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Risk Factors for Early Childhood Caries among Children in Multi-centered Montessori at Karachi

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ABSTRACT

OBJECTIVE: To explore the possible risk factors associated with early childhood caries (ECC) at one point in time in Montessori children.
METHODOLOGY: A multi-centred cross-sectional study was conducted where n= 370 children aged ≥ 37 to ≤ 72 months from different Montessori of Karachi were randomly selected. After getting informed consent from the caregivers, a self-administered questionnaire was distributed to collect data. The oral examination of children was carried out to assess dental caries status using the decayed missing and filled teeth (DMFT) index. Data was analyzed using Stata/SE version 17.
RESULTS: The factors significantly associated with ECC in Montessori children were the age of leaving bottle feeding, sleeping with a bottle and delayed initiation of tooth-brushing *[$p \leq 0.05$]*. Guided tooth-brushing practice was observed to be higher in children suffering from ECC *[AOR=1.77, p= 0.048]*. The multivariate analysis also suggested that an increased tooth-brushing duration significantly reduced ECC chances by 70% in Montessori children.
CONCLUSION: This study concludes that bottle feeding alone or combined with breastfeeding, prolonged bottle feeding, and children sleeping with a bottle are significant predictors for ECC. Increased brushing duration significantly reduces the chances of ECC.

KEYWORDS: Dental caries, primary dentition, breastfeeding practices, factors, pediatric dentistry, oral health, child, tooth discoloration

INTRODUCTION

According to the World Health Organization (WHO), dental caries is a pandemic among school-aged children at 60 to 90% [1]. A prevalence of almost 68% of dental caries is found in at least two teeth in primary dentition of children in Pakistan. It is close to what is found worldwide in the early childhood stage[2]. In developed countries, the prevalence is estimated to range from 1 to 12% in preschool children and 50 to 80% in high-risk groups in developing countries[3-5]. Early childhood caries (ECC) in primary dentition at a very early age has been considered a multi-factorial, cariogenic and infectious disease that demineralizes dental hard tissues[6]. Though ECC is not a fatal condition, if left untreated, it may lead to considerably severe and persistent problems in children at an early age, such as bacteremia, pain, abscess, loss of teeth, high treatment costs due to orthodontic issues in succeeding permanent dentition, low self-esteem, and failure to thrive[7]. Recently, it has been recognized that since dental caries is a serious public health problem and is largely preventable, its behavioral aspect must be further explored[8]. The World Health Organization held its Global Consultation on ECC in January 2016 in Thailand. WHO Collaborating Centers reviewed the global epidemics of ECC and emphasized the existing risk factors for the preventive programs[9]. Unfortunately, Pakistan was not part of this review, and the ECC epidemic in Pakistan was not reported, possibly resulting in a non-existing ECC preventive program. It is crucial to understand that dental caries in any age group must be included in any preventive program focusing on non-communicable diseases (NCDs) since NCDs are preventable through collaborative efforts, unlike communicable diseases[10].

More than 120 risk factors for ECC have been found in 89 studies comprising 25-50% of high-to-moderate-quality data[11]. These factors were divided into ones related to higher prevalence and incidence of ECC and the factors about milk feeding, oral microflora, and other factors, such as those related to the systemic condition, behaviors, and attitudes of the children and their caregivers. The most important of these factors was enamel hypoplasia, which is associated with ECC, particularly in developing countries[12,13]. Despite finding 123 risk factors for ECC, they could not be generalized to low-middle-income countries like Pakistan since most of the data available was from high-income or upper-middle-income countries.

It is imperative to engage children, caregivers and future mothers and develop appropriate oral health education and other protective strategiesx[14,15]. Almost 50% of children in Pakistan are sent to Montessori as early as 3 years of age[16]. Therefore, the overarching aim was to investigate the baseline situation of ECC in Pakistan, particularly in children who attend Montessori, since their dynamics may differ from children who are not sent to Montessori at a very early age. This study was conducted to explore and describe the risk factors related to ECC so that, in the long run, actual risk factors pertinent to ECC in Montessori going children in Pakistan can be shortlisted to help develop a preventive plan for this population group.

METHODOLOGY

This cross-sectional study was carried out with the inclusion of registered Montessori children of Karachi. The sample size was calculated using Open Epi Software considering 68% prevalence of ECC with a 5% margin of error, 95% confidence interval, and design effect=1.0. [2] The calculated sample size was 335. However, this number was increased by 10% and rounded off (n= 370) to overcome missing data. Montessori from five districts, including suburban and urban sites of Karachi city, were randomly selected to achieve the calculated sample size. Participants were excluded if the children's parents or caregivers could not complete the self-administered questionnaire sent to their homes through the Montessori administration. Those children whose parents/caregivers did not consent to the child's dental examination and their participation in the study were excluded, too. Also, the selection was not considered if the child was found non-cooperative for any reason or if the child was absent on the day of the dental examination. The age and gender of the child were recorded, and any child whose age was below 36 months or exceeded 72 months was excluded. The age of the children was recorded in categories including 37-48 months, 49-60 months, and 61-72 months.

A self-administered questionnaire for parents/caregivers:

The questionnaire contained information regarding children's milk consumption patterns and practices, as well as oral hygiene practices. Basic standard questions were asked based on the risk factors that may be emphasized for the prevention identified by the WHO Global Consultation on Public Health Intervention against ECC[9]. These questions were administered in English and Urdu (local language) for the parents to choose from. All questions were translated from English to Urdu, and the answers were returned. Pertinent questions and their categories included: manner of feeding of child (breast feeding, bottle feeding or both), age when bottle feeding was stopped (≤ 12 or > 12 months) and sleeping with bottle in mouth (yes or no). The oral hygiene-related questions included age when brushing was started (≤ 24 months or > 24 months), duration of brushing (≤ 1 minute or > 1 minute), frequency of brushing (once daily, twice daily, occasionally, or never), method of cleaning teeth (rinse, rinse with finger or use of brushing aid) and whether brushing was done independently by the child or guided/ supervised by care-providers. Sugary food consumption practices included consumption between meals or just before bedtime (yes, no, or occasionally).

Child dental examination:

The principal investigator carried out the dental examination using sterilized dental examination instruments in daylight at Montessori. The decayed, missing, filled teeth (dmft) index assessed the dental caries. Exfoliated teeth were not considered when counting. The data was recorded using the WHO Oral Health Assessment Form for Children[17].

Statistical analyses:

The data was analyzed using Stata/SE version 17. The descriptive data was reported as frequencies and percentages. The association between ECC and its possible risk factors was analyzed using the chi-square test while considering ECC's dmft score = 2 as a cut-off. The p-value of ≤ 0.05 was considered statistically significant for these associations. However, p-value ≤ 0.2 was considered for variables to have a probable effect on ECC, based on which multivariate logistic regression was run to build the final prediction model. Adjusted odds ratios (AOR) with 95% confidence interval (CI) were calculated.

RESULTS

A response rate of 90% (n= 333) was achieved by randomly selecting eight Montessori from sub-urban and urban sites of Karachi. Each Montessori had a range of 40 – 50 children registered with them. Almost 10% (n= 37) were excluded because their parents returned the forms unfilled or did not consent their children to be examined for dental caries status.

Description of participants:

Table I presents the distribution of the factors and their categories in the study population (n=333)**.** Only 12% (n= 41) of the children under study were found in the age group 49-60 months. Most of these children were males (62%; n= 207) compared to females. The results of factors under study in **Table I** include the feeding practices, added sugar consumption patterns and teeth cleaning methods from birth to current age.

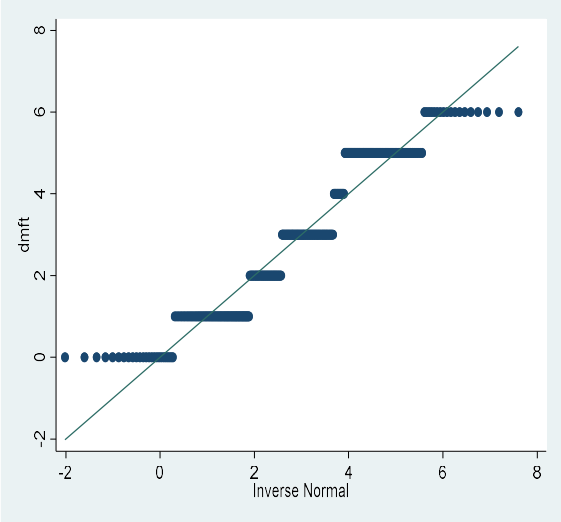
Only less than 8% of the children (n=25) had all sound teeth, meaning the prevalence of dental caries that were either decayed, missing, or filled teeth was 93%. However, the prevalence of ECC with ≥ 2 dmft was 62%. The mean dmft score of all children under study was 2.79±1.74 (range= 0-6 dmft). **Figure-I (a)** shows the distribution of dmft scores of the children under study. **Figure I (b)** shows the distribution of dmft scores concerning age groups. Early childhood caries was more prevalent in male children (63%) than females (37%).

Associated risk factors and predictive model:

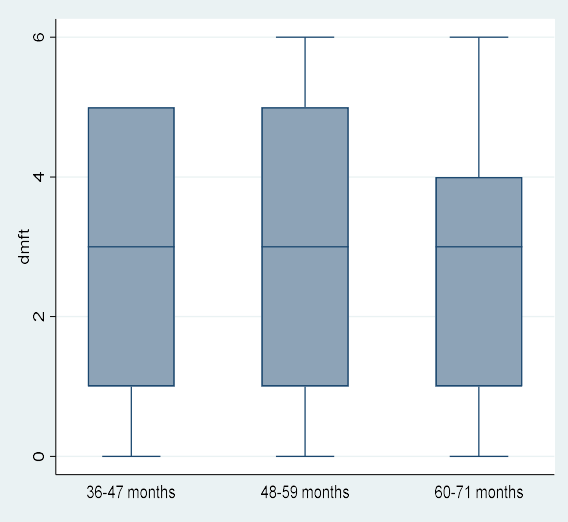
The children were divided into two groups based on the cut-off mean dmft score= 2. Table-II presents the association between ECC groups and variables as possible risk factors for ECC. No statistically significant relationship was found between the mean dmft score, the child's age [p= 0.942], and gender *[p= 0.494]*. Perhaps age and gender have no role in ECC. Factors that indicate a higher risk of ECC were the mode of milk feeding in the first two years of the child *[p <0.001]*, the duration the child would take to stop bottle feeding *[p <0.001]*, duration and frequency of tooth-brushing *[p=0.003]*, teeth cleaning method *[p=0.003]*, supported or independent cleaning of the child's teeth *[p=0.003]* and increased frequency of daily added sugar intake. *[p <0.017]*.

After adjusting the model by risk factors, it was found to be significant with p-vale ≥ 0.2. Six significant predictors were found, as seen in **Table III**. Compared to children who stop bottle feeding in their first year of life, children who stop bottle feeding later have 5 times more chances of having ECC *[AOR=5.23, 95% CI=2.507-10.932]*. Similarly, children who are bottle-fed alone or in combination with mother-feed are almost four times at increased risk of having ECC *[AOR=3.90; 95% CI= 2.553- 5.968]* as compared to those children who are on exclusive breastfeeding. Other predicting factors for ECC were children sleeping with bottle feeder in mouth *[AOR=2.04; 95% CI= 1.074- 3.888]* and children starting tooth brushing as late as after 2 years *[AOR=2.31; 95% CI=1.069-5.014]*. Increasing the duration of toothbrushing by 2 minutes as compared to < 2 minutes is likely to have 71% lesser chances of causing ECC *[AOR=0.29; 95% CI= 0.163- 0.542]*. However, surprisingly, toothbrushing of children guided by their caregivers/parents were observed to be 77% higher in children already suffering from ECC *[AOR=1.77; 95% CI= 1,005- 3.115]*.

Figure I: (a) Distribution of dmft scores of the study group (n=333); (b) Description of dmft scores with respect to age groups (in months)



(a)



(b)

Table I: Distribution of study participants (n=333) according to the variables under study

Study Variables	Categories	Frequency (%)
Age (in months)	37-48	149 (44.7)
	49-60	41 (12.3)
	61-72	143 (42.9)
Gender	Male	207 (62.2)
	Female	126 (37.8)
What was the milk feeding mode in first two years of your child?	Breast feed only	150 (45.1)
	Bottle feed only	67 (20.1)
	Both	116 (34.8)
How long your child took to stop bottle feeding?	≤ 12 months	61 (18.3)
	> 12 months	272 (81.6)
Did your child have a habit of sleeping with bottle feed in mouth?	Yes	148 (44.4)
	No	185 (55.6)
At what age your child started brushing?	≤ 2 years	60 (18.0)
	> 24 years	273 (82.0)
What was the usual duration of your child tooth brushing?	≤ 2 minutes	214 (64.3)
	> 2 minutes	119 (35.7)
What was the usual frequency of your child tooth brushing?	Once a day	74 (22.2)
	Twice a day	188 (56.5)
	Occasionally	67 (20.1)
	Seldom	4 (1.2)
What is the method for cleaning since your child's first tooth erupted?	Just rinse with water	60 (18.0)
	Rub with finger	87 (26.1)
	Wet cloth	53 (16.0)
	Brush+ paste	133 (39.9)
How was tooth brushing done in first two years of your child?	Independently	177 (53.2)
	Guided	156 (46.8)
What was the frequency of daily added sugar consumption until 2 years?	Once	43 (12.9)
	Twice	144 (43.24)
	> twice	146 (43.8)
Was your child allowed to consume sugary food between meals?	Yes	111 (33.3)
	Occasionally	76 (22.8)
	No	146 (43.8)
Was your child allowed to consume sugary food just before bedtime?	Yes	172 (51.7)
	Occasionally	110 (33.0)
	No	51 (15.3)

Table II: Bivariate association between risk indicators and current ECC status (Group A= ECC < 2 dmft; Group B= ECC ≥ 2 dmft)

Study Variables	Categories	Group A *(n=101)*	Group B *(n=232)*	p-value
Distribution According to Milk Consumption Practices				
What was the milk feeding mode in first two years of your child?	Breast feed only	75	75	< 0.001*
	Bottle feed only	7	60	
	Both	19	97	
How long your child took to stop bottle feeding?	≤ 12 months	35	26	< 0.001*
	> 12 months	66	206	
Did your child have a habit of sleeping with bottle feed in mouth?	Yes	49	136	0.088
	No	52	96	
Distribution According to Oral Hygiene Practices				
At what age your child started brushing?	≤ 2 years	24	36	0.072
	> 2 years	77	196	
What was the usual duration of your child tooth brushing?	≤ 2 minutes	53	161	0.003*
	> 2 minutes	48	71	
What was the usual frequency of your child tooth brushing?	Once a day	32	42	0.003*
	Twice a day	42	146	
	Occasionally/ seldom	27	44	
What is the method for cleaning since your child's first tooth erupted?	Just rinse with water	24	36	0.003*
	Rub with finger	35	52	
	Wet cloth	8	45	
	Brush+ paste	34	99	
How was tooth brushing done in first two years of your child?	Independently	66	111	0.003*
	Guided	35	121	
Distribution According to Sugary Food Consumption Practices				
What was the frequency of daily added sugar consumption until 2 years?	Once	21	22	0.017*
	Twice	41	103	
	> twice	39	107	
Was your child allowed to consume sugary food between meals?	Yes	33	78	0.343
	No	40	106	
	Occasionally	28	48	
Was your child allowed to consume sugary food just before bedtime?	Yes	48	124	0.360
	No	14	37	
	Occasionally	39	71	

* p-value ≤ 0.05.

Table III: Adjusted multivariate predictive model for factors predicting increased ECC

Study Variables	Adj Odd's Ratio	p-value	95% Confidence Interval
Bottle feed alone or in combination with breast feed	3.90	< 0.001*	2.553 – 5.968
Stopping bottle feeding late (>12 months)	5.23	< 0.001*	2.507 - 10.932
Child sleeping with bottle feeder in mouth	2.04	0.029*	1.074 – 3.888
Starting toothbrushing late (>2 years)	2.31	0.033*	1.069 – 5.014
Increased duration of brushing (≥2 minutes)	0.29	< 0.001*	0.163 – 0.542
Guided toothbrushing	1.77	0.048*	1.005 – 3.115

* p-value ≤ 0.05.

DISCUSSION

A recent meta-analysis shows an overall national prevalence of 56.6%, ranging from 49.5 to 63.5% for dental caries of ≥1 dmft in Pakistan[18]. Our study, on the other hand, shows a prevalence of ECC that is ≥2 dmft within the same range, 62%. Currently, ECC is considered a more complex disease that is not only related to sugar intake. This study aimed to explore the factors in the first two years of childhood that may pose a risk to children's development of ECC to understand this complexity. The results of this study did not find gender and age to have any significant role as risk factors, which means that dental caries in early childhood age are equally present in both genders. Although the results showed that gender had no significant effect on caries, we observe that males are more affected than females. The same pattern was observed in the study conducted by **Peltzar et al.** in Thailand[19]. Unlike Egyptian children, the dmft score in all age groups of children in our study was almost the same as that of ≈ 3 dmft[20]. The significant positive correlation between dmft scores and age in Egyptian children could be because the distribution of children's age was not expected and contained few outliers that perhaps resulted in overestimated dmft scores in the age group between 5- 6 years. Our participants' age and dmft distribution were normal *[p >0.05]*, on the other hand. Nevertheless, age and gender may be associated with dental caries in older age groups[21] rather than earlier age groups. Hence, even if the mean caries score statistically remains the same, as the child will grow in age, the caries level may also increase, as seen in **Figure I(b)** of this study.

Although it has been primarily recognized that breastfeeding is protective against dental caries compared to bottle feeding, the recent scoping review shows that ECC may be associated with prolonged breastfeeding[21]. The authors, however, have failed to justify this conclusion. The bivariate as well as multivariate analyses of our study, showed that bottle feeding alone and in combination with breastfeeding both put the children at risk for ECC. This result may be considered in light of the sugary content in the bottle and the delay in the oral hygiene practice of the children whose tooth-brushing is usually initiated after 2 years of childhood. Similarly, children who do not stop bottle feeding until their first year of childhood are at a 5-times higher risk of having ECC, and those children who sleep with a bottle in their mouth are twice as at risk of having ECC, may be attributed to the pH level of the saliva, which may become acidic in the oral environment where children keep milk in the buccal sulcus while sleeping with a bottle in their mouth. Had the bottle been filled with plain water, their salivary pH could have been kept neutral, which would not have caused tooth decay or provided an acidic substrate to the oral microbiome.

Furthermore, it is observed that almost 85% of the children who were suffering from ECC were having their teeth cleaned after 2 years of their childhood. Even after adjusting for other significant variables, the odds of ECC remained substantial. However, it was surprising that the children supervised or guided for tooth cleaning have 77% more chances of having ECC than children who independently clean their teeth. Perhaps the parents/caregivers realize the importance of tooth-brushing after the child's suffering has started. Children of this age are usually explorers and enjoy doing work independently. They do not usually like anyone guiding or supervising them. However, unsupervised activities of these children may be threatening to their lives. Based on the result, we propose that this threat may be considered a strength and an opportunity simultaneously. The children may learn quickly to be independent and take care of their oral hygiene if given a chance by handing them a toothbrush with a very minute quantity of 1000ppm of fluoridated toothpaste[22]. Since the increased duration of brushing also results in

almost 70% fewer chances of ECC, if the children enjoy this activity of brushing, they can keep the brush in hand all day like they keep a pacifier. The only concern will perhaps be the microbial contamination of the toothbrush, which the caregivers must deal with through periodic decontamination[23].

Although the results cannot be generalized due to certain limitations, the results of this study will help us formalize a well-focused future preventive program for Montessori children in Karachi likely to be suffering from ECC. One major limitation of this study was that the results were based on the reported responses for only eleven questions. One crucial question that was missed was about intake of fresh cow's milk and tetra-pack milk, which may be preferred over formula and powdered milk. Fresh cow's milk is commonly available at local dairy shops in Pakistan and is considerably less expensive than powdered or formula milk. At a low cost, as a routine practice, more water is added by the local milkmen to make it available to the entire family. A group of systematic reviewers has previously identified this limitation[24]. However, our study deliberately missed out on questioning cow milk and formula milk in bottles since there are many more concerns regarding these milk products, such as pasteurization, boiling, powdered/ liquid form, quantity of water addition in milk, etc[25].

Another limitation identified in our previous study is that only cavitated lesions were considered, and non-cavitated and white spot lesions were not counted as decayed[26]. This may have influenced the disease prevalence reported in this study. However, despite these limitations, our focus is extensively on formulating a plan to target the prevention of NCDs through ECC from an early age while engaging the Community Healthcare Workers (CHWs) and looking into its contribution and impact on the Universal Health Coverage (UHC).

CONCLUSION

This study concludes that bottle feeding alone or combined with breastfeeding, prolonged bottle feeding, and children sleeping with a bottle are significant predictors for ECC. Moreover, regarding teeth cleaning practices, delayed initiation of tooth-brushing and supervised teeth cleaning are significantly more common in children suffering from ECC. Considering the limitations of this cross-sectional study, it is also concluded that increased brushing duration substantially reduces the chances of ECC.

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Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHOR CONTRIBUTION

Qureshi A: Drafted the manuscript, analyzed the results
Jafferi AA: Idea of research study, data collection tool design, data collection
Shaikh AA: Data entry, analysis
Haroon K: Data interpretation, intellectual content assistance
Yasir M: Data interpretation, intellectual content assistance
Masood S: Proof reading, final formatting of manuscript

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