

Original Article

# THE ASSOCIATION BETWEEN MATERNAL ORAL BACTERIA WITH EARLY CHILDHOOD CARIES DEVELOPMENT IN THEIR CHILDREN

Shweta Singh<sup>1</sup>, Neerja Singh<sup>2</sup>, Sahana Shivakumar<sup>3</sup>

<sup>1</sup> Reader, Public Health Dentistry, Babu Banarasi Das College of Dental Sciences and Research Centre, Lucknow, Uttar Pradesh

<sup>2</sup> Professor, Pedodontics and Preventive Dentistry, Babu Banarasi Das College of Dental Sciences and Research Centre, Lucknow, Uttar Pradesh

<sup>3</sup> Professor and Head, Public Health Dentistry, Peoples College of Dental Sciences and Research Centre, Peoples University, Bhopal, Madhya Pradesh

## Abstract:


**Objective:** The objective of this prospective study was to investigate the association between development of early childhood caries (ECC) in their children over a two-year period.

**Methods:** A cohort of mothers and their children was recruited during the prenatal period. Maternal oral samples were collected to assess the presence and abundance of specific cariogenic bacteria, including *Streptococcus mutans* and *Lactobacillus* species, using polymerase chain reaction (PCR) techniques. The children were followed up at regular intervals from birth until two years of age. Oral examinations were conducted to assess the presence and severity of ECC. Statistical analyses was performed to determine the association between maternal oral bacteria and ECC development in their children.

**Results:** The study included 98 mother-child pairs, with an average follow-up period of 24 months. The results demonstrated a significant association between maternal oral bacteria and ECC development in their children. Maternal colonization of cariogenic bacteria, particularly *S. mutans*, was found to be a strong predictor of ECC development in their offspring, even after adjusting for confounding factors such as maternal oral hygiene, socioeconomic status, and child's diet. Higher levels of *S. mutans* in maternal oral samples were associated with an increased risk of ECC in children at two years of age.

**Conclusion:** This prospective study provides evidence for an association between maternal oral bacteria and the development of early childhood caries in their children over a two-year period. Maternal colonization of cariogenic bacteria, especially *Streptococcus mutans*, was found to be a significant risk factor for ECC development. Early interventions, including oral hygiene education and preventive strategies, should be implemented to promote maternal oral health and improve oral health outcomes in children..

**Key words-** Maternal oral bacteria, early childhood caries, prospective study, polymerase chain reaction, *Streptococcus mutans*, *Lactobacillus* species

 This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/).

DOI: <https://doi.org/10.58935/joas.v2i1.29>

Received date: 17/11/2023

Accepted date: 1/12/2023

Published date: 21/12/2023

## **INTRODUCTION**

The association between maternal oral bacteria and the development of early childhood caries (ECC) in their children has been a topic of research interest. ECC, also known as baby bottle tooth decay or nursing caries, is the presence of tooth decay in children under the age of six.[1] Several studies have investigated the role of maternal oral bacteria in transmitting cariogenic (tooth decay-causing) bacteria to their children. [2-4] The primary mode of transmission is through saliva, primarily through shared utensils, pacifiers, or other objects that come into contact with the mother's saliva and then the child's mouth. Mutans streptococci, particularly *Streptococcus mutans*, is a bacterium strongly associated with dental caries. It is commonly found in dental plaque and has been linked to ECC development. Maternal transmission of *S. mutans* to their children has been identified as a risk factor for ECC.[5] Research has shown that higher levels of *S. mutans* in maternal saliva are associated with an increased risk of ECC in their children. Maternal oral hygiene practices, such as toothbrushing frequency and the presence of untreated dental caries in mothers, can influence the transmission of *S. mutans* and subsequent ECC development in their children.

Other factors that contribute to the association between maternal oral bacteria and ECC development include dietary habits, socioeconomic status, and overall oral health practices within the family. Maternal diet, particularly high sugar intake, can increase the likelihood of *S. mutans* colonization and transmission. Additionally, a lack of access to dental care or poor oral hygiene practices within the family can exacerbate the risk of ECC.[6] It is worth noting that while the association between maternal oral bacteria and ECC has been established, it is not the sole determinant of the disease. There are multiple factors involved in the development of ECC, including the child's oral hygiene practices, diet, genetics, and environmental factors.

The association between maternal oral bacteria, particularly *S. mutans*, and the development of ECC in their children is well-established. Maternal transmission of cariogenic bacteria through saliva and shared objects plays a significant role in ECC development. Implementing preventive measures and promoting good oral health practices are crucial in reducing the risk of ECC in children. Hence the study was undertaken with the objective to examine the prevalence and levels of cariogenic bacteria in maternal saliva and dental plaque and to determine a correlation between maternal oral bacterial levels and the presence and severity of ECC in their children, if any.

## MATERIALS AND METHODS

*Study Design:* The study utilizes a prospective cohort design, following pregnant mothers and their children from birth until the children reach 2 years of age. Informed consent was obtained from all participating pregnant mothers. Confidentiality and privacy of the participants' data will be strictly maintained. Participants were informed about the purpose of the study and their right to withdraw at any time without consequences.

*Study Participants:* Pregnant mothers were recruited from prenatal clinics and obstetric departments.

*Eligibility criteria:*

- Inclusion criteria: Women second or third trimester of pregnancy, having no severe systemic diseases, and providing informed consent.
- Exclusion criteria: Pregnant mothers with a history of antibiotic use within the past three months, severe dental caries or periodontal disease, and incomplete dental records.

*Data Collection:* Data was collected in multi-phases. Baseline data was collected during pregnancy.

- Prenatal maternal data: Maternal demographic information (age, education, occupation, income), oral hygiene practices (toothbrushing frequency, dental visits), dietary habits (sugar consumption), and oral health status (dental caries, periodontal condition) were collected through structured interviews, questionnaires, and dental examinations. Maternal saliva and dental plaque samples were collected using sterile swabs and stored for laboratory analysis.
- Follow-up Data Collection (Postpartum):

*Birth data:* Information on the newborn's gender, birth weight, gestational age, and any medical complications were collected from hospital records.

*Maternal data:* Oral hygiene practices, dietary habits, and oral health status were reassessed at regular intervals through questionnaires and interviews.

*Children's data:* Children's demographic information, oral hygiene practices, dietary habits, and oral health status were collected from mothers through questionnaires and interviews.

Dental examinations were conducted on children to assess the presence and severity of ECC. The International Caries Detection and Assessment System (ICDAS) criteria was used for caries diagnosis.

*Laboratory Analysis:* Maternal saliva and dental plaque samples collected during pregnancy

and at subsequent follow-ups were analyzed for the presence and levels of cariogenic bacteria, especially *Streptococcus mutans*, using culture techniques and molecular methods (e.g., polymerase chain reaction).

- **Microbial Culture:** Microbial culture involved collecting saliva samples and transferring them onto culture media that provided suitable conditions for the growth of specific bacteria. The samples were then incubated for a period of time, typically 24-48 hours, to allow bacterial colonies to form. After incubation, the colonies were counted, identified, and characterized based on their morphology, growth patterns, and biochemical tests. This method provided information about viable and cultivable bacteria present in the sample.
- **Polymerase Chain Reaction (PCR):** PCR is a molecular technique that allows for the amplification and detection of specific DNA or RNA sequences of bacteria present in saliva samples. This method targeted specific bacterial genes or regions, such as the 16S rRNA gene, to identify and quantify bacteria. PCR-based techniques, such as quantitative PCR (qPCR) or real-time PCR, provided information about the presence and relative abundance of specific bacterial species or groups without the need for bacterial cultivation.

*Data Analysis:* Descriptive statistics was used to summarize the demographic, clinical, and microbiological data. The association between maternal oral bacteria (specifically *S. mutans*) and ECC development in children was analyzed using chi-square tests with level of significance set at 5 percent.

## RESULTS

The study included a total of 98 pregnant mothers who were followed up until their children reached 2 years of age. The mean age of the pregnant mothers was  $29.86 \pm 7.47$  years. The majority of the participants had a high school education or above (67.5%), and the average household income was 21,539 rupees.

### *Maternal Oral Health and Bacterial Analysis:*

At baseline (during pregnancy), 37 (37.7%) of the pregnant mothers had dental caries, and 29(29.5) % had periodontal disease. The mean number of decayed, missing, or filled teeth (DMFT) in pregnant mothers was  $1.804 \pm 0.53$ , indicating a moderate level of dental caries. *Streptococcus mutans*, a cariogenic bacterium as detected in 82% of the maternal and 83.3% of children's saliva and dental plaque samples respectively as seen in Table 2.

### *Early Childhood Caries (ECC) Development:*

During the follow-up period, 26% of the children developed ECC by the age of 2 years.

The mean number of decayed, missing, or filled primary teeth (dmft) in the affected children was  $1.934 \pm 0.429$ , indicating a moderate severity of ECC. The most commonly affected primary teeth were the maxillary incisors and first molars.

*Association Between Maternal Oral Bacteria and ECC:*

A significant association was found between maternal oral bacteria (specifically *Streptococcus mutans*) and ECC development in children. Children whose mothers had detectable levels of *S. mutans* in their saliva or dental plaque were significantly more likely to develop ECC compared to children whose mothers had undetectable levels as observed in Table 1. Maternal levels of *S. mutans* were positively correlated with the severity of ECC in children, as indicated by the dmft score.

*Other Factors Influencing ECC Development:*

Maternal oral hygiene practices, such as toothbrushing frequency and dental visits, were found to significantly affect ECC development in children. Children whose mothers reported brushing their teeth less than twice a day had a significantly higher risk of ECC compared to those with more frequent brushing. Maternal dietary habits, particularly high sugar consumption, were also identified as risk factors for ECC in children.

**Table 1: Association of maternal dental caries with ECC**

Dental Caries	Child with caries	Child without caries	Total
Mothers – with caries	22 (75.9)	15 (21.7)	37 (37.8)
Mothers – without caries	7 (24.1)	54 (78.3)	61 (62.2)
Total	29 (29.6)	69 (70.4)	98 (100.0)
Chi square statistic	25.451		
Df	1		
P value	0.000*		

\*=Significant

**Table 2: Microorganisms isolated from both mothers and children**

Microbes	Mothers (%)	Child (%)
<i>Streptococcus mutans</i>	82	83.2
<i>Streptococcus sobrinus</i>	43.3	37.4
<i>Lactobacillus</i> species	38.2	33.6
<i>Actinomyces</i> species	15.6	11.3
<i>Veillonella</i> species	7.5	1.3

Fusobacterium nucleatum	2.7	1.1
Porphyromonas gingivalis	0.7	0
Prevotella species	0.3	0
Aggregatibacter actinomycetemcomitans	0.3	0
Treponema denticola	0.1	0

## DISCUSSION

The presence of *S. mutans* and other cariogenic bacteria in maternal oral flora has been associated with an increased risk of early childhood caries (ECC) in their children. Maternal factors such as high bacterial counts, frequent salivary transmission, and inadequate oral hygiene contribute to the colonization of the child's oral cavity with cariogenic bacteria and subsequent caries development. Understanding the association between maternal oral bacteria and early childhood caries is crucial for preventive strategies and interventions. Maternal oral health promotion, including education on proper oral hygiene, dietary counselling, and reducing the transmission of cariogenic bacteria, can help reduce the risk of ECC in children.

The association between maternal oral bacteria and early childhood caries development in their children is a topic of interest in understanding the transmission and risk factors for dental caries. This discussion will focus on a study that followed a cohort of mothers and their children from prenatal to postnatal stages, with a two-year follow-up period, to explore the potential impact of maternal oral bacteria on the development of early childhood caries (ECC).

The two-year follow-up period in this study allowed for the examination of the long-term impact of maternal oral bacteria on the development of ECC in their children. The findings revealed a significant association between the presence of specific cariogenic bacteria in maternal oral flora and the increased risk of ECC in their children. Children whose mothers had higher levels of cariogenic bacteria, such as *S. mutans*, were more likely to develop dental caries during early childhood. Literature evidence shows a varying degree of correlation between the mother's dental caries scores and the children's caries experiences. This is in accordance to the study of Smith RE et al who reported maternal high streptococcusmutans levels, maternal active decay, and maternal sugar consumption are all significant risk factors for ECC. [7] The DMFS scores of mothers were also observed as

significant risk factors for the colonisation of cariogenic bacteria and ECC in the research done by Ersin NK et al.[8]A strong correlation between maternal caries history and ECC was also discovered by Thitasomakul, de Souza Pd et al., and Bathsheba J. Turton et al. [9,10,11] The cariogenic microflora in a mother's mouth is likely passed on to her offspring, increasing their chance of developing ECC.

During the prenatal period, the oral microbiota of mothers can influence the colonization of their children's oral cavity. Several studies have indicated that specific bacteria, such as *Streptococcus mutans*, have a higher prevalence in the oral flora of mothers with dental caries. The transmission of cariogenic bacteria from mothers to infants can occur through close contact, such as sharing utensils or through vertical transmission. This transmission can result in the early establishment of cariogenic bacteria in the oral cavity of children, increasing their susceptibility to ECC.

These results emphasize the importance of maternal oral health in preventing ECC in children. Strategies to reduce the transmission of cariogenic bacteria from mothers to infants should be implemented, including oral hygiene education, dietary counseling, and early preventive interventions. Promoting good oral hygiene practices in mothers, such as regular toothbrushing and the use of antimicrobial mouth rinses, may help reduce the colonization and transmission of cariogenic bacteria. Furthermore, prenatal and postnatal oral health interventions can play a significant role in preventing ECC. Educating expectant mothers about the importance of oral health during pregnancy, including regular dental visits and appropriate oral hygiene practices, can help reduce the maternal transmission of cariogenic bacteria. Postnatally, early dental visits for children, starting around the eruption of the first tooth, can aid in early detection of caries risk and provide preventive measures, such as fluoride treatments and dental sealants.

*Limitations:*

It is crucial to acknowledge the limitations of the study, such as potential confounding factors that were not fully controlled for and the reliance on self-reported data. Long-term prospective studies with larger sample sizes and rigorous methodology would further enhance our understanding of the association between maternal oral bacteria and ECC development in children. The study was also limited by the relatively small sample size and potential selection bias in recruitment. The results may not be generalizable to the broader population due to the specific characteristics of the study population.

**CONCLUSION**

In summary, the study found a significant association between maternal oral bacteria, particularly *Streptococcus mutans*, and the development of early childhood caries (ECC) in children up to 2 years of age. Maternal oral hygiene practices and dietary habits were also identified as important factors influencing ECC development. These findings highlight the importance of promoting good oral health practices in pregnant mothers to reduce the risk of ECC in their children.

In conclusion, this study with a two-year follow-up period highlights the significant association between maternal oral bacteria and the development of early childhood caries in their children. The findings underscore the importance of maternal oral health and the need for preventive measures to reduce the transmission of cariogenic bacteria from mothers to infants. Dental professionals should emphasize oral health promotion and early interventions to prevent ECC, ensuring the oral health of both mothers and their children.

#### REFERENCES

1. Colak H, Dülgergil CT, Dalli M, Hamidi MM. Early childhood caries update: A review of causes, diagnoses, and treatments. *J Nat Sci Biol Med.* 2013 Jan;4(1):29-38. doi: 10.4103/0976-9668.107257. PMID: 23633832; PMCID: PMC3633299.
2. Damle SG, Yadav R, Garg S, Dhindsa A, Beniwal V, Loomba A, Chatterjee S. Transmission of mutans streptococci in mother-child pairs. *Indian J Med Res.* 2016 Aug;144(2):264-270. doi: 10.4103/0971-5916.195042. PMID: 27934807; PMCID: PMC5206879.
3. Chaffee BW, Gansky SA, Weintraub JA, Featherstone JD, Ramos-Gomez FJ. Maternal oral bacterial levels predict early childhood caries development. *J Dent Res.* 2014 Mar;93(3):238-44. doi: 10.1177/0022034513517713. Epub 2013 Dec 19. PMID: 24356441; PMCID: PMC3929977
4. Divya MS, Raju SS, Gowtham P. Correlation between Early Childhood Caries and Maternal Oral Hygiene Status: A Cross-sectional Study in Vijayawada, Andhra Pradesh, India. *World J Dent* 2022;13(4):336-340.
5. Anil S, Anand PS. Early Childhood Caries: Prevalence, Risk Factors, and Prevention. *Front Pediatr.* 2017 Jul 18;5:157. doi: 10.3389/fped.2017.00157. PMID: 28770188; PMCID: PMC5514393.
6. Priyadarshini HR, Hiremath SS, Fernandes B. Association between maternal - child levels of salivary Mutans Streptococci and early childhood caries. *Dent Res J (Isfahan).* 2013 Nov;10(6):728-31. PMID: 24379859; PMCID: PMC3872622.



7. Smith RE, Badner VM, Morse DE, et al. Maternal risk indicators for childhood caries in an inner city population. *Community Dent Oral Epidemiol* 2002;30(3):176–181. DOI: [10.1034/j.1600-0528.2002.300303.x](https://doi.org/10.1034/j.1600-0528.2002.300303.x)
8. Ersin NK, Eronat N, Cogula D, et al. Association of maternal-child characteristics as a factor in early childhood caries and salivary bacterial counts. *J Dent Child* 2006;73(2):105–111.
9. Thitasomakul S, Piwat S, Thearmontree A, et al. Risks for early childhood caries analyzed by negative binomial models. *J Dent Res* 2009;88(2):137–141. DOI: [10.1177/0022034508328629](https://doi.org/10.1177/0022034508328629)
10. De Souza Pd, Mello Proenca MA, Franco MM, et al. Association between early childhood caries (ECC) and maternal caries status: a cross-sectional study in Sao Luis, Maranhao, Brazil. *Eur J Dent* 2015;9(1):122–126. DOI: [10.4103/1305-7456.149659](https://doi.org/10.4103/1305-7456.149659)
11. Turnon BT, Durward C, Manton DJ, et al. Early childhood caries and maternal caries experience in a convenience sample of Cambodian pre-schoolers. *Pediatr Dent J* 2015;25(1):14–18. DOI: [10.1016/j.pdj.2015.02.001](https://doi.org/10.1016/j.pdj.2015.02.001)
12. Kaan AMM, Kahharova D, Zaura E. Acquisition and establishment of the oral microbiota. *Periodontol* 2000. 2021 Jun;86(1):123-141. doi: 10.1111/prd.12366. Epub 2021 Mar 10. PMID: 33690935; PMCID: PMC8252790.
13. Jang H, Patoine A, Wu TT, Castillo DA, Xiao J. Oral microflora and pregnancy: a systematic review and meta-analysis. *Sci Rep*. 2021 Aug 19;11(1):16870. doi: 10.1038/s41598-021-96495-1. PMID: 34413437; PMCID: PMC8377136.