The 3rd International Conference on Health, Education and Technology (ICHET)

The Impact Of Formula Milk Consumption On Salivary pH In Pre-School Children: A Cross-Sectional Study

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ARTICLE INFO

Keywords:

Early Childhood Caries;
Formula Milk;
Pre-School Children;
pH Saliva

ABSTRACT

Background: Early childhood caries (ECC) is a significant global health problem affecting nearly half of pre-schoolers worldwide. Some research suggests that formula consumption patterns, including duration, frequency, timing, and mode of consumption, may affect ECC risk. Previous research found that infants with early childhood caries had an acidic salivary pH, while caries-free infants had a normal salivary pH. The purpose of the study was to analyze the relationship of formula milk to the salivary pH of preschool children. Research Methods using analytical surveys. The cross-sectional study approach is to look for the relationship between formula milk consumption and salivary pH. The sample in this study was 48 students of SPS TA'AM Mathlaul Anwar Kota Tasikmalaya aged 3 to 6 years. The results of the Spearman Correlation test obtained p of 0.001 ($p < 0.05$) with the result r -709 means a strong relationship. This study concludes that there is a strong and unidirectional relationship that the more often you consume formula milk, the lower the salivary pH in preschool children.

1. INTRODUCTION

Early childhood caries (ECC) is a significant global health problem affecting nearly half of preschoolers worldwide (Anil & Anand, 2017; Uribe et al., 2021). Dental caries is a common problem in preschoolers, with risk profiles and prevalence rates varying depending on research and location. Dental caries is a common oral disease caused by the interaction between acid-producing bacteria and fermentable carbohydrates on the surface of the teeth (Selwitz et al., 2007). The process of caries involves many factors such as tooth structure, saliva and diet (Selwitz et al., 2007). The results of bibliometric analysis show that research on caries is mostly carried out in developed countries (C et al., 2023).

ECC can cause pain, discomfort, and developmental delays involving articulation, and speech patterns that affect a child's oral health and quality of life (Anil & Anand, 2017). The results of the systematic review stated that the average global prevalence of ECC was 23.8% in children aged less than 36 months and 57.3% in children aged 36 to 71 months (El Tantawi et al., 2018). Another study reported that the global prevalence of ECC from 1960 to 2019 in children aged 1, 2, 3, 4, and 5 years

was 17%, 36%, 43%, 55%, and 63%, respectively (Uribe et al., 2021). The prevalence of ECC in Indonesia in the age group of 3 to 4 years is 81.5% (Kementerian Kesehatan RI, 2018).

Several studies highlight the multifactorial properties of ECC such as karyogenic exposure to carbohydrates that can be fermented frequently and prolonged through improper feeding, duration of breastfeeding, socioeconomic background, knowledge, attitudes, behaviour and parental roles (Bagherian & Asadikaram, 2012; Rai & Tiwari, 2018; Ravikumar et al., 2021). Some research suggests that formula consumption patterns, including duration, frequency, timing, and mode of consumption, may affect ECC risk (Febriana, 2012; Jingga et al., 2019).

Another study compared the number of salivary bacterial colonies and potential of hydrogen (pH) values in early childhood and non-early childhood caries due to the consumption of formula milk using bottles. Previous research found that infants with early childhood caries had an acidic salivary pH, while caries-free infants had a normal salivary pH (Elianora et al., 2019). However, evidence regarding the pathogenicity of infant formula products is limited. In addition, few studies have specifically explored the impact of formula feeding on salivary pH in preschool-age groups. The pH of saliva is an important parameter because it affects the process of demineralization and remineralization in teeth (Cochrane et al., 2008; Ebrahimi et al., 2017). Therefore, this study aims to analyze the relationship between formula milk and to salivary pH of preschool children. The findings will provide insight into the karyogenic potential of infant formula and its role in the development of ECC into a caries prevention strategy in high-risk children.

2. METHODS

The research design used in this study was an analytical survey. The cross-sectional study approach is to look for the relationship between formula milk consumption and salivary pH. The sampling technique in this study is total sampling. Total sampling is a sampling technique where the number of samples equals the population. The sample in this study was 48 students of SPS TA'AM Mathlaul Anwar Tasikmalaya City. Data was obtained from respondents through questionnaires to parents and direct examination of research objects with salivary pH examination. The measuring instruments used in this study were observation sheets on the frequency of formula milk consumption and salivary pH examination sheets. Salivary pH measurement using a pH indicator paper analyzer (Song et al., 2015). The first step of salivary pH measurement is to collect the necessary materials such as pH indicator paper, cotton wool, and a small, clean container to collect saliva. The second step is to prepare the child by explaining the procedure in a simple and friendly way to help the child feel comfortable.

The third step is to collect saliva by placing a small cotton roll or cotton roll in the child's mouth to absorb saliva, after the cotton roll is wet, transfer the saliva to a clean container. The fourth step is to measure pH by immersing the pH indicator paper in the collected saliva until the colour of the paper changes according to the indicator. The final step is to interpret the results by comparing the colour of the pH indicator paper with the colour table available to determine salivary pH (Ravikumar et al., 2023). Statistical analysis using the Spearman Correlation Test. The pH categories of saliva are as follows:

Category	Score
Acidic	1 – 6,7
Neutral	6,8 – 7
Alkaline	7,1 - 14

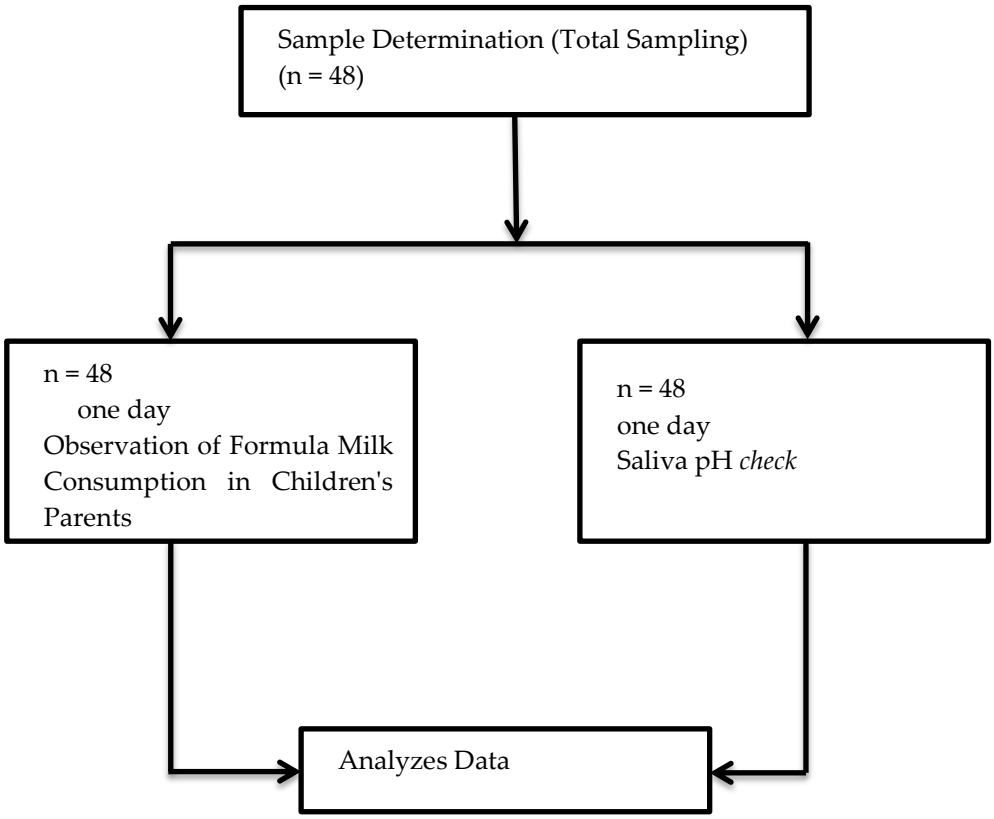

Figure 1. Research Flow

3. FINDINGS AND DISCUSSION

The sample in this study amounted to 48 children. Data on formula milk consumption is obtained from mothers who deliver children to school. The study was conducted during one visit (cross-sectional study). The sex sample was mostly women with an average age of 5 years (Table 1).

Table 1. Demographic Sample

Characteristic	Sample (n=24)
Age [a]	4,69
Child Gender	
Man	22(45,8%)
Woman	26(54,2%)

[a] Mean (SD)

Data on children who consume formula milk ≥ 3 times per day more than the < category 3 times per day, which is 28 people (58.4%) (Table 2).

Table 2. Frequency distribution of formula milk consumption

No.	Category	N	F (%)	$\bar{x}$ Formula Milk Frequency
1.	< 3 times	20	41,7	3
2.	≥ 3 times	28	58,3	
	Total	48	100	

The majority of salivary pH scores in children were acidic as many as 36 people (75%) with an average salivary pH of 5.89 (Table 3).

Table 3. Salivary pH Frequency Distribution

No.	Category	N	F (%)	$\bar{x}$ *pH Saliva*
1.	acidic	36	75	5,89
2.	alkaline	0	0	
3.	neutral	12	25	
	Total	48	100	

The results of the Spearman Correlation test obtained p of 0.001 ($p < 0.05$), then H_a was rejected and H_o was accepted which means there is a significant relationship between formula milk consumption and salivary pH in preschool children at SPS TA'AM Mathlaul Anwar Tasikmalaya City, and obtained results r -709 means a strong relationship. The symbol (-) indicates that the direction of the independent and bound variables is opposite, which means that the smaller the value of the independent variable, namely formula milk consumption, the greater the value of the bound variable, namely salivary pH (Table 4).

Table 4. Results of Data Analysis Using *Spearman Correlation Test*

Variable	r	P
Consume Formula Milk with *pH Saliva*	-709**	,001

Caries is a dental and oral disease that most often occurs in adults and children. Children who consume sugar frequently between the main meal and two hours before bedtime have a higher risk of dental caries (Echeverria et al., 2023; Taqi et al., 2018). Excessive sugar consumption is a major cause of dental caries, and it is very common, affecting almost half the world's population (World Health Organization, 2017).

Dental caries develops when bacteria in the mouth metabolize sugars and then produce acids that cause loss of minerals in the teeth (demineralization) of tooth enamel (Feldens et al., 2022; World Health Organization, 2017). Saliva has a buffering capacity that helps neutralize the acid produced by bacteria in the mouth (Dowd, 1999; Hegde et al., 2019).

A cross-country exploratory study found that the average sugar content was 5.9g/100ml across the products sampled, with most products being above 6.2g/100ml (Bridge et al., 2020). It is important to note that some infant formulas contain more sugar than soda drinks, but there is still little research on the relationship between consuming formula and salivary pH. This study reported the results of an analysis of the relationship between consuming formula milk and salivary pH in preschool children aged 3-6 years. The results of this study revealed that the average preschool child consumes formula milk at least 3 times a day or more. High-frequency feeding in late infancy, including bottle use and breastfeeding, is positively associated with dental caries in early childhood (Feldens et al.,

2018). The results of salivary pH examination in preschool children aged 3-6 years at SPS TA'AM Mathlaul Anwar Tasikmalaya City were found to be acidic on average with a score of 5. The acidogenic environment is caused by a low salivary pH so it becomes an environment for the growth of acidic bacteria that cause dental caries (Rusu et al., 2022; Seethalakshmi, 2016). We report the results of the Spearman Correlation test that there is a significant, strong and non-directional relationship between consuming formula milk and salivary pH in preschool children, which means that the more often children consume formula milk the lower the salivary pH (acidic). Lactose is the main carbohydrate in high-quality infant formula, mimicking the sugar present in breast milk, while other forms of sugar such as sucrose are also used in some formulas. A randomized controlled crossbreeding trial found that full-fat milk caused an initial decrease in salivary pH after 5 minutes of consumption, followed by gradual recovery within 60 minutes, while UHT (Ultra High Temperature) milk caused an increase in salivary pH due to its high buffering capacity content (Zamzam et al., 2023). Another study found that there was a statistically significant difference in salivary pH levels at baseline and after 30 minutes of consuming three different infant formulas (Chaudhary et al., 2011). The pH of saliva plays an important role in the process of dental caries. The low pH of saliva provides an acidogenic environment for the growth of acidic bacteria, which cause dental caries. In line with the results of previous studies that revealed that the high concentration of lactose in formula milk and the frequency of feeding can increase the risk of dental caries in infants (van Meijeren-van Lunteren et al., 2021). Bottle feeding causes a decrease in saliva at night, thus inhibiting the remineralization process which results in an increased risk of dental caries (Feldens et al., 2018; van Meijeren-van Lunteren et al., 2021). Previous research results confirmed that the frequency of bottle feeding is a major contributing factor to ECC syndrome (Rizal et al., 2010; van Meijeren-van Lunteren et al., 2021). Therefore, we urge caregivers or parents to pay more attention to the sugar content in formula milk, and the frequency of milk feeding by the product instructions used after consuming formula milk, it is expected to immediately clean the child's oral cavity so that it does not become an acidogenic environment for bacteria.

4. CONCLUSION

Our findings found that the average preschooler aged 3-6 years consumed formula at least 3 times a day or more and the average salivary pH was acidic. There is a strong and non-unidirectional relationship so that the more often you consume formula milk, the lower the salivary pH in preschool children. The pH of saliva plays an important role in the process of dental caries. The low pH of saliva provides an acidogenic environment for the growth of acidic bacteria, which cause dental caries

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