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RESEARCH ARTICLE

Correlation Between Cariogenic Diets and Oral Hygiene Habits on Early Childhood Caries in Klungkung, Bali

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ABSTRACT

Background: *Early Childhood Caries (ECC) is one of the most common dental and oral diseases occurring in children aged 48-71 months. Several factors can influence the occurrence of dental caries in children, one of which is the consumption of cariogenic foods that easily stick to teeth. These foods are fermented by certain bacteria to form acids, which can lead to plaque formation and damage tooth structures if left unchecked for an extended period.* ***Objective:*** *To examine the influence of cariogenic dietary patterns and dental and oral hygiene habits on ECC in children aged 48-71 months at Kumara Bhuana Saraswati Kindergarten, Klungkung.* ***Materials and Methods:*** *This research employs a quantitative study design with an analytical cross-sectional approach. The sampling technique used was non-probability sampling. The study involved 67 pairs of parents and their children (aged 48-71 months) from Kumara Bhuana Saraswati Kindergarten, Klungkung.* ***Results:*** *This study indicate a correlation with a p-value of <0.05 between the consumption of cariogenic foods with dental and oral hygiene maintenance behavior, and between the consumption of cariogenic foods with incidence of ECC in children aged 48-71 months at Kumara Bhuana Saraswati Kindergarten, Klungkung.* ***Conclusion:*** *There is a significant influence of cariogenic dietary patterns and dental and oral hygiene maintenance behavior on the incidence of Early Childhood Caries (ECC) in children aged 48-71 months at Kumara Bhuana Saraswati Kindergarten, Klungkung. Efforts to reduce ECC cases should focus on promoting healthier dietary choices and improving dental and oral hygiene practices among children and their caregivers.*

Keywords: *Cariogenic Diet, Early Childhood Caries, Oral Hygiene Habits*

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INTRODUCTION

Child dental caries often occurs in the maxillary deciduous teeth and first permanent molars.[1] This pattern of caries is commonly referred to as Early Childhood Caries (ECC).[2] ECC is a complex disease that involves the maxillary deciduous incisors, which can develop within a month after the eruption of these teeth and spread rapidly to other deciduous teeth.[3,4] ECC not only affects the oral health of infants and preschool-aged children but can also impact their overall health. ECC leads not only to pain in the oral cavity and enamel defects but also causes other issues, such as difficulties with eating and speaking, as well as an increased risk of caries in permanent teeth.[5]

Dental caries remains one of the most common oral health problems faced by children worldwide. The prevalence of dental caries in children aged 3-5 years varies across continents and countries.[6] Data from the United States show a higher prevalence compared to countries in Europe, with 40% of children experiencing dental caries by preschool age, while in the UK, 12% of 3-year-old children show visible signs of dental caries.[7] Studies in other countries indicate higher caries prevalence among children, with 36-85% in Asia, 38-45% in Africa, and 22-61% in the Middle East.[8] Surveys in Cambodia and Indonesia show high prevalence and severity of ECC, with 90% of children aged 3-5 years having a dmf-t index > 6.[9] The 2018 Basic Health Research (Riskesdas) survey indicated that the proportion of the population with oral health problems, based on Indonesian characteristics, was 41.1% for children aged 3-4 years, 67.3% for those aged 5-9 years, and 55.6% for those aged 10-14 years, with a national percentage of 57.6% of the population having oral health issues.[10]

Children are vulnerable to dental caries because they typically have behaviors or habits that do not support good oral health. One such behavior is the consumption of cariogenic foods, which are foods that can lead to dental caries. Cariogenic foods tend to be sticky, break down easily, and are high in carbohydrates, especially refined carbohydrates, such as candies, chocolate, bread, and biscuits. Excessive consumption of cariogenic foods can increase acid production by bacteria, making the oral cavity more acidic and damaging the tooth enamel.[8,9]

In addition, oral hygiene habits are also identified as a risk factor for dental caries. There is a strong association between oral hygiene behaviors and the prevalence of dental caries.[11,12] The quality of children's oral hygiene practices and parents' ability to limit the consumption of cariogenic foods are factors that can influence dental caries in children.[13] Oral hygiene behaviors, such as the method of brushing teeth, brushing from an early age, brushing with parental supervision, and using fluoride toothpaste daily, have been proven to significantly reduce the prevalence of ECC.[14] A study by Chu et al. in 2012 showed that tooth brushing is one of the factors that influences dental caries in preschool-aged children. The survey in this study revealed that children who started brushing their teeth at an early age had fewer dental caries. Brushing teeth helps keep erupted teeth clean and can deliver fluoride to the tooth surface when using fluoride toothpaste.[15] Parental assistance and guidance are crucial in reducing the risk of developing dental caries. Children's tooth brushing with the help of parents or caregivers is more effective in removing dental plaque and maintaining the oral cavity environment optimally, thus reducing the risk of dental caries in children.[16] Based on the previous explanation, the objective of this study is to determine the impact of cariogenic dietary patterns and oral hygiene habits on ECC in children aged 48-71 months at Kumara Bhuana Saraswati Kindergarten in Klungkung.

MATERIALS AND METHODS

The type of research used is a quantitative research method with an analytic

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cross-sectional approach. The research was conducted from April to May 2022 at Kumara Bhuana Saraswati Kindergarten, Klungkung District, Klungkung Regency. The sampling technique used in this study is non-probability sampling. The sampling type used is purposive sampling. The sample size in this study is 67 pairs of parents and children aged 48 - 71 months who meet the inclusion criteria and do not have exclusion criteria. The ECC assessment is conducted by asking parents to send photos of their child's teeth via the available google form. The photo-taking procedure follows the instructions and examples provided, which include front view, right and left side views, and occlusal views of maxilla and mandible. The photos submitted will be analyzed to determine the ECC classification. Cariogenic food consumption and oral hygiene habits are evaluated using a questionnaire. The questionnaire has been tested for validity and reliability using SPSS. The data obtained were processed using SPSS. Univariate analysis was presented in the form of frequency distribution tables and interpreted narratively, while bivariate analysis to examine the relationship between cariogenic food consumption and oral hygiene habits was conducted using Fisher's Exact Test.

RESULTS

Respondents in this study were parents (father/mother) and the sample in this study were children who attended Kindergarten Kumara Bhuana Saraswati Klungkung who met the inclusion and exclusion criteria and who were willing to be the research sample. The total number of respondents and samples in this study were 67 pairs of parents and children. The following are the characteristics of the respondents, namely parents' education and the characteristics of the sample, namely the sex of the child and the age of the child.

Table 1. Sociodemographic characteristics

Sociodemographic Characteristics	Frequency (n)	Percentage (%)
Parents Education:		
Did not finish elementary school	0	0
Graduated from elementary school/middle school	4	6
Graduated from high school/equivalent	22	32.8
Graduated from college S1/S2/S3	41	61.2
Total	67	100
Gender		
Man	30	44.8
Woman	37	55.2
Total	67	100
Sample Age		
48-59 months	20	29.9
60-71 months	46	70.1
Total	67	100

Based on parents' education, the highest number of respondents were in the S1, S2, S3 tertiary graduate group, namely 41 people (61.2%) and the least were in the elementary school/middle school graduate group, namely 4 people (6%). In the gender of the sample, there were more women, namely 37 children (55.2%), while there were fewer male samples, namely 30 children (4.8%). In the sample age, there were 46 children (68.7%) aged 60-71 months compared to those aged 48-59 months, namely 21 children (31.3%).

Table 2. Distribution of consumption of cariogenic diets

Cariogenic Diets	Frequency (n)	Percentage (%)
Low	30	44.8
Moderate	28	41.8
High	9	13.4
Total	67	100

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Table 3. Cross-tabulation of cariogenic diets by genders

Cariogenic Diets	Male		Female		Total	
	n	%	n	%	n	%
Low	12	17.9	18	26.9	30	44.8
Moderate	11	16.4	17	25.4	28	41.8
High	7	10.4	2	3.0	9	13.4
Total	30	44.8	37	55.2	67	100

Table 2 shows the highest number of samples with a cariogenic diet in the low criteria, namely 30 samples (44.8%) and the least in the high criteria, namely 9 samples (13.4%). Table 3 shows that the male is mostly in the low criteria, namely 12 samples (17.9%) and the least in the high criteria, namely 7 samples (10.4%). In the female, the most were in the low criteria, namely 18 samples (26.9%) and the least in the high criteria, namely 2 samples (3.0%).

Table 4. Cross-tabulation of cariogenic diets by age

Cariogenic Diets	48-59 months		60-71 months		Total	
	n	%	n	%	n	%
Low	9	13.4	21	31.3	30	44.8
Moderate	8	12.0	20	29.9	28	41.8
High	3	4.5	6	8.9	9	13.4
Total	20	29.9	47	70.1	67	100

Table 5. Distribution of dental & oral hygiene behavior

Dental & Oral Hygiene Behavior	Frequency (n)	Percentage (%)
Poor	28	41.8
Fair	21	31.3
Good	18	26.9
Total	67	100

Table 4 shows that at the age of 48-59 months most of the low criteria are 9 samples (13.4%) and the least are high criteria, namely 3 samples (4.5%). At the age of 60-71 months the most were in the low criteria, namely 21 samples (31.3%) and the least in the high criteria, namely 6 samples (8.9%). Table 5 shows that the behavior of maintaining dental & oral hygiene is most common in the poor criteria, namely 28 samples (41.8%) and at least in the good criteria, 18 samples (26.9%).

Table 6. Cross-tabulation of dental & oral hygiene behavior by genders

Dental & Oral Hygiene Behavior	Male		Female		Total	
	n	%	n	%	n	%
Poor	17	25.4	11	16.4	28	41.8
Fair	9	13.4	12	17.9	21	31.3
Good	4	6.0	14	20.9	18	26.9
Total	30	44.8	37	55.2	67	100

Table 7. Cross-tabulation of dental & oral hygiene behavior by age

Dental & Oral Hygiene Behavior	48-59 months		60-71 months		Total	
	n	%	n	%	n	%
Poor	8	11.9	20	29.9	28	41.8
Fair	6	9.0	15	22.3	21	31.3
Good	6	9.0	12	17.9	18	26.9
Total	20	29.9	47	70.1	67	100

Table 6 shows that the male is mostly in the less criteria, namely 17 samples (25.4%) and the most slightly on good criteria, namely 4 samples (6.0%). In the female, the most were in good criteria, namely 14 samples (20.9%) and the least were in poor criteria, namely 11 samples (16.4%). Table 7 shows that at the age of 48-59 months the most are in the less criteria, namely 8 samples (11.9%) and the least in the sufficient and good criteria, namely 6 samples (9.0%). At the age of 60-71 months, the most were in the less criteria, namely 20 samples (29.9%) and the least in the good criteria, namely 12 samples (17.9%).

Table 8. ECC incidence

ECC	Frequency (n)	Percentage (%)
ECC 0	17	25.4
ECC 1	4	6.0
ECC 2	16	23.8
ECC 3	30	44.8
Total	67	100

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Table 9. Cross-tabulation of ECC by genders

ECC	Male		Female		Total	
	n	%	n	%	n	%
ECC 0	3	4.5	14	20.9	17	25.4
ECC 1	2	3.0	2	3.0	4	6.0
ECC 2	6	9.0	10	14.9	16	23.9
ECC 3	19	28.4	11	16.4	30	44.8
Total	30	44.8	37	55.2	67	100

Table 8 shows that the highest number of samples is in the ECC 3 criteria of 30 samples (44.8%) and the least number of samples is in the ECC 1 criteria, namely 4 samples (6.0%). Table 9 shows that male is mostly at ECC 3 of 19 samples (44.8%) and the least in ECC 1, namely 2 samples (3.0%). Female is the most common in ECC 0 criteria, namely 14 samples (20.9%) and the least in ECC 1 criteria, namely 2 samples (3.0%).

Table 10. Cross-tabulation of ECC by age

ECC	48-59 months		60-71 months		Total	
	n	%	n	%	n	%
ECC 0	6	9.0	11	16.4	17	25.4
ECC 1	1	1.5	3	4.5	4	6.0
ECC 2	5	7.5	11	16.4	16	23.9
ECC 3	8	11.9	22	32.8	30	44.8
Total	20	29.9	47	70.1	67	100

Table 10 shows that the age of 48-59 months is the most in ECC 3 criteria, namely 8 samples (11.9%) and the least in ECC 1 criteria, namely 1 sample (1.5%). At the age of 60-71 months the most on ECC criteria 3, namely 22 samples (32.8%) and the least on ECC criteria 1, namely 3 samples (4.5%). Bivariate analysis in this study used the chi-square test to determine the effect between the two variables. However, the results of the chi square test did not meet the requirements because the expectation value was more than 20%, so the Fisher's Exact Test was used as an alternative test.

Table 11. The effect of consuming cariogenic diets on ECC incidence

Cariogenic Diets	ECC 0		ECC 1		ECC 2		ECC 3		Total		*p*-value
	n	%	n	%	n	%	n	%	n	%	
Low	8	11.9	2	3.0	7	10.4	13	19.4	30	44.8	0.029
Moderate	9	13.4	2	3.0	9	13.4	8	11.9	28	41.8	
High	0	0	0	0	0	0	9	13.4	9	13.4	
Total	17	25.3	4	6.0	16	23.9	30	44.8	67	100	

The p-value of the cariogenic food consumption variable with ECC is 0.029 (<0.05), so that the null hypothesis (H0) is rejected, and the alternative hypothesis (Ha) is accepted. It can be concluded that there is an effect of a cariogenic diet on the incidence of ECC in children aged 48-71 months at Kumara Bhuana Saraswati Klungkung Kindergarten.

Table 12. The influence of dental & oral hygiene behavior with ECC incidence

Dental & Oral Hygiene Behavior	ECC 0		ECC 1		ECC 2		ECC 3		Total		*p*-value
	n	%	n	%	n	%	n	%	n	%	
Poor	2	3.0	1	1.5	9	13.4	16	23.9	28	41.8	0.000
Fair	3	4.4	2	3.0	6	9.0	10	14.9	21	31.3	
Good	12	17.9	1	1.5	1	1.5	4	6.0	18	26.9	
Total	17	25.3	4	6.0	16	23.9	30	44.8	67	100	

The p value of the dental & oral hygiene maintenance behavior variable with the incidence of ECC is 0.000 (<0.05) so the null hypothesis (H0) is rejected, and the alternative hypothesis (Ha) is accepted. It can be concluded that there is an influence of dental & oral hygiene maintenance behavior on the incidence of ECC in children aged 48-71 months at TK Kumara Bhuana Saraswati Klungkung

DISCUSSIONS

The results of the study show that there is an effect of a cariogenic diet on the incidence of ECC (p-value 0.029). Based on these results, it can be concluded that children who consume cariogenic foods are more at risk of developing dental caries compared to children who do not consume cariogenic foods. Cariogenic foods are those that contain high amounts of processed carbohydrates, which can lead to dental caries.[17]

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Dental caries is mainly caused by the frequent consumption of refined carbohydrates. Refined carbohydrates, often referred to as simple carbohydrates, are carbohydrates that have had their nutrients removed. Sucrose is the most cariogenic simple carbohydrate because it has a unique ability to support the synthesis of extracellular glucan by *Streptococcus mutans*. All fermentable carbohydrates are metabolized by bacteria in various ways, producing acids as byproducts.[18] This can lower the pH of the oral cavity to as low as 4.5. After consuming cariogenic foods, the plaque pH decreases and remains low until the sugar is cleared from the mouth and the acid produced is dissolved or neutralized by saliva. Persistent acidic conditions can lead to the dissolution (demineralization) of minerals in the hard dental tissue underneath.[19]

Caries tends to develop relatively slowly, over months or years. In the early stages, lesions under the surface can be arrested or reversed. When the plaque pH returns to neutral, mineral ions in the plaque contribute to the remineralization of carious lesions. The process of dental caries is caused by an imbalance between demineralization and remineralization.[20] Thus, a high consumption of cariogenic foods can lower plaque pH, disrupting the balance between demineralization and remineralization, which leads to dental caries. The results of this study align with research conducted by Rekawati and Frisca on children in grades 1–3 at SD Negeri 3 Fajar Mataram, which showed a significant statistical relationship between the consumption of cariogenic foods and dental caries.[21] A study by Winahyu et al on children in grades 1 and 2 at SDN 1 Sepatan, Tangerang, also reported a significant relationship between the consumption of cariogenic foods and the incidence of dental caries.[22]

This study also found an effect between oral hygiene habits and the incidence of ECC (p-value 0.000). The results of this study are consistent with research conducted by Maulidta et al, which stated that there is a relationship between tooth brushing habits and the incidence of dental caries in preschool-aged children.[23] A study by Percival et al also showed a link between children with ECC and poor oral hygiene in children aged 3-5 years.[24] As we know, dental caries is a multifactorial disease. Several interactions between the host, diet, and microorganisms on the tooth surface over time result in the dissolution of tooth tissue, which causes dental caries.[25] Caries will not occur if children have good oral hygiene, such as regular tooth brushing habits. Regular tooth brushing helps remove food particles stuck to teeth after consuming cariogenic foods, thereby reducing the risk of dental caries.[26]

Behaviors related to dental and oral health, such as cleaning teeth, dietary practices, and using preventive dental services when visiting the dentist, are linked to the incidence of ECC. Oral hygiene behaviors such as brushing techniques, starting tooth brushing at an early age, brushing with parental supervision, and using fluoride toothpaste daily can reduce the prevalence of ECC.[27] Brushing regularly with fluoride toothpaste can decrease *Streptococcus mutans* colonization, helping to reduce the risk of ECC. Brushing teeth can help remove plaque from teeth and reduce the number of bacteria, while fluoride in toothpaste aids in remineralizing carious lesions. Parents are advised to start brushing their children's teeth with a soft-bristled toothbrush and fluoride toothpaste as soon as the first tooth erupts to prevent ECC.[28]

The causes of early childhood caries are more complex than dental caries that occur in adulthood due to the strong influence of infant feeding practices and parental oral hygiene behaviors.[29] The etiology of ECC also includes other risk factors such as genetics, saliva, oral hygiene, family, child behavior and habits, as well as the environment. Physical characteristics of teeth, such as deep and narrow occlusal fissures, deep buccal or lingual pits, and enamel hypoplasia, will affect the development of dental caries. The shape, size, and arrangement of

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teeth will also influence the cleaning effects of saliva.[30]

CONCLUSION

There is a relationship between cariogenic food consumption and oral hygiene habits with Early Childhood Caries (ECC) in children aged 48-71 months at Kumara Bhuana Saraswati Klungkung Kindergarten.

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