ORIGINAL ARTICLE

The association of cariogenic foods consumption frequency on the occurrence of dental caries in children with autism spectrum disorders

Chita Sintya Dewi[1]
Risti Saptarini Primarti[1*]
Inne Suherna Sasmita[1]

[1]Department of Pediatric Dentistry, Faculty of Dentistry, Padjadjaran University, Indonesia

* Correspondence:
risti.saptarini@fkg.unpad.ac.id

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ABSTRACT

Introduction: Dental caries is a multifactorial disease that invades the hard tissues of the teeth. Dental caries is among the most common oral manifestations in children with autism spectrum disorders (ASD). ASD is a neurodevelopmental disorder characterized by deficits in social interactions, communication difficulties, and restricted repetitive behavior. ASD children have a higher risk of dental caries due to their difficulty maintaining good oral hygiene and poor diet, such as having a high preference for cariogenic foods. This study aims to analyze the association between cariogenic foods consumption frequency and the occurrence of dental caries in ASD children. **Methods:** Quantitative study was performed with a cross-sectional design and total sampling techniques on 15 ASD children. Data analysis using Spearman Rank test. **Results:** This study found (66,7%) of ASD children had low levels of cariogenic foods consumption. Respectively, the ASD children's deft and DMFT indices were (3.3) and (4.4). A significant value between the frequency of consumption of cariogenic foods and DMFT/deft was (0.297). The level of relationship between the frequency of consumption of cariogenic foods with DMFT/deft is (0.289), indicating a low association. **Conclusions:** There is no association between cariogenic foods consumption frequency and the occurrence of dental caries in children with ASD. The average indices of DMFT and deft of ASD children are at moderate levels. ASD children have low levels of cariogenic food consumption frequency.

KEYWORDS
Autism Spectrum Disorder (ASD), Cariogenic Foods, Dental Caries.

INTRODUCTION

Dental caries are a result of the interaction between biofilm and fermentable dietary carbohydrates on the tooth surface for a long time. Oral bacteria, carbohydrates, and the availability of the tooth surface (host), all play a role in the development of dental caries. Other factors that influence the rate of development of dental caries include oral hygiene, tooth morphology, surface characteristics, eating habits, and the quality and quantity of saliva.[1] According to the Global Burden of Disease Study 2017, 2.3 billion people had permanent dental caries and over 530 million children had primary tooth decay.[2] Riset Kesehatan Dasar (Riskesdas) in 2018, reported that caries prevalence in Indonesia reached (88,8%).[3]

Dental caries is one of the most common oral manifestations in children with autism spectrum disorders (ASD).[4] In 1943, Leo Kanner, a child psychiatrist, was the first who described autism. Leo Kanner identified 11 children with physical and mental disorders who struggled to adapt to their surroundings., has trouble forming relationships with others, craves solitude, and has repetitive routines or activities. Autism is a neurodevelopmental disorder characterized by deficits in social interactions, communication difficulties, and the presence of restricted, repetitive behavior.[5]

DSM 5th edition (2013) merged the diagnosis of autistic disorder, Asperger's disorder, childhood disintegrative disorder and pervasive developmental disorder-not otherwise specified (PDD-NOS).[6] Autism is classified as a disorder on the autism spectrum. The term "spectrum" represents the variability in symptom severity ranging from mild, moderate to severe autism that requires long-term specialist support.[5]

The global prevalence of ASD has steadily increased over the past two decades.[5] The Center for Disease Control's (CDC) Autism and Developmental Disabilities Monitoring (ADDM) in 2020 reported the prevalence of ASD reached 1 in 54 eight year old children, with a higher prevalence in boys than girls.[7] A meta-analysis study verified that the prevalence of dental caries in children and adolescent with ASD reached (60,6%).[8] Children with ASD have a higher risk of dental caries due to their difficulty maintaining oral hygiene and having a high preference for cariogenic foods.[9,10]

The cariogenic food is sticky and sugar-containing food, which has the potential to induce dental caries.[11] Sugar, especially sucrose, has the ability to form bacterial colonization, allowing more bacterial adhesion on the tooth surface, as the biofilm viscosity increases.[12] Foods that contain high sugar, which is cariogenic, are preferred by ASD children, such as bananas, mangoes, sponge cakes, biscuits, candies, doughnuts, etc.[13] Previous study showed that autistic children are very sensitive to bitter taste leading to refusal of certain foods and it could be the potential reason for reduced intake of vegetables. The study shows that 68.9% of the children rejected having vegetables. In contrast, 78.7% of the

children preferred having fruits because of their texture and sweet taste. Regarding to dental caries, previous researchers analysed that having fruits/vegetables as snacks replacing the sugar or sweets reduced dental caries. Similar results were achieved but not significant.[13] The most important factor in cariogenic biofilms formation is the high frequency of carbohydrate (sucrose) consumption.

Biofilms are capable of metabolizing sucrose and glucose, producing various organic acids (lactic, acetic and propionic acids) on the tooth surface. These organic acids cause pH below 5.5 within three minutes and initiate the demineralization process.[1] Demineralization that continues to occur can develop to form a cavity.[14] The cavity formed becomes a more protective and retentive place for cariogenic bacteria, making the lesion progression more progressive.[1]

The Biruku Foundation, located in Bandung, is an active foundation that provides a place for learning and therapy for ASD children. On the other hand, study on the relationship between the frequency of cariogenic food consumption and the occurrence of dental caries in ASD children in Indonesia is still lacking, especially in ASD children who receive an early education for dental health care. This study aims to analyze the association between the frequency of cariogenic food consumption and the incidence of dental caries in ASD children at the Biruku Foundation, Bandung.

METHODS

The research design was cross-sectional. The sampling method used was non-probability sampling with a total sampling technique. The inclusion criteria were; (1) children diagnosed ASD by a pediatrician (2) ASD children who are able to follow instructions (3) have never received oral prophylaxis before (six months) (4) well-communicated parents/caregivers (5) live with parents/caregivers. The exclusion criteria were; (1) ASD children diagnosed with other diseases/disorders that can affect caries (chronic kidney disease, cerebral palsy, sarcoidosis and amyloidosis) (2) ASD children with Down Syndrome/Diabetes.The independent variable of the study was the frequency of consumption of cariogenic foods and the dependent variable of the study was dental caries. Cariogenic foods contain a lot of sugar, a sweet and sticky substance which can cause dental caries.[11] The frequency of cariogenic foods consumption in ASD children measured using the Food Frequency Questionnaire (FFQ). The FFQ is an instrument for assessing food consumption to determine the relationship between certain foods and the onset of disease.[15]

The FFQ was tested for validity and reliability, the test result for reliability is Alpha Croncbah 0.965. Dental caries is damage to the surface of the teeth which is marked with discontinuity of enamel surface, definite catch to probe, and definite cavitation. Dental caries measured using the DMFT index for permanent teeth and deft for primary teeth. DMFT or deft is used to measure the caries experience of teeth with D (decay) to indicate tooth decay or there are brown to black spots due to caries, M (missing) or e (exfoliated) to indicate teeth missing due to caries, F (filling) to indicate teeth patched for caries.[16] Data collecting procedure was done by conducting informed consent, FFQ, DMFT and deft form, using examination instruments, personal protective equipment, headlamps and laptops. The research procedure begins with an explanation about the procedure and purpose of the study, then filled out the informed consent and FFQ form by the parents/caregivers, and ends with dental caries examination. Data analysis includes univariate and bivariate analysis. Univariate analysis to describe each of the variables, the frequency of cariogenic food consumption and dental caries. Bivariate analysis using Spearman Rank correlation to determine the relationship between the frequency of cariogenic food consumption to the incidence of dental caries.

The Spearman rank correlation analysis is used to measure the strength and direction of relation between two different variables with a small sample size (less than 30).[17] The Spearman Rank Correlation sign shows the relationship between the variables being analyzed. A positive sign indicates an increase in the independent variable will affect an increase in the dependent variable, while a negative sign indicates an increase in the independent variable will affect a decrease in the dependent variable.

RESULTS

The study was conducted on ASD children with an age range of 6-21 years. There are 15 children who met the inclusion criteria, consisting of 12 boys and three girls. Research subjects were characterized by gender and age.

Table 1. Characteristics of Research Subjects.

Characteristic	Frequency	Percentage (%)
Gender		
Male	12	80
Female	3	20
Total	**15**	**100**
Age		
5-11	5	33,3
12-16	3	20
17-25	7	46,7
Total	**15**	**100**

Table 1 presents that 12 (80%) out of 15 subjects were males, and most of them were aged 17-25 years (46%).

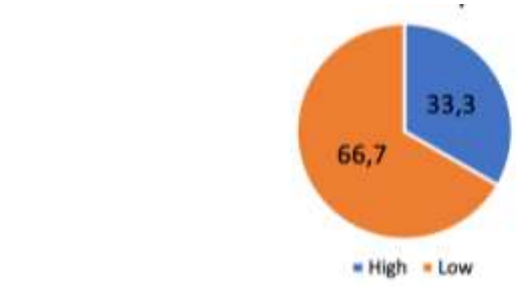

Figure 1. Frequency Distribution ASD Children's Cariogenic Food Consumption.

Figure 1 shows that as many as 10 (66,7%) out of 15 subjects had a low frequency of cariogenic foods consumption.

Table 2. ASD Children deft & DMFT Index Distribution.

Caries Index	D/d	M/e	F/f	Total	Index	Criteria
deft	18	2	0	20	3,3	Moderate
DMFT	35	9	0	44	4,4	Moderate

Table 2 presents the ASD children's deft and DMFT indices were (3.3) and (4.4), which means at moderate level.

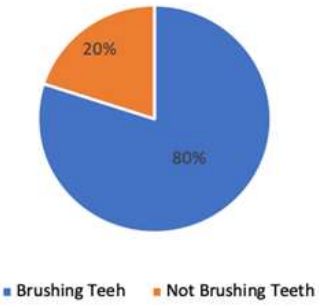

Figure 2. Frequency Distribution of ASD Children's Brushing Teeth Behavior After Consuming Sweet Foods.

Figure 2 shows that of the 15 subjects, 12 (80%) of the ASD children brushed their teeth after consuming cariogenic foods.

Table 3. Correlation of Cariogenic Food Consumption Frequency with DMFT and deft Index

			DMFT	FFQ
Spearman's rho	**DMFT**	*Correlation Coefficient*	1.000	0.289
		Sig. (2-tailed)	.	0.297
		N	15	15
	FFQ	*Correlation Coefficient*	0.289	1.000
		Sig. (2-tailed)	0.297	.
		N	15	15

Table 3 presents the value of sig. is (0.297) indicating there is no significant correlation between the frequency of cariogenic food consumption and DMFT/deft. The association level was (0.289), indicating a low correlation between cariogenic food consumption and DMFT/deft.

Table 4. Correlation of Brushing teeth Behavior after Consuming Cariogenic Food with DMFT and deft.

			DMFT	Brushing teeth
Spearman's rho	**DMFT**	*Correlation Coefficient*	1.000	-0.739**
		Sig. (2-tailed)	.	0.002
		N	15	15
	Brushing teeth	*Correlation Coefficient*	-0.739*	1.000
		Sig. (2-tailed)	0.002	.
		N	15	15

**Correlation is significant at the 0.01 level (2-tailed).

Table 4 presents the value of sig. is (0.002) so it can be concluded that there is a significant correlation between brushing teeth behavior after consuming cariogenic food and DMFT/deft. The correlation between brushing teeth behavior after consuming cariogenic food and DMFT/deft is very strong, as indicated by the magnitude of the association level (-0,739).

DISCUSSION

The increasing prevalence of ASD and the risk of dental and oral disease, mainly dental caries, due to their lifestyle and diet. As shown in Table 1, the ASD children who met the inclusion criteria were 15 children with an age range of 6-21 years and a distribution of 12 boys and three girls. Research data shows that the prevalence of ASD is higher in boys compared to girls, with a ratio of 4:1. Various studies have similar results with a higher prevalence of ASD in boys than in girls.[13,20,21]

The results showed that (66,7%) children with ASD had a low frequency of cariogenic food consumption. Our results are in line with the previous studies that have investigated ASD children consume low-carbohydrate foods and tend to dislike sweet foods.[22] According to the results of the present study, ASD children as their research subjects, did not like sweet foods and consumed lower sugar than the control group.[23] This was similar to the findings observed by Park *et al*., in his study ASD children in their study preferred meat, fish, eggs, nuts, milk, and snacks. They tend to dislike foods that contain fat and are sweet.[24] ASD children prefer foods that contain grains, such as wheat, oats, corn, and also prefer chicken. The preferred food texture is often soft food and semi liquid.[25]

Children with ASD have an eating disorder in the form of food selectivity. Food selectivity is a manifestation of sensory sensitivity or sensory responsiveness to the texture and smell of food. Food selectivity that occurs in ASD causes them to be reluctant to try new foods *(neophobia)* and their limited food preferences.[26] The low frequency of consumption of cariogenic foods in ASD children may be related to their sensory sensitivity to the texture and smell of cariogenic foods.

The results of the study are not in accordance with Hariyani et al*.,* which showed (51.4%) ASD children in their study consumed sweet foods more than twice a day.[4] Nonong et al., found (82.6%) ASD children in their study have strong preference to cariogenic foods and (52.17%) they consumed cariogenic foods three times a day or more.[27] Difference in research findings could be due to disproportionate sample size, differences in research instruments, and differences in parenting patterns.[28]

Table 2 shows that the DMFT and deft indices of ASD children are at a moderate level. Our results are in agreement with the previous studies that have investigated the deft and DMFT of ASD children in Turkey were at moderate level, respectively (3,54) and (3,4).[29] Dosah et al., which examined the differences in DMFT index of ASD children and normally developing children, showed that the DMFT index of ASD children (3,09) was at a moderate level, while the DMFT index of typically developing children (4,59) was at a high level.[30] The low dental caries index in ASD children is related to good parental supervision, such as often helping brush teeth and giving less cariogenic food.[31] Low caries prevalence in ASD could be due to less snacking and eating only when food was served, less interest in food, including sweet food, and no initiative to take food by themselves.[32] Many other studies found that there was no difference in the prevalence of dental caries in ASD children with typically development children.[29]

We found that (80%) of children with ASD brush their teeth after consuming cariogenic foods. Similar to previous studies, (97%) of children with ASD brush their teeth regularly. Suhaib's study showed (82,7%) children brush their teeth with the help of others.[33] The high awareness about the dental hygiene of ASD children can be related to parents' knowledge of oral hygiene. Parents play a key role as transmitters of oral health behavior for their children, in this study parents often receive education about dental and oral health.

This study shows there was no significant correlation between the increase in cariogenic food consumption frequency and the increase in dental caries. Similar to previous study that found the correlation between cariogenic diet and the incidence of dental caries was not significant, and there was an insignificant correlation between the frequency of cariogenic food consumption and the incidence of dental caries.[34,35] Furthermore, Kotha et al*.,* found that the food reward in the form of

sweet foods given by parents did not significantly increased dental caries risk in ASD children and also had a low statistical correlation.[13]

Cariogenic food is one of the main factors that plays a role in the occurrence of caries, however dental caries is a multifactorial disease caused by host factors, time, carbohydrates, and bacteria which makes it difficult to pinpoint a single cause. Acidogenic bacteria begin to produce acid to initiate demineralization after meal.[36] Demineralization is the process of dissolution of the mineral hydroxyapatite from tooth enamel. Dental caries is result from the ongoing demineralization without balanced by remineralization for a long time will cause dental caries.[1]

Remineralization is the process of returning mineral hydroxyapatite to the tooth enamel. Remineralization can occur as a natural repair process from saliva and assisted by tooth brushing behavior that can return the pH of the oral cavity back to neutral (pH>7.5).[1] The insignificant relationship in the study could be caused by brushing teeth behavior after consuming cariogenic foods which can be a preventive factor for dental caries,[34] most of the ASD children in this study brushed their teeth after consuming cariogenic foods which makes demineralization did not occur. In addition, the fluoride content in the toothpaste would form fluorapatite (FA) which is more resistant to acid (critical pH 4.5).

There was a significant relationship between brushing teeth behavior after consuming cariogenic foods and the incidence of dental caries represented in this study. The results showed the correlation coefficient value was minus (-), which indicated the direction of the relationship between brushing teeth behavior and DMFT, when the brushing teeth behavior increased it would decrease the index of DMFT/deft. Consumption of cariogenic foods followed by brushing teeth can reduce dental caries risk. The research results are in accordance with the theory that brushing teeth can reduce the risk of dental caries. Aprita et al. discovered a significant relationship between brushing teeth behavior and the occurrence of dental caries, as well as that children who brushed their teeth less than twice a day were (7,7) times more likely to experience dental caries than children who brushed their teeth less than twice a day.[37]

Brushing teeth behavior aims to prevent plaque formation that can cause caries, gingivitis and periodontitis. Brushing teeth behavior is not only one of the preventive factors in the incidence of dental caries but is also essential for maintaining oral hygiene. The fluoride contained in toothpaste helps prevent dental caries, besides the detergent *(sodium lauryl sulfate)* helps improve oral hygiene.

There were limitation that should be noted in this research, including (1) the study was only conducted at one foundation, so the sample size was small and the results could not be generalized to the entire ASD population (2) FFQ, as the questionnaire used in this study only measured the frequency of cariogenic food consumption without measuring the quantity (number of serving consumed), it also cannot assess the actual daily consumption, and (3) respondents could not develop alternative answers because the questionnaire consists of closed questions.

CONCLUSION

There is no association between cariogenic foods consumption frequency and the occurrence of dental caries in children with ASD. The average indices of DMFT and deft of ASD children are at moderate levels. ASD children have low levels of cariogenic food consumption frequency.

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Data Availability Statement: The availability of research data will be given with the permission of all researchers via email correspondence with due regard to ethics in research
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