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Association of dental caries in the first permanent molars with related factors among 6 to 8 years school going children of Maharashtra. A cross sectional study

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Abstract
Background: Dental caries remains one of the most prevalent chronic diseases among children and poses a significant public health challenge, particularly during the mixed dentition period. The first permanent molars are highly susceptible to caries because of their early eruption and complex occlusal morphology. Assessment of caries experience using the dmft and DMFT indices, along with associated demographic, behavioural, and parental factors, is essential for planning preventive oral health strategies.
Objective: To assess the dental caries experience in the primary dentition (dmft) and first permanent molars (DMFT) and evaluate their association with demographic characteristics, oral hygiene practices, parental education, and occupation among 6–8-year-old school children in Maharashtra.
Materials and Methods: A descriptive cross-sectional study was conducted among 350 school children aged 6–8 years from selected public and private schools in Pune and Solapur, Maharashtra. Clinical examinations were performed using a mouth mirror and CPI probe under natural light. Dental caries was recorded using the WHO-modified dmft index for primary teeth and DMFT index for first permanent molars. Demographic information, oral hygiene practices, parental education and occupation, and gingival characteristics were recorded using a structured questionnaire. Data were analyzed using IBM SPSS Statistics version 25.0. Independent t-test, one-way ANOVA, and Spearman's rank correlation were applied, with statistical significance set at $p < 0.05$.
Results: Among 350 children (mean age 7.07 ± 0.74 years), father's education and mother's occupation were significantly associated with dmft, while flossing practice was significantly associated with DMFT. Father's education showed a weak inverse correlation with DMFT ($\rho = -0.117$, $p = 0.029$), whereas brushing frequency showed no significant association with caries experience.
Conclusion: Dental caries was common in both primary teeth and first permanent molars among 6–8-year-old school children. Caries experience was associated with some parental and oral hygiene factors, highlighting the importance of early identification of risk factors and timely preventive dental care during the mixed dentition period.

Keywords: Dental caries, DMFT index, DMFT index, first permanent molar, mixed dentition, school children, oral hygiene, parental education, Maharashtra

Introduction

Oral health is an essential component of general health and contributes significantly to the physical, psychological, and social well-being of children [1]. Healthy primary teeth are important for mastication, speech, nutrition, facial aesthetics, and proper eruption of permanent teeth [2]. Dental caries remains one of the most prevalent chronic diseases affecting children worldwide and continues to be a major public health concern [3]. It is a multifactorial, biofilm-mediated disease characterized by progressive demineralization and destruction of tooth structure [4]. Despite advances in fluoride use and preventive dentistry, dental caries remains highly prevalent in developing countries, including India [5].

The mixed dentition period, which begins around six years of age, is an important stage of dental development during which primary teeth exfoliate and permanent teeth erupt [6]. The first permanent molars are particularly susceptible to dental caries because of their early eruption, immature enamel, complex occlusal morphology, and deep pits and fissures [7]. These teeth play an important role in establishing functional occlusion, maintaining arch length, and guiding the eruption of the remaining permanent dentition [8]. Their premature loss or extensive destruction may result in space loss, malocclusion, impaired mastication, and increased orthodontic treatment needs [9]. The dmft and DMFT indices are commonly used to assess dental caries experience in the primary and permanent dentitions, respectively [10].

Caries experience may also be influenced by demographic characteristics, oral hygiene practices, parental education and occupation, dietary habits, and gingival health [11]. Understanding these factors is essential for identifying children at increased risk and developing appropriate preventive and school-based oral health programmes [12]. Therefore, the present study aimed to assess the dmft of primary teeth and DMFT of first permanent molars among 6–8-year-old school children in Pune and Solapur, Maharashtra, and to evaluate their association with demographic characteristics, oral hygiene practices, parental education and occupation, and gingival characteristics.

Methodology

Study Design and Setting: The present study was a descriptive cross-sectional study conducted among 6–8-year-old school children studying in selected public and private schools of Pune and Solapur, Maharashtra.

Study Population& sampling technique: The study included school children aged 6–8 years who were in the mixed dentition stage. Schools were selected using convenience sampling, based on accessibility and willingness of the school authorities to participate in the study. children studying in the selected schools whose parents or guardians provided written informed consent and who were present on the day of examination were included in the study. Children with systemic diseases affecting oral health, developmental dental anomalies, those undergoing orthodontic treatment, or those who were absent or unwilling to participate were excluded.

The sample size was calculated using the formula

$n = Z^2pq/d^2$,

n = minimum required sample size

Z = standard normal deviate corresponding to the desired confidence level; for 95% confidence, Z = 1.96

P = expected prevalence of dental caries; 65% = 0.65

Q = complement of prevalence, calculated as 1 – p; therefore, q = 1 – 0.65 = 0.35

D = allowable (absolute) error/margin of error; 5% = 0.05

considering a 95% confidence interval, an expected prevalence of dental caries of 65%, and an allowable error of 5%. The calculated minimum sample size was approximately 350. Accordingly, a total of 350 school children were included in the study.

Study Procedure: After obtaining permission from the school authorities and written informed consent from parents or guardians, the children were examined within the school premises under adequate natural light. A structured recording proforma was used to record demographic details, oral hygiene practices, parental education and occupation, and gingival characteristics. Clinical examination was performed using a mouth mirror and CPI probe while following standard infection control measures. Dental caries in the primary dentition was assessed using the dmft index, while the caries status of the first permanent molars was assessed using the DMFT index [13]. Gingival characteristics, including colour, size, contour, consistency, texture, and position, were also recorded during the examination [14].

Statistical Analysis: The collected data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 25.0. Descriptive statistics were expressed as frequency, percentage, mean, and standard deviation. One-way analysis of variance (ANOVA) was used to compare mean dmft and DMFT scores across variables with more than two categories, while the independent samples t-test was used for comparisons between two groups. Multiple linear regression analysis was performed to identify independent predictors of dmft and DMFT after adjusting for potential confounding variables. Statistical significance was set at $p < 0.05$.

Results

A total of 350 school children with mixed dentition participated in the study. Of these, 164 (46.9%) were boys and 186 (53.1%) were girls. The participants were almost equally distributed between Private schools (176, 50.3%) and public schools (174, 49.7%). Most of the children belonged to Pune (57.1%), while 42.9% were from Solapur areas. Grade-wise, 84 (24.0%) children were in the 1st grade, 158 (45.1%) were in the 2nd grade, and 108 (30.9%) were in the 3rd grade. The mean age of the participants was 7.07 ± 0.74 years.

Table 1: Demographic Characteristics of the Study Population

Variable	Category	n (%) / n
Age	6 years	103(29.4)
	7 years	113(32.2)
	8 years	134(38.2)
Gender	Male	164 (46.9)
	Female	186 (53.1)
Grade	1st	84 (24.0)
	2nd	158 (45.1)
	3rd	108 (30.9)
Area	Pune	200 (57.1)
	Solapur	150 (42.9)
School type	Private	176 (50.3)
	Public	174 (49.7)

Data are presented as frequency and percentage.

Table 2: Distribution of Oral Hygiene Practices and Corresponding dmft and DMFT Scores

Variable	Category	n	dmft (Mean ± SD)	DMFT (Mean ± SD)
Brushing frequency	Irregular	36	4.63 ± 2.30	2.77 ± 1.12
	Once daily	163	4.03± 2.25	2.79 ± 1.62
	Twice daily	150	4.37 ± 1.98	2.84 ± 1.51
		One way, Anova F test	F =1.642	F = 0.048
		P value	P=0.195	P=0.953
Variable	Category	n	dmft (Mean ± SD)	DMFT (Mean ± SD)
Flossing	Yes	54	3.90 ± 2.05	3.96 ± 1.47
	No	295	4.30 ± 2.16	2.6 ± 1.44
		Unpaired t test	t = -1.251	t = 6.337
		P value	p = 0.212	p <0.001**

Data are presented as frequency (n) and mean ± standard deviation (SD).

Brushing frequency showed no statistically significant association with either dmft ($F = 1.642$, $p = 0.195$) or DMFT ($F = 0.048$, $p = 0.953$), indicating that self-reported brushing frequency alone did not differentiate caries experience in either the primary or permanent dentition in this sample.

Flossing showed no significant association with dmft ($t = -1.251$, $p = 0.212$). However, flossing was significantly

associated with DMFT ($t = 6.337$, $p < 0.001$): children who flossed had a higher mean DMFT (3.96 ± 1.47) than those who did not (2.60 ± 1.44). This direction is counter to the usual clinical expectation that flossing reduces caries experience, and most plausibly reflects reverse causation or an age/eruption-stage confound (children with more erupted permanent teeth, and therefore more DMFT opportunity, may also be more likely to have been taught to floss) rather than flossing itself increasing caries risk. This point is worth flagging explicitly in the discussion section rather than left to interpret.

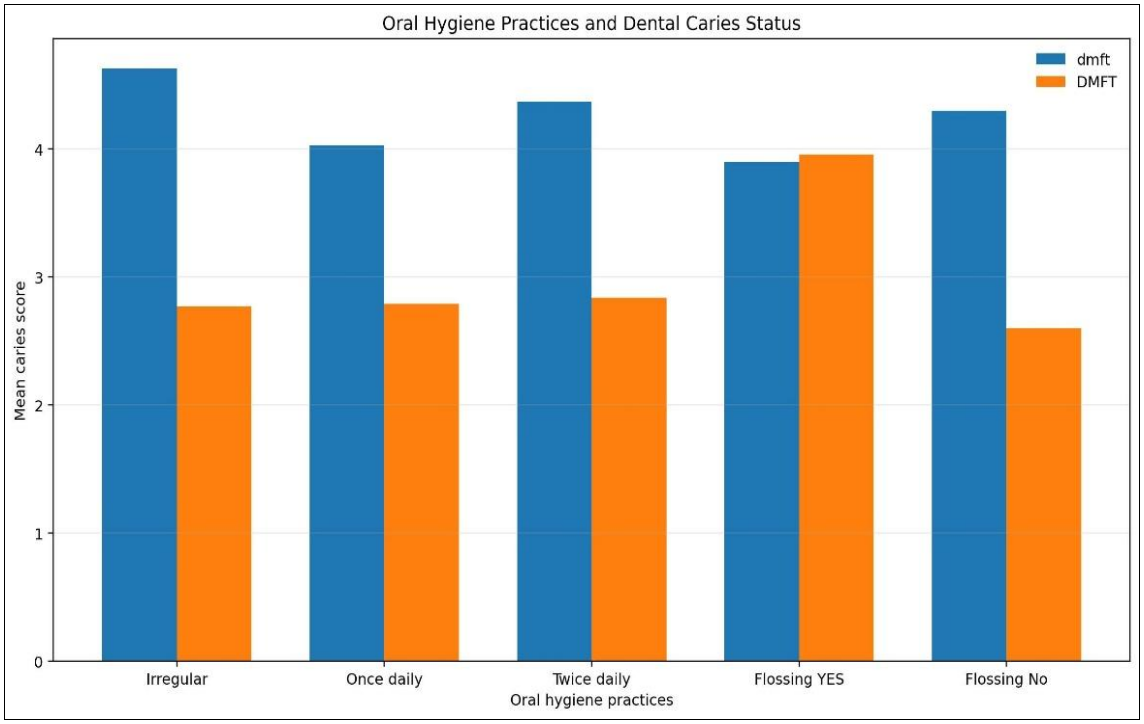

Fig 1: Oral Hygiene Practices and Dental Caries Status

Table 3: Association of Parental Educational and Occupational Characteristics with dmft and DMFT Scores

Variable	Category	dmft	DMFT
Father education	Illiterate	5.58 ±1.81	3.05 ±1.66
	Primary	4.63 ±2.17	3.12 ±1.47
	Secondary	3.85 ±2.06	2.50 ±1.22
	Graduate	3.65 ±2.03	2.76 ±1.57
	One way, Anova F test	F = 9.432	F = 3.757
	P value, Significance	P<0.001**	P=0.011*
Mother education	Illiterate	3.71 ±2.25	2.71 ±1.27
	Primary	4.5 ±1.89	2.86 ±1.49
	Secondary	4.10 ±2.28	2.79 ±1.59
	Graduate	4.58 ±2.32	2.82 ±1.88
	One way Anova F test	F = 2.261	F = 0.125
	P value, Significance	P=0.081	P=0.946
Father occupation	Business	4.56 ±1.84	3.18 ±1.5
	Service	4.08 ±2.17	2.64 ±1.43
	Labor	4.17 ±2.35	2.67 ±1.45
	Farmer	4.32 ±1.91	3.00 ±1.76
	One way Anova F test	F = 0.633	F = 2.149
	P value, Significance	P=0.594	P=0.094
Mother occupation	Housewife	4.62 ±2.12	2.97 ±1.47
	Working	3.82 ±1.82	2.59 ±1.65
	Unpaired t test	t = 0.422	t = -1.659
	P value	p = 0.674	p =0.098

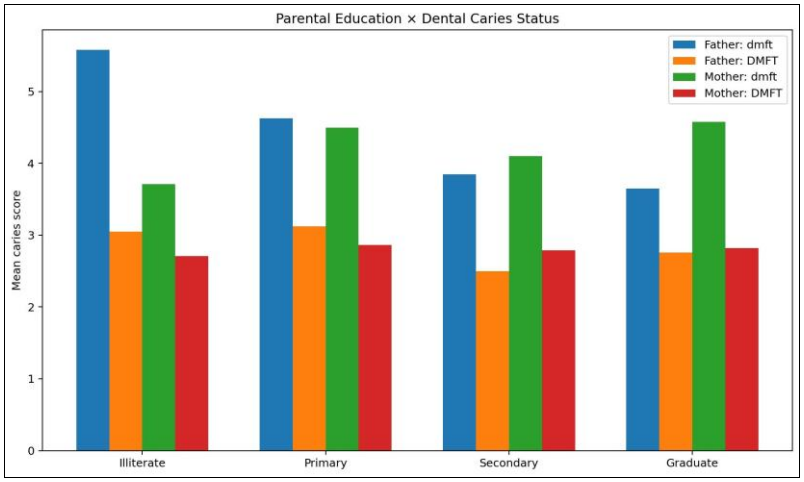

Fig 2: Association of Parental Educational Attainment with Dental Caries Experience

Father's education showed a clear, statistically significant inverse gradient with dmft ($F = 9.432$, $p < 0.001$) and DMFT ($F = 3.757$, $p = 0.011$): children of illiterate fathers had the highest mean caries scores (dmft 5.58 ± 1.81), declining stepwise through primary, secondary, and graduate education levels (dmft 3.65 ± 2.03 for graduate). This is consistent with the well-established literature link between paternal education/socioeconomic status and children's oral health.

Mother's education, father's occupation, and mother's occupation showed no statistically significant association with either dmft or DMFT (all $p > 0.05$) in this sample, once corrected. This suggests that, in this cohort, father's education level — rather than mother's education or either parent's occupation — is the parental characteristic most strongly linked to children's caries experience.

Table 4: Correlation of Caries Experience in First Permanent Molars with dmft, Oral Hygiene Status, and Parental Education

Variable	Spearman's ρ	p-value	Strength of Correlation
dmft	-0.063	0.242	Very low negative correlation
Oral hygiene (OHI-S)	0.016	0.767	Very low positive correlation
Father's education	-0.117	0.029*	Very low negative correlation
Mother's education	0.010	0.856	Very low positive correlation

Spearman's rank correlation coefficient (ρ) was used. Correlation strength was interpreted as very low (0–0.19), low (0.20–0.39), moderate (0.40–0.59), high (0.60–0.79), and very high (0.80–1.00). A p-value < 0.05 was considered statistically significant.

Spearman's rank correlation analysis showed a very low negative correlation between dmft and DMFT6 ($\rho = -0.063$, $p = 0.242$); however, this association was not statistically significant. Father's education demonstrated a very low negative correlation with DMFT6 ($\rho = -0.117$, $p = 0.029$), indicating that children whose fathers had higher educational attainment tended to have slightly lower caries experience in the first permanent molars. Although statistically significant, the magnitude of this association was very weak. Oral hygiene (OHI-S) ($\rho = 0.016$, $p = 0.767$) and mother's education ($\rho = 0.010$, $p = 0.856$) showed very low positive correlations with DMFT6, and neither association was statistically significant. Overall, only father's education showed a statistically significant, albeit very weak, inverse relationship with DMFT.

Table 5A: Multiple linear regression analysis for factors associated with dmft

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.478	1.481		2.348	.019
	Age (years)	.254	.156	.087	1.622	.106
	Gender (Male vs Female)	-.008	.227	-.002	-.036	.971
	Area of residence	-.319	.224	-.074	-1.421	.156
	Father's education (Illiterate–Graduate)	-.610	.131	-.252	-4.644	.000
	Mother's education (Illiterate–Graduate)	.106	.131	.043	.806	.421
	Father's occupation	-.055	.118	-.025	-.467	.641
	Mother's occupation (Housewife vs Working)	-.056	.225	-.013	-.249	.803
	Brushing frequency	.197	.177	.061	1.115	.266
	Flossing (Yes vs No)	.392	.311	.066	1.262	.208

Interpretation: Multiple linear regression analysis showed that father's education was the only statistically significant predictor of dmft in the adjusted model ($B = -0.610$, $\beta = -0.252$, $t = -4.644$, $p < 0.001$). The negative coefficient indicates that higher levels of father's education were associated with lower dmft scores, after adjustment for age, gender, area of residence, mother's education, parental occupation, brushing frequency, and flossing. Age ($p = 0.106$), gender ($p = 0.971$), area of residence ($p = 0.156$), mother's education ($p = 0.421$), father's occupation ($p = 0.641$), mother's occupation ($p = 0.803$), brushing frequency ($p = 0.266$), and flossing ($p = 0.208$) were not statistically significant independent predictors of dmft.

Table 5B: Multiple linear regression analysis for factors associated with DMFT

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.628	1.031		6.431	.000
	Age (years)	-.135	.109	-.065	-1.243	.215
	Gender (Male vs Female)	.017	.158	.005	.106	.916
	Area of residence	.042	.156	.014	.268	.789
	Father's education (Illiterate–Graduate)	-.236	.091	-.137	-2.579	.010
	Mother's education (Illiterate–Graduate)	-.037	.091	-.021	-.404	.687
	Father's occupation	-.004	.082	-.003	-.050	.960
	Mother's occupation (Housewife vs Working)	.313	.157	.102	1.994	.047
	Brushing frequency	-.109	.123	-.047	-.883	.378
	Flossing (Yes vs No)	-1.357	.216	-.321	-6.275	.000

Interpretation: Multiple linear regression analysis identified three statistically significant factors associated with DMFT in the adjusted model. Father's education was negatively associated with DMFT (B = −0.236, β = −0.137, t = −2.579, p = 0.010), indicating lower DMFT scores with increasing father's education. Mother's working occupation was positively associated with DMFT (B = 0.313, β = 0.102, t = 1.994, p = 0.047), while flossing was significantly negatively associated with DMFT (B = −1.357, β = −0.321, t = −6.275, p < 0.001). Age (p = 0.215), gender (p = 0.916), area of residence (p = 0.789), mother's education (p = 0.687), father's occupation (p = 0.960), and brushing frequency (p = 0.378) were not statistically significant independent predictors of DMFT.

Discussion

The present cross-sectional study was conducted to evaluate the dmft index of the primary dentition and the DMFT index of the first permanent molars among 6–8-year-old school children in selected schools of Pune and Solapur, Maharashtra. The study also assessed the association of these indices with demographic characteristics, oral hygiene practices, parental education and occupation, and gingival characteristics.

A total of 350 school children participated in the present study, comprising 46.9% boys and 53.1% girls, with a mean age of 7.07 ± 0.74 years. This age group represents the early mixed dentition stage, during which both primary teeth and newly erupted permanent molars coexist, making it an appropriate period for simultaneous assessment of dmft and DMFT. Similar age groups have been evaluated in previous epidemiological studies, which emphasized that assessment during this period provides baseline information regarding caries experience and assists in planning preventive oral health programmes [6, 7].

Children studying in public schools demonstrated slightly higher mean dmft (4.43 ± 2.09) and DMFT (2.84 ± 1.52) scores than children studying in private schools (dmft: 4.05 ± 2.20; DMFT: 2.77 ± 1.55), although these differences were not statistically significant. Comparable findings were reported by Sofola *et al*., who observed no significant difference in dental caries experience between children attending public and private schools after adjusting for socioeconomic factors [10]. However, Priyanka *et al*. reported significantly higher caries prevalence among government school children, which they attributed to lower socioeconomic status, reduced parental awareness, and limited utilization of preventive dental services [11]. Similarly, Kamiab *et al*. found significantly higher dmft scores among public school children, while no significant difference was observed in the DMFT index of the first permanent molars [6].

When compared according to grade, children in the third grade demonstrated the highest mean dmft score (4.48 ± 2.03), whereas the highest mean DMFT score (3.06 ± 1.48) was observed among second-grade children. Nevertheless, these differences were not statistically significant. Similar observations were reported by Emamian *et al*., who found only minimal variation in caries experience among children within a narrow age range because the permanent teeth had erupted only recently [13].

Oral hygiene practices play a fundamental role in the prevention of dental caries. In the present study, children who brushed irregularly demonstrated the highest mean dmft score (4.63 ± 2.30), followed by those brushing twice daily (4.37 ± 1.98) and once daily (4.03 ± 2.25). However, the association between brushing frequency and dmft was not statistically significant (F = 1.642, p = 0.195). Similarly, brushing frequency showed no significant association with DMFT (F = 0.048, p = 0.953), with mean DMFT scores of 2.77 ± 1.12, 2.79 ± 1.62, and 2.84 ± 1.51 among children who brushed irregularly, once daily, and twice daily, respectively. These findings differ from those reported by Pine *et al*., who observed significantly lower caries prevalence among children who brushed their teeth at least twice daily with fluoridated toothpaste [16]. Similarly, Ramezani *et al*. reported that increasing tooth-brushing frequency was associated with a significant reduction in both dmft and DMFT scores among school children [17]. Abdelhamid *et al*. also demonstrated that children who maintained regular tooth-brushing habits had significantly better oral health compared with those who brushed infrequently [18]. In contrast, the absence of a significant association in the present study may be explained by differences in brushing technique, duration of brushing, parental supervision, dietary habits, and fluoride exposure rather than brushing frequency alone. Since children aged 6–7 years are still dependent on their parents for oral hygiene maintenance, the quality of brushing may have a greater influence than the reported frequency.

A noteworthy finding of the present study was the significant association between flossing and DMFT scores. Children who reported using dental floss had a significantly higher mean DMFT score (3.96 ± 1.47) than those who did not floss (2.60 ± 1.44), whereas no significant association was observed with dmft scores. This finding appears contradictory to the expected preventive effect of flossing. However, a possible explanation is that children with previous dental caries or those undergoing regular dental treatment were more likely to receive professional advice regarding flossing after disease had already developed. Featherstone emphasized that preventive oral hygiene practices are frequently adopted after children experience

dental disease rather than before its occurrence [19]. Likewise, Marinho *et al*. reported that preventive measures such as flossing and fluoride use often reflect previous dental awareness rather than the original risk of developing caries [20]. Conversely, Kamiab *et al*. found significantly lower dmft and DMFT scores among children who regularly used dental floss, suggesting that consistent plaque control contributes to better oral health [6]. The difference between the present study and previous reports may be attributed to the relatively small proportion of children reporting floss use and the cross-sectional design of the study, which does not establish a temporal relationship between oral hygiene practices and disease occurrence.

Parental education is considered an important determinant of childhood oral health because educated parents are generally more aware of preventive dental practices, healthy dietary habits, and the importance of regular dental visits. In the present study, father's educational status showed a statistically significant association with dmft scores ($p < 0.001$). Children whose fathers were illiterate had the highest mean dmft score (5.58 ± 1.81), whereas those whose fathers were graduates had the lowest mean score (3.65 ± 2.03). Father's education was also significantly associated with DMFT scores ($p = 0.011$). Similar findings were reported by Hooley *et al.*, whose systematic review concluded that lower parental educational status significantly increases the risk of dental caries in children [15]. Pine *et al*. also demonstrated that higher parental education was associated with improved oral hygiene behaviour and reduced caries prevalence among school children [14]. Comparable findings were observed by Kamiab *et al*., who reported a significant decline in both dmft and DMFT scores with increasing parental educational level [6]. These findings emphasize that parental education influences children's oral health through improved awareness, healthier dietary practices, timely dental visits, and better supervision of oral hygiene.

The present study showed that father's education was the parental factor most consistently related to dental caries among 6–8-year-old children. Father's education had a very weak but significant negative correlation with DMFT (l $p = 0.029$), meaning that children whose fathers had higher education tended to have slightly lower DMFT scores. This finding is similar to a systematic review by Hooley *et al*., which reported that parental factors, including education, can influence the risk of dental caries in children, although the findings were not the same in all studies [17]. In the present study, mother's education and both parents' occupations were not significantly related to dmft or DMFT. Also, dmft was not significantly correlated with DMFT ($p = 0.242$), suggesting that caries in primary and first permanent teeth may be affected by different factors during mixed dentition.

In the multivariable analysis, father's education remained the only significant independent predictor of dmft ($p < 0.001$) and was also significantly associated with lower DMFT ($p = 0.010$). This suggests that father's education had a modest but consistent relationship with caries experience in this sample. Mother's working occupation showed a small positive association with DMFT ($p = 0.047$), Flossing was significantly associated with dmft ($p < 0.001$),

The present study has some limitations. Since it was a cross-sectional study, a cause-and-effect relationship between the factors studied and dental caries could not be established. The study was conducted in selected schools in Pune and Solapur using convenience sampling, which may limit the generalizability of the findings to other populations. Information regarding oral hygiene practices and parental characteristics was collected through questionnaires and may therefore be affected by recall or reporting bias. Factors such as dietary habits, fluoride exposure, dental visiting habits, socioeconomic status, and other behavioural factors were also not comprehensively assessed. The eruption status of individual first permanent molars was not considered separately, which may have influenced DMFT scores. Based on the findings, regular school-based dental screening and preventive programmes should be encouraged during the mixed dentition period, along with parental oral health education to improve children's oral health practices. Future studies with larger and more representative samples, preferably using longitudinal designs, should also consider dietary, socioeconomic, fluoride-related, eruption-stage, and other behavioural factors to better understand the factors influencing dental caries in children.

Despite these limitations, the study provides useful information regarding caries experience in the primary dentition and first permanent molars among children in the early mixed dentition period. Identification of familial and behavioural factors associated with caries at this stage may facilitate early preventive interventions and contribute to improved oral health outcomes among school-going children in Maharashtra.

Conclusion

Within the limitations of the present study, dental caries experience in both the primary dentition (dmft) and the first permanent molars (DMFT) was found to be considerable among 6–8-year-old school children. Father's educational status and mother's occupation showed significant associations with dmft, while father's education demonstrated a weak but significant inverse correlation with DMFT of the first permanent molars. Oral hygiene practices, particularly brushing frequency, were not significantly associated with caries experience, whereas flossing showed a significant association with DMFT. These findings highlight the influence of parental and behavioural factors on children's oral health and emphasize the need for early school-based preventive programmes, including oral health education, regular dental screening, fluoride use, dietary counselling, and timely preventive treatment, to reduce the occurrence of dental caries during the mixed dentition period.

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