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Association of maternal risk factors with early childhood caries in schoolchildren of Moradabad, India

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Background. Children who have caries in their primary teeth in infancy or toddlerhood tend to develop dental caries in their permanent dentition. Although risk indicators are helpful in identifying groups at risk, they give little information about the causes of difference in caries experience.

Aim. To identify the association between maternal risk factors and early childhood caries among 3- to 5-year-old schoolchildren of Moradabad City, Uttar Pradesh, India.

Design. A total of 150 child–mother pairs participated in the study. The maternal risk factors were assessed by a pretested questionnaire. After obtaining the consent, the mothers and their children were clinically examined for dental caries using Radike criteria (1968). Saliva was collected from all the participating mothers for assessing the *Streptococcus mutans* level.

Results. Significant differences were found in mothers' caries activity, high level of *S. mutans*, educational level, socioeconomic status, frequency of maternal sugar consumption, and their child's caries experience ($P < 0.001$).

Conclusions. Differences between children's situations in these underlying factors play out as consequential disparities in both their health and the health care they receive.

Introduction

Motherhood is the most desired phase of every woman. It is a bond that commences with the umbilical cord and embalms in the years that follow. Oral health of the mother can affect the general and dental health of the child during the perinatal life. A mouth infection can lead to general health problems like premature birth and low birthweight putting the unborn baby at serious risk of life and also certain oral diseases like *'early childhood caries'* (*ECC*)[1]. Currently, ECC is defined as 'the presence of 1 or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child 71 months of age or younger'[2].

Cariogenic or decay-causing bacteria are typically transmitted from mother or caregiver to child by behaviours that directly pass saliva, such as sharing a spoon when tasting baby food, cleaning a dropped pacifier by mouth, or wiping the baby's mouth with saliva[3,4]. The mother is the most common donor as noted in DNA fingerprinting studies that show genotype matches between mothers and infants in over 70% of cases[5]. Therefore, mothers who themselves have experienced extensive past or current caries have a particularly strong need for counselling on how to prevent childhood caries. Furthermore, adoption of consistent behavioural habits in childhood takes place at home, with the parents, especially the mother, being the primary sculpts for behaviour.

According to ecological plaque hypothesis, caries is a result of changes in the environment

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because of acid production from the fermentation of dietary carbohydrates, which selects for acidogenic and acid-tolerating species such as *Streptococcus mutans* and Lactobacillus. Disease could be prevented not only by targeting the putative pathogens directly but also by interfering with the key environmental factors driving the deleterious ecological shifts in the composition of the plaque biofilms[6].

Childhood caries is a public health problem that affects infants and preschoolers throughout the world, leading to pain, chewing difficulties, speech problems, general health disorders, psychological problems, and lower quality of life[7]. Further decay of primary teeth can affect children's growth, leading to malocclusion by adversely affecting the correct guidance of the permanent dentition.

The prevalence of caries experience was found to be high in Uttar Pradesh state in all the age groups. According to national oral health survey, the caries prevalence in 5-year-old children was found to be 42.3% with a mean dmft of 1.4[8]. Moradabad in Uttar Pradesh, India, is a home to a population of various ethnicities, socioeconomic status, and religion. Although adequate data are available for recognition that dental caries is a social problem in disadvantaged communities, childhood caries requires the implementation of educational and preventive programmes, especially where the disease is highly prevalent[9].

There is, however, still insufficient scientific evidence, on which the public health interventions to prevent childhood caries could be based. There are several unexplained interactions among unknown confounders and traditional risk factors, such as the maternal level of education, family income, oral hygiene practices, and frequency of sugar consumption that can contribute to the causation of ECC[10]. The literature has emphasized the need for cross-sectional studies starting from the earliest possible age to provide information regarding how to promote infant oral health[11]. Hence, this study was undertaken with the objective to associate the maternal risk factors with ECC among 3–5-year-old schoolchildren of Moradabad city.

Material and methods

Study area and design

A cross-sectional study was conducted in Moradabad having eight administrative blocks division. The list of primary schools of Moradabad was obtained from the Basic Shiksha Adhikari of the city. One school from each block was selected randomly by Tippet's random number table (total eight schools) to obtain a purposive sample of 150 children. All children aged between 3 and 5 years attending the selected schools, accompanied by their mothers on the parent–teacher meeting day, were invited to participate. Children whose parents gave consent for the same were included in the survey. Given that children have all their primary teeth by the age of 3 years and as the focus of this study is on ECC, only children aged between 3 and 5 years were considered.

Ethical clearance and consent

The study was reviewed and approved by the Ethical Committee of Kothiwal Dental College and Research Center, Moradabad. Written permission to conduct the survey in selected schools was obtained from the local administration authorities and respective school authorities. Informed consent was obtained from the mothers before clinical examination of their children.

Data collection

A pretested questionnaire designed in local language was used for collecting all the required and relevant information regarding personal data, socioeconomic profile, oral hygiene practices, frequency of dental visits, sugar consumption, family income, and educational level of mothers. Children of those parents who gave the informed consent and duly filled questionnaire were clinically examined for dental caries using Radike criteria (1968)[12], which was modified so that no lesions were recorded unless there was frank open cavitation accessible to the explorer. For appropriate analysis, similar identification

number was used for the questionnaire and the forms in which the saliva samples collected from the mother and the respective child was recorded. The examiner was trained and calibrated to limit the examiner variability (Kappa score = 0.8).

Saliva collection and microbiological analysis

Semi-quantitative microbiological analysis was carried out using the sterile saliva swab collected from the dorsum of tongue. On every subject, the dorsum of tongue was swabbed on fixed four sites without the stimulation of salivary secretion, and the saliva specimen was dispersed in 1 mL of sterile distilled water. This saliva sample was then added to 2 mL of thioglycolate transport medium and refrigerated at 4°C till it was transported to laboratory within an hour. Using a cyclomixer, all the samples were vortexed to ensure uniform mix. A 5 μL was inoculated on Mitis Salivarius Bacitracin (MSB; HI Media Labs Pvt. Ltd, Mumbai, India) agar, selective medium for *S. mutans* and incubated at 37°C for 48 h. The colonies grown on the MSB agar were counted using a digital colony counter.

Average duration of acid production (in minutes)

The average duration of acid production (in minutes) was calculated by multiplying the frequency of sugar consumption in any form (solid/liquid) in a day by a factor of 20. The factor 20 represents approximately the number of minutes that the plaque pH remains at a tooth demineralization potential when concentrated sweets in liquid form come into contact with dental plaque.

Clinical examination

The clinical examination was carried out by a single trained and calibrated investigator, facilitated by the primary teachers, whereas a trained assistant recorded the observations. Caries experience of children and mothers was assessed under field conditions using natural light. The child was seated on a chair facing away from the examiner and reclining to rest her or his head on a cushion placed on the examiner's lap, whereas the mothers were asked to sit comfortably on the chair and recline their head such that the oral cavity is clearly visible to the examiner. Type III clinical examination was carried out for dental caries using plain mouth mirror and explorer. Each mother whose child was found to have at least one frank active or restored carious lesion was enrolled in the case group (75 subjects). For each participating mother in the case group, the mother of the next caries-free child screened was offered a place in the control group (75 subjects). The dmft/DMFT score for each child/mother was calculated, and teeth lost as a result of trauma or exfoliation was excluded from the calculation. Strict sterilization protocol was maintained throughout the examination.

Statistical methods

The Statistical Package for Social Sciences Version 15.0 software (SPSS Inc., Chicago, IL, USA) was used for data analysis. Differences in group means were tested using Student's *t*-test, and differences in proportions were evaluated using chi-square test. Multivariate analyses were performed using logistic regression analysis to assess maternal characteristics as potential covariates. *P*-value ≤0.05 was considered as statistically significant.

Results

Correlation between caries experience of children and their mothers

A total of 150 children (75 cases and 75 controls) participated in the study, among which 27 (36%) girls and 48 (64%) boys were in case group and 37 (49.3%) girls and 38 (50.7%) boys belonged to control group. There was no significant difference between children with caries and children without caries ($P = 0.099$) with respect to gender as shown in Table 1. The children and their mothers were distributed according to the number of carious teeth. Among the cases, mean number of carious teeth in mothers was 3.53 and in children, the mean was 4.51, whereas among controls, the mean number

Table 1. Distribution of children according to gender.

	Cases (*n* = 75)		Control (*n* = 75)	
Gender	**No.**	**%**	**No.**	**%**
Girls	27	36	37	49.3
Boys	48	64	38	50.7

of carious teeth in mothers was 1.45 and in children, the mean was zero. Difference between mean number of carious teeth of mothers in case group (3.53 ± 1.81) and mean number of carious teeth of mothers in control group (1.45 ± 1.85) was statistically significant ($P < 0.001$). A moderate positive correlation ($r = 0.554$; $P < 0.001$) between number of caries affected teeth of mothers and number of caries exposed teeth of children was also seen (Table 2).

Bivariate analysis showed a significant positive correlation ($r = 0.548$; $P < 0.001$) between mother's DMFT and child's dmft indicating that those mothers who had higher DMFT had children with higher dmft (Table 3, Fig. 1).

Correlation of caries experience between mothers and their children according to demographic variables

Table 4 summarizes the distribution of study subjects in relation to the demographic variables. The mothers of children with ECC showed higher percentage of either low level of education or illiteracy. Thirty (40%) and 41 (54.7%) belonged to the upper class, and 7 (9.3%) and 1 (1.3%) belonged to lower class group among ECC and caries-free children (CFC), respectively; the difference was statistically significant ($P = 0.038$). Chi-square test revealed 62 (82.7%) mothers of the cases and 5 (6.7%) mothers in the control group had >50 number of *S. mutans* colony count.

Table 2. Distribution of study subjects according to mean number of carious teeth.

	Cases (*n* = 75)	Controls (*n* = 75)	Total (*n* = 150)		
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	***t***	***P***
Mothers	3.53 ± 1.81	1.45 ± 1.85	2.49 ± 2.10	6.963	<0.001
Children	4.51 ± 2.55	0 ± 0	2.25 ± 2.888	15.31	<0.001

$r = 0.554$; $P < 0.001$.

Table 3. Correlation between DMFT of mothers and dmft of children (irrespective of caries status) (*n* = 150).

Parameter	Mothers of cases (mean ± SD)
DMFT of mothers	4.59 ± 3.77
dmft of children	3.01 ± 3.95

$r = 0.548$; $P < 0.001$.

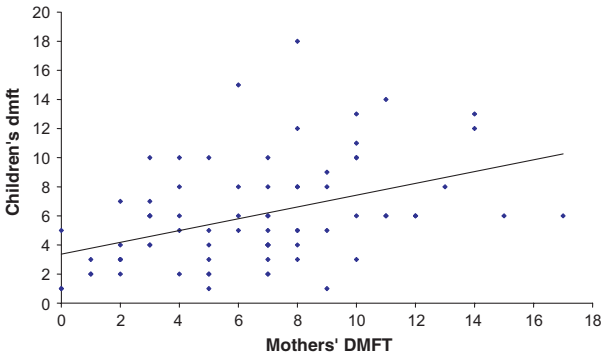

Fig. 1. Correlation between DMFT of mothers and dmft of children (irrespective of caries status).

Table 4. Distribution of study subjects according to demographic variables.

Demographic variables	Mothers' of cases *n* (%)	Mothers' of controls *n* (%)	χ^2 value *P*-value
Mothers' education			
Illiterate	1 (1.3)	0 (0.0)	$\chi^2 = 6.648$
Up to intermediate	42 (56.0)	28 (37.3)	$P = 0.036$
University graduate/PG	32 (42.7)	47 (62.7)	
Socioeconomic status			
Lower class	7 (9.3)	1 (1.3)	$\chi^2 = 6.533$
Upper lower class	6 (8.0)	3 (4.0)	$P = 0.038$
Lower middle class	22 (29.3)	11 (14.6)	
Upper middle class	10 (13.3)	19 (25.3)	
Upper class	30 (40.0)	41 (54.7)	
No. of mutans colony in mother's saliva			
<50 cfu	13 (17.3)	70 (93.3)	$\chi^2 = 87.637$
More than 50 cfu	62 (82.7)	5 (6.7)	$P < 0.001$
Frequency of mothers' toothbrushing			
Once	72 (96.0)	66 (88.0)	$\chi^2 = 6.533$
Twice	3 (4.0)	9 (12.0)	$P = 0.038$
Use of dentifrice			
Toothpaste	9 (12.0)	6 (8.0)	$\chi^2 = 0.667$
Toothpowder	66 (88.0)	69 (92.0)	$P = 0.414$
Frequency of mother's dental visits			
Once/year	2 (2.7)	8 (10.7)	$\chi^2 = 0.667$
Whenever needed	27 (36.0)	21 (28.0)	$P = 0.414$
Never	46 (61.3)	46 (61.3)	

The difference between the two groups was statistically significant ($P < 0.001$). In this small purposive sample, no statistically significant relationship was found between childhood caries and oral hygiene practices.

Correlation of caries experience between children and the sugar consumption of their mothers

Based on reported sugar consumption, the mothers were dichotomized according to the average duration of acid production (in minutes) per day into low sugar use (duration <40 min) and high sugar use groups (duration >40 mins). In the ECC, the mean number of mothers who consumed snacks in between meals or with meals had the mean duration of acid production value (in minutes) of 66.13 ± 22.28, whereas that of mothers of CFC was 20.45 ± 15.03, which was statistically significant ($P < 0.001$). The mothers of children in case group had significantly higher mean DMFT 6.52 ± 2.38 as compared to those in controls 2.65 ± 3.29 ($P < 0.001$) as shown in Table 5.

Table 5. Distribution of mothers according to frequency of sugar consumption [average duration of acid production (in minutes) per day] and caries experience.

	Mothers of children with caries	Mothers of children without caries	*t*-value *P*-value
Average duration of acid production/day	66.13 ± 22.28	20.45 ± 15.03	$t = 14.719$ $P < 0.001$
Caries experience	6.52 ± 2.38	2.65 ± 3.29	$t = 6.691$ $P < 0.001$

Table 6. Multivariate logistic regression to predict the possibility of caries among children.

Parameters	*B*	SE	Wald	*P*-value
No. of mutans colonies >50	3.040	0.859	12.538	0.000
Mother's DMFT >4	0.170	0.671	0.064	0.801
Mother's caries >2	0.282	0.656	0.184	0.668
Mother's education up to intermediate	−0.050	0.723	0.005	0.945
Not upper income group	0.743	0.739	1.011	0.315
Average duration of acid production (>40 min)	1.604	0.679	5.586	0.018
Constant	−2.536	0.668	14.395	0.000

Logistic regression was used to measure the association between childhood caries and the various potential maternal risk indicators, while simultaneously controlling for each of the other potential covariates. Using this method, the only variables to attain or approach statistical significance were the mother's *S. mutans* level (≥50 *vs* <50 cfu) and sugar consumption (average duration of acid production) (Table 6).

Discussion

An analysis of caries experience in recent years, especially in developing countries, demonstrates that a significant proportion of infants and preschoolers are still affected by the disease with a strong polarization[11]. Some studies showed that about 10–17% of children concentrate 50% of carious lesions and 25–30% bears 75% of the lesions[13].

Untreated decayed teeth dominated the dmft score (3.01 ± 3.95) among the children in this study indicates a high rate of unmet treatment needs. It corroborates Uttar Pradesh National Oral Health Survey Reports, which describe high caries prevalence rates in the primary dentition of under 5-year-old children[9]. A similar trend of caries was reported in Dharwad in 1999[14], Ahmedabad in 2006[15], in eastern states of India like urban areas of Sikkim[16].

The prevalence of caries among boys and girls in this study did not show any statistically significant difference. This may be because at this early age, dietary and oral hygiene practices related to dental caries are mostly controlled by parents/caregivers. Cariogenic bacteria are typically acquired by young children through direct salivary transmission from their mothers[3]. Factors influencing transmission are the levels of these bacteria in maternal salivary reservoirs, frequency and efficiency of transmission, the child's receptivity to implantation, timing of transmission, which is affected by the window of infectivity and the age of the child, and the composition and flow of the child's saliva.

Earlier, the transmission and more caries-supportive the diet, the earlier and more

substantial the transfer will be. For this reason, mothers who have experienced extensive tooth decay most likely harbour high titres of *S. mutans* in their saliva and will more effectively transmit this infection vertically, thereby putting their young children at elevated risk for ECC[17]. This study demonstrated significantly higher proportions of children whose mothers had high *S. mutans* colonies and had caries. The findings given by Zanata *et al.*[18], were similar to our study who reported a strong positive association between caries activity of mother–child couples.

The mother's education level and caries prevalence in this study were inversely proportional and similar with other studies carried out by Owusu *et al.*[19], Dini *et al.*[20], Sabbah *et al.*[21] This study also concurs with the findings given by Hallet and Rourke[22] who reported that children from low socioeconomic status are likely to have more ECC at preschool age. The difference between ECC experiences among children with regard to mother's educational level could be attributed to lack of knowledge and awareness of mothers regarding dental health, oral hygiene practices, and feeding habits. The recognition that maternal education is a strong determinant of childhood caries confirms that oral health cannot be achieved without educational policies in developing countries[23].

Promoting toothbrushing in preschool children is of great relevance because this is a way to favour dental health by maintaining clean teeth. Dental visits for preschool children in most countries have been noted to be strikingly low as reported by Carino *et al.*[24] It was similar to our study where a large proportion of the study population had never been to the dentist. Preventive measures were not reported in any of the subjects, and the proportion of children using toothpaste to clean their teeth was very low.

Even though the multifactorial aspect of the aetiology of ECC is now well established, the question of why its risk of occurrence is highest among some group is unanswered. When considering possible explanations, dietary habits and sweetened food intake frequency may be likely contributing factors. Mothers who consumed snacks in between meals or with meals had higher caries prevalence. A highly significant association between mother's frequency of sugar consumption and caries in children was seen. Similar findings were reported by King[25] showing that children acquire their dietary and oral hygiene habits from parents. It also seems that children are being trained to accept a sweetened diet early in childhood by mothers transmitting their own, well-established taste patterns to their children. Sugars are not only used as a food but are also given for other reasons such as taste, as a pacifier, and a means of showing love and affection. Measures should be taken to improve the public awareness and oral health–related practices of women of childbearing age and of their children to reduce the personal and maternal child health consequences of poor oral health.

While we chose to study the relationship between maternal risk factors and ECC, a multifactorial and comprehensive model that incorporates other psychological and behavioural aspects may be more intrusive in understanding of the aetiology of ECC. With this picture in mind, planners of dental service should develop new national strategies to support oral health education and caries prevention. Strategy should be that every child should receive dental care prior to the age of one so that needful children can be instituted with preventive measures and their parents can be targeted for educational programmes.

What this paper adds?

- Stresses on the importance of good parental (especially mothers) oral health and hygiene.
- Draws paediatricians attention to take the opportunity of educating the mothers of young children during antinatal check-ups and immunization.

Why this paper is important to paediatric dentists?

- Early childhood is an important period for instituting preventive programmes because primary teeth erupt, bacteria colonize tooth surfaces, and dental behaviour starts to develop during this time.
- For preventing dental caries both clinically and economically.
- India, a developing country with scarce resources that are available for dental care, emphasis should be put on prevention and simple treatment.

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