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THE EFFECT OF MODE OF CHILD DELIVERY AND OTHER MATERNAL FACTORS ON ACQUISITION OF SOME ORAL MICROFLORA IN A GROUP OF EGYPTIAN INFANTS

Nora Sherif Salman^{*}, Nadia Ezz El Din Metwalli^{**} and Mariem Osama Wassel^{***}

ABSTRACT

Background: Early childhood caries is etiologically associated with bacterial colonization. Streptococcus mutans (S.mutans) have been related to dental caries based on well-defined cariogenicity. A body of evidence suggests that children acquire S. mutans primarily from their mothers. It was also suggested that mode of child delivery can lead to differences in the initial foundation of oral microbiota.

Purpose: To assess the acquisition of S.mutans and Streptococcus mitis (S. mitis) in a group of Egyptian infants in relation to mode of child delivery and maternal salivary bacterial counts and caries index scores.

Subjects and Methods: A total of 50 mothers and their infants were recruited in this study to assess the acquisition of S. mutans and S.mitis in relation to mode of child delivery, maternal salivary bacterial counts and DMFT scores.

Results: Acquisition of S. mutans was significantly higher in cesarean-section (C- section) group compared to vaginally delivered group at 3 months. S. mitis was found in all children at 3 and 6 months regardless the mode of child delivery. A highly significant direct correlation between infants' S. mutans counts at 3 & 6 months and maternal DMFT mean scores, as well as maternal S.mutans counts was found. While, there was a highly significant inverse correlation between infants' S. mutans counts at 3 & 6 months and maternal S. mitis mean counts. Also, there was a highly significant inverse correlation between infants' S. mitis mean counts at 3 & 6 months and maternal DMFT mean scores and maternal S. mutans mean counts. While, there was a highly significant direct correlation between infants' S. mitis at 3 & 6 months and maternal S.mitis mean counts.

Conclusions: C- section delivered infants had earlier acquisition and higher counts of S. mutans. S. mitis was found in all investigated infants as early as 3 months of age. Early S. mutans acquisition in infants was detected in infants whose mothers had high maternal S. mutans and low S. mitis counts and high DMFT scores.

KEYWORDS: Mode of delivery, Infants, Streptococcus mutans, Streptococcus mitis, Early childhood caries.

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INTRODUCTION

Early childhood caries (ECC) is a virulent type of dental caries. It is characterized by early onset and rapid progression. ECC is a major public health problem, being the most common chronic infectious childhood disease, which is hard to control. Although it's not life-threatening, its impact on individuals and communities is extensive, resulting in pain, impairment of function, harmful effects on the child's growth rate, body weight, and ability to thrive, thus reducing quality of life⁽¹⁾.

ECC is etiologically associated with bacterial colonization in deciduous dentition. Mutans streptococci (MS), especially *S. mutans* and *Streptococcus sobrinus* (*S. sobrinus*), have been related to dental caries based on well-defined cariogenicity⁽²⁻⁵⁾. A body of evidence suggests that children acquire *S. mutans* primarily from their mothers⁽⁶⁻⁹⁾, and possibly other sources^(10,11).

Some studies suggested that mode of child delivery whether C-section or vaginal can lead to differences in the initial foundation of oral and gut microbiota and consequently, contributing to variations in child health. Whether the mode of child delivery can alter the infant's oral microbiota and the development of ECC in the future still remains unclear^(12,13).

Several studies showed that mothers as primary care givers were found to harbor identical genotypes of salivary *S. mutans* as their children, none of the children harbored genotypes similar to their fathers, even though their fathers had very high salivary *S. mutans* levels⁽¹⁴⁻¹⁷⁾. The infection of *S. mutans* is done by vertical transmission from the mother's saliva containing high levels of *S. mutans* at a very specific time called "window of infectivity." The severity of ECC has been directly linked to the level of bacteria in the mouth and the early infection. The bacteria have been found to be present as early as six months of age, even before tooth eruption^(18,19).

S. mitis, *Streptococcus oralis* (*S. oralis*) and *Streptococcus salivarius* (*S. salivarius*) are species of Viridians streptococci that are pioneer colonizers of the oral cavity of infants during the first few days of life and remain numerically significant throughout life⁽²⁰⁾. The colonization of these bacteria is important because they induce the development of host defense and immune system function. One important aspect of colonization with these non-pathogenic bacteria is that they also exclude potential exogenous pathogens from becoming established in the oral cavity^(21,22).

AIM: The main objective of the present study was to investigate the relation between the mode of child delivery (vaginal versus C-section), and other maternal factors to the colonization of oral microflora in infants.

SUBJECTS AND METHODS

The present study was a cohort study where a convenient sample of a total of 50 mothers and their infants were examined. The subjects were recruited from El Ezab hospital, a public hospital at El Sharabia, Cairo, Egypt during their regular visits for vaccination of their infants. Verbal and written informed consents were obtained from the parents before clinical examination and taking the samples.

Selection criteria of mothers

Mothers of infants met specific selection criteria which were: ⁽²³⁾

- (1) Age: from 25-35 years old
- (2) Medically free

Selection criteria of infants:

Infants selected met specific selection criteria which were: ⁽²³⁾

- (1) Age: 3-4 months old.

- (2) Medically free of any diseases at birth and at time of investigation.
- (3) Full term infants with complete gestational period of 9 months.

I. Exclusion criteria for mothers and infants: ⁽²³⁾

- (1) Medically compromised.
- (2) Premature infants (born before 9 months).
- (3) Antibiotic use 2-4 weeks before sampling.

Infants were divided into two groups; (Group I): 25 Vaginally delivered infants, and (Group II): 25 C-section delivered infants. Clinical examination of the mother's oral cavity and assessment of dental caries was performed by DMFT index for permanent teeth⁽²⁴⁾

Saliva samples collection:

Saliva samples were collected from mothers and their infants at the first visit. After written informed consent, unstimulated saliva samples were collected from the mothers and infants in the morning. Samples were collected with the disposable needleless syringes from buccal and labial vestibules. The collected saliva of each subject in the syringe was capped and coded, and were sent immediately to the immunology laboratory⁽²⁵⁾. Another salivary sample was collected from infants by the same technique after 3 months when they were 6 months old.

Bacterial culture and analysis of the salivary sample was done using MitisSalivarius Agar culture medium, (MSA. Difco, USA), to detect the acquisition of *S. mutans* and *S. mitis* bacteria in each sample⁽²⁶⁾.

Statistical analysis

The collected data was revised, coded, tabulated and introduced to a PC using Statistical package for Social Science (SPSS 15.0 for windows; SPSS Inc, Chicago, IL, 2001). Data was presented and

suitable analysis was done according to the type of data obtained for each parameter. The normality of distribution parameters was evaluated by One-Sample Kolmogorov-smirnov first; then Fisher's exact Chi-Square test was used for nonparametric distribution. Spearman's Correlations test was used to correlate acquisition of oral flora to maternal factors.

RESULTS

1. Acquisition of *S. mutans* and *S. mitis* in infants at 3 and 6 months in relation to mode of child delivery

(*Table.1*) shows that the acquisition of *S. mutans* was significantly higher in C- section group compared to vaginally delivered group at 3 months. This difference wasn't statistically significant at 6 months. *S. mitis* was found in all children at 3 and 6 months regardless the mode of child delivery

2. Correlation between *S. mutans* and *S. mitis* counts in infants at 3 and 6 months and maternal DMFT, maternal *S. mutans* and *S. mitis* counts

Spearman Correlations showed that there was a highly significant direct correlation between infants' *S. mutans* counts at 3 & 6 months and maternal DMFT mean scores, as well as maternal *S. mutans* counts.

While, there was a highly significant inverse correlation between infants' *S. mutans* counts at 3 & 6 months and maternal *S. mitis* mean counts, as well as between infants' *S. mitis* mean counts at 3 & 6 months and maternal DMFT mean scores and maternal *S. mutans* mean counts. While, there was a highly significant direct correlation between infants' *S. mitis* at 3 & 6 months and maternal *S. mitis* mean counts (*Table.2*).

TABLE (1) Acquisition of *S. mutans* and *S. mitis* in infants at 3 and 6 months in relation to mode of child delivery

Acquisition		Mode of delivery		Total (n=50)	X ²	P Value	Sig.
		Vaginal(n=25)	C-section (n=25)				
<i>S. mutans</i>	3 Ms	No	13 (52%)	0	17.57*	<0.001	HS
		Yes	12 (48%)	25 (100%)			
	6 Ms	No	2 (8%)	0	2.08*	0.490	NS
		Yes	23 (92%)	25 (100%)			
<i>S. mitis</i>	3 Ms	No	a	a	a	a	a
		Yes	25 (100%)	25 (100%)			
	6 Ms	No	a	a	a	a	a
		Yes	25 (100%)	25 (100%)			

Fisher's exact Chi-Square test* a= test can't be performed on empty groups

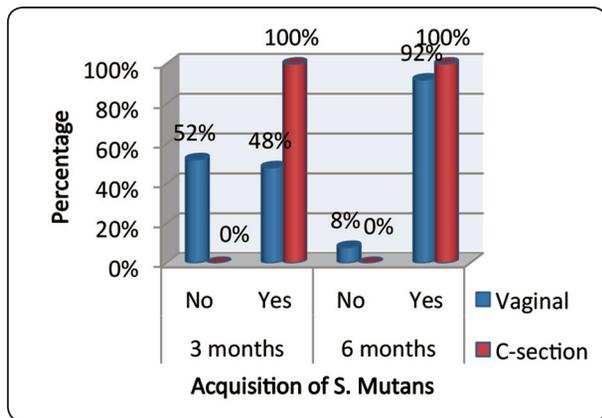


Fig. (1) Bar chart representing acquisition of *S. mutans* in infants at 3 and 6 months in relation to mode of child delivery

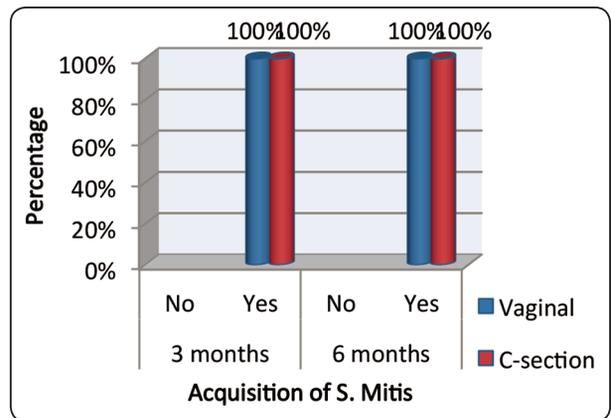


Fig. (2) Bar chart representing acquisition of *S. mitis* in infants at 3 and 6 months in relation to mode of child delivery

TABLE (2) Correlation between S. mutans and S. mitis counts in infants at 3 and 6 months and maternal DMFT, maternal S. mutans and S. mitis counts

Risk factor 3 months		Infants' S. mutans mean counts		Infants' S. mitis mean counts	
		6 months	3 months	6 months	3 months
Maternal DMFT	rho	0.984	0.968	-0.987	-0.991
	P Value	<0.001**	<0.001**	<0.001**	<0.001**
	Sig.	HS	HS	HS	HS
Maternal S.mutans mean counts	rho	0.989	0.997	-0.969	-0.983
	P Value	<0.001**	<0.001**	<0.001**	<0.001**
	Sig.	HS	HS	HS	HS
Maternal S.mitis mean counts	Rho	-0.973	-0.960	0.970	0.966
	P Value	<0.001**	<0.001**	<0.001**	<0.001**
	Sig.	HS	HS	HS	HS

*Spearman Correlations, **HS= highly significant*

DISCUSSION

In this study the acquisition of S. mutans was higher in C-section group than the vaginally delivered group at both 3 months and 6 months. However, the differences were statistically significant at 3 months only (*Table 1*). These findings are similar to those of Li, et al⁽²⁷⁾ who suggested that the C-section delivery-accelerated initial acquisition of S. mutans. On the other hand a study by Pattanaporn, et al⁽²⁸⁾ found that a significantly higher proportion of vaginally born children were colonized with high levels of S. mutans when compared to C-section born children.

Multiple studies have documented maternal-to-child transfer of caries-causing oral bacteria^(27,29-31). Our study showed that infants who had earlier acquisition of S. mutans at 3 and 6 months of age, their mothers' showed higher maternal S. mutans counts (*Table 2*). This was also agreed upon by Pattanaporn, et al⁽²⁸⁾ who suggested that children may be at increased risk for high levels of S.

mutans colonization if their mothers experienced high levels of S. mutans suggesting that maternal factors play a significant role in determining children's oral health.

The acquisition of S. mitis was found to be positive in all infant's salivary samples starting 3 months of age to 6 months of age. This supports that S. mitis is one of the pioneer bacteria that colonize the oral cavity within days after birth⁽³²⁻³⁴⁾.

Moreover, a significantly high inverse correlation was detected between maternal S. mutans and infants' S. mitis counts (*Table 2*). This suggests that S. mitis is associated with a healthy oral environment and reduced caries risk.

A direct correlation between maternal S. mutans counts and infants' S. mutans counts at 3 and 6 months was proven in this study (*Table 2*). This goes in line with Kohler, et al⁽³⁵⁾ and Priyadarshini, et al⁽³⁶⁾ who showed that children of mothers having high levels of S. mutans are more likely to exhibit levels of S. mutans corresponding to their mothers'

levels. This implies that mother's *S. mutans* level is a risk indicator for early acquisition and high levels of *S. mutans* in their children and subsequent development of ECC. On the contrary, Zhou, et al⁽³⁷⁾ did not find a significant association between maternal *S. mutans* and *S. mutans* colonization in 8 – 32 months old children.

The present study also showed that the level of infants' salivary *S. mutans*, was significantly directly related to the caries status (DMFT scores) in the mothers (**Table.2**). This was also reported by Kishi, et al⁽³⁸⁾ who showed that the high levels of maternal *S. mutans* was directly related to high DMFT scores in mothers and that affected their infants' *S. mutans* counts and caries status. Our study also showed an indirect relationship between infants' *S. mitis* counts and maternal DMFT scores (**Table.2**), confirming that poor maternal oral health is associated with an unhealthy oral environment of their infants.

A direct relationship was also found between maternal *S. mitis* counts and infant's *S. mitis* counts, and it was highly significant (**Table.2**). This result was supported by the study of Boustedt, et al⁽³⁹⁾ who studied the oral microbial profile including bacterial strains as *S. mutans* and *S. mitis*, and showed great resemblance between the mother and child. This resemblance in oral microflora between mothers and their infants was attributed to the fact that mothers are the primary caregiver with frequent close salivary contact as explained earlier by Thorild, et al⁽⁴⁰⁾. Later, this resemblance was also suggested by Virtanen, et al⁽⁴¹⁾ to be due to mother's behaviors as kissing their infants from the lips or cleaning infants' pacifiers by their own mouths.

A limitation of our study was the small sample size, however, it can be concluded that the mode of child delivery affects *S. mutans* acquisition where C- section delivered infants had earlier acquisition and higher counts. Also, maternal oral health had a direct effect on their infants' oral health. Moreover, early *S. mutans* acquisition in infants was detected in infants whose mothers had high maternal *S. mutans* and low *S. mitis* counts and high DMFT scores.

More cohort studies with longer observational periods are needed to assess the future caries experience in relation to mode of child delivery. Additionally, more studies are needed to investigate other significant risk factors of ECC in Egyptian children. Most importantly, oral health education for expected mothers is needed to educate them about potential risk factors for ECC and how to avoid it.

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