screen exposure duration.

Groups	Age (years)		
	Mean $\pm$ SD	Median (IQR)	Min-Max
Group 1 (≤ 2 hours/day)	6.90 $\pm$ 0.71	7.00 (1.00)	6.00-8.00
Group 2 (> 2 hours/day)	6.99 $\pm$ 0.73	7.00 (2.00)	6.00-8.00
Mann-Whitney U test	U = 2296.000, P = 0.486 (>0.05), Not significant		

Table 2: Comparison of gender distribution between study groups based on screen exposure duration.

Groups	Gender		Total n (%)
	Male n (%)	Female n (%)	
Group 1 (≤ 2 hours/day)	37 (52.86)	33 (47.14)	70 (100.00)
Group 2 (> 2 hours/day)	39 (55.71)	31 (44.29)	70 (100.00)
Chi-square test	$\chi^2 = 0.115$, df = 1, P = 0.734 (>0.05), Not significant		

Table 3: Comparison of socioeconomic status distribution between study groups based on screen exposure duration.

Groups	Socioeconomic class (Modified Kuppuswamy Socioeconomic Scale)					Total n (%)
	Upper n (%)	Upper middle n (%)	Lower middle n (%)	Upper lower n (%)	Lower n (%)	
Group 1 (≤ 2 hours/day)	21 (30.00)	26 (37.14)	23 (32.86)	00 (0.00)	00 (0.00)	70 (100.00)
Group 2 (> 2 hours/day)	20 (28.57)	21 (30.00)	29 (41.43)	00 (0.00)	00 (0.00)	70 (100.00)
Chi-square test	$\chi^2 = 1.249$, df = 2, P = 0.536 (>0.05), Not significant					

Table 4: Comparison of caries experience (DMFT) in first permanent molars between study groups based on screen exposure duration.

Groups	DMFT		
	Mean $\pm$ SD	Median (IQR)	Min-Max
Group 1 (≤ 2 hours/day)	1.33 $\pm$ 1.19	1.00 (2.00)	0.00-4.00
Group 2 (> 2 hours/day)	1.93 $\pm$ 1.17	2.00 (2.00)	0.00-4.00
Mann-Whitney U test	U = 1755.000, P = 0.003 (<0.05), Significant		

Figure 1: Correlation between screen exposure duration and caries experience (DMFT) in first permanent molars.

