Analyzing Children Cariogenic Profile During The COVID-19 Pandemic in Indonesia

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Abstract

Since the World Health Organization (WHO) declared the COVID-19 pandemic on March 11, 2020, the world has changed dramatically. The pandemic has affected daily life among children, including changes in lifestyle, eating habits and daily behaviors.

In this study, we arrange the research to analyze cariogenic profile in children during the COVID-19 pandemic in Indonesia.

An analytic cross-sectional study of 755 children aged 6-12 years was conducted in April 2022. Given the pandemic circumstances, data were collected using a questionnaire through Google forms platform. The questionnaire consists of 12 questions related to oral health care, dietary habits, daily activity during the pandemic, and the characteristics of the study participants. We performed questionnaire validation, K-mean cluster, descriptive, bivariate, and multivariate analyses. Cariogenic profile of each group according to the cluster analysis consist of: low risk caries (67.3%) and high risk caries (32.7%).

The result perform that there is no significant association between mothers' characteristics such education, age, and employment status) and cariogenic profile. Conclusion: Caries risk groups (low and high risk) were determined by five indicators (caries experience, tooth brushing, snacking, sweet beverages consumption, regularly dental visit, family income, and free time activities during stay at home).

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Introduction

The World Health Organization (WHO) on March 11, 2020, declared coronavirus disease 2019 (COVID-19) as a pandemic. COVID-19 has spread rapidly to more than 170 countries and territories around the world. Since then, many studies have been conducted to better understand the disease. Our world has changed dramatically due to a new pandemic virus, that spread all over the globe. The COVID-19 pandemic has contributed to several changes in life, including change in lifestyles, eating habits, and daily behaviors. To prevent disease transmission, public health authorities had applied social isolation, which had led to lifestyle changes in the population. Physical distancing and self-isolation had affected society to a large extent.[1-3]

During the pandemic, vast literature and public policies had recommended children to stay at home due to the high risk of COVID-19 infection. Children's lifestyles had consequently been changed. Limited studies showed the effect of this recommendation on eating habits of young children. Moreover, many children staying at home might have a reduction in the amount of daily physical activity, particularly outdoor activities. These children also might snack more. An international online survey reported unhealthier food consumption and meal patterns, as well as decreased physical activities during the COVID-19 lockdown.[4] During the COVID-19 pandemic, a balanced and healthy diet has been recommended to protect general health and support the immune system. Another recommendation was to avoid sugary food consumption in children, as well as to restrict the consumption of sweets and sugar-sweetened

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beverages, such as flavored milk, carbonated drinks, and fruit-flavored juices.[5,6]

Healthy dietary practices during the pandemic are not only necessary for children's general health but are also for oral health. Diet plays an important role in the occurrence of dental caries since sticky foods and sugars make the oral environment more susceptible to dental caries. Healthy dietary habits and proper regular toothbrushing in children are essential to prevent dental caries, not least during the pandemic.[7-9]

While WHO and governmental health authorities have been actively working on containing the COVID-19 transmission, such circumstances affected health and wellbeing in the general population, including psychological distress and its related symptoms (e.g., stress, panic, and anxiety). Exposure to COVID-19 information from the media can be stressful. Stress might lead to sedentary behavior and overeating. When these consequences occur in children, the children's cariogenic profile might be affected.[10-11]

To date, there has been a very high prevalence of oral disease, especially dental caries, across all ages, comprising a persistent public health challenge. Many surveys of dental caries show that caries experience has increased by around 10% over the last decade.[12]

Dental caries is a preventable disease. However, to date, dental caries is still an important global health problem. It is the most common oral infectious disease in children. Dental caries is five times more common than asthma, and seven times more common than hay fever or allergic rhinitis in children.[13,14] According to the Indonesian Ministry of Health in 2018, the prevalence of dental caries in children was 93% (3-4 years of age), 65.5% (12 years of age), and 67.4% (15 years of age).[15]

Several large studies have shown a strong relationship between diet and dental caries. Some studies conducted in humans that showed this relationship are the Hopewood House Study, the Vipeholm Study, the Turku Study, the Experimental Production of Caries in Man study, and the Hereditary Fructose intolerance study. It has also been known that snacking and eating frequency are associated with dental caries. Several beverages (such as carbonated, sweetened, and energy drinks) have high cariogenic potential. Frequent consumption of such beverages can accelerate caries progression.[16,17]

Cariogenic profile–can be defined as the patient's condition that describes all the things related to the possibility the developmental of caries or decay. Many factors associated with cariogenic profile are unseen in the clinical examination, yet they contribute to dental caries. These factors, considered as risk factors, are the indirect causes of dental caries and play an important role in the disease pathology, particularly in the disease progression. In pathological conditions, risk factors can explain the treatment of imbalance after clinical onset of disease.[18,19] A questionnaire of pediatric cariogenic profile measures caries occurrence, oral hygiene, dietary habit, economic status, dental visit, and the use of orthodontics appliances. The aim of the present study was to assess cariogenic profile in children. Understanding the pediatric cariogenic profile would assist clinicians to provide an appropriate and comprehensive management (promotion, prevention and treatment) of dental caries in children during the pandemic and after.

Materials and methods

Study design and participants

A cross-sectional study was conducted in Indonesia between April and May 2022. Data were collected using a questionnaire through the Google Forms. Study participants were recruited from Indonesian government employees and wives' community of the Indonesian Military Forces (Armed Force, Navy Force, and Air Force). The purpose sampling techniques were applied. Inclusion criteria were Indonesian government employees and wives' community of the Indonesian Military Forces who had children aged between 5 and 12 years residing in the same household. Exclusion criterion was inability to fill out the questionnaire due to any reasons (e.g., not having internet access, inability to understand the questionnaire, unwillingness to participate).

Preparation and data collection

Questionnaire was determined as the study instrument with a purpose to explore opinions, belief, behaviors, and attitudes indicating cariogenic profile. We constructed a questionnaire based on literature review, clinical expertise, relevant previous studies, and adjusted for the study population setting. A total

of 12 questions (study indicators) were included to collect data of characteristics, dental caries experience, tooth brushing frequency and timing, snacking habit and its frequency, consumption of sweet and beverages, regular meals (i.e., breakfast, lunch, dinner), periodic dental check-ups, treatment with orthodontics appliance, use of toothpaste and mouthwash, family income, and daily activities during COVID-19 stay-at-home period. A scoring system was applied for the questionnaire. Consistency of the scoring rules was assessed that the scoring would not introduce any voters' preferences.

The questionnaire was validated in a subgroup of study participants. Cronbach's alpha was used to assess the reliability, respectively. The questionnaire was validated in a subgroup of study participants. Cronbach's alpha was used to assess the reliability, respectively. Given the pandemic circumstances, the validated questionnaire was filled out by the study participants online using google form. It took approximately 10 minutes to answer the questionnaire completely. Cariogenic profile was categorized into two groups, namely low risk and high risk.

Statistical analyses

Data cleaning and tabulation was performed using google form, then exported to the statistical software Statistical Package for Social Sciences (IBM SPSS Statistic for Windows software version 25.0). Several statistical analyses were conducted, such as cluster analysis, univariate, bivariate, and multivariate analyses. Cluster analysis is a multivariate technique used to group objects that have similar characteristics/behaviors as a cluster. As a result, high internal homogeneity is found within each cluster and high external homogeneity between clusters.

Ethical consideration

This study was approved by the Ethical Committee of Health Research, Faculty of Dentistry, Trisakti University, Jakarta, Indonesia. Written informed consent was obtained from each study participant at the beginning of the study (No: 019/S3/KEPK/FKG/4/2022 ; April 5Th, 2022).

Results

Study participants' characteristics

Of 755 individuals participating in the study, 709 participants filled out the questionnaire completely (i.e., answered the study indicators and demographic data). A total of 725 participants answered only the study indicators, 46 participants did not fill out age data, and 30 participants did not answer their education and employment status. Overall response rate was 93.9%. The characteristics of the study participants are presented in Table 1.

Cluster analysis and testing difference between means.

		n	%
Mother's education	Elementary – junior high school	19	2.6%
	Senior high school	239	33.0%
	Diploma - PhD	467	64.4%
Mother's age	> 30 years	663	93.5%
	≤ 30 years	46	6.5%
Employment	Unemployed	421	58.1%
	Employed	304	41.9%

Table 1. Characteristic of the study participant.

		Count	%
Cariogenic profile in children	Low risk	488	67.3%
	High risk	237	32.7%
	Total	725	100.0%

Table 2. Cariogenic profile.

A total of 725 participants were divided into two groups according to the 12 study indicators. K-means clustering method was used to group study participants having similar characteristics into a cluster. Testing difference between means was performed using analysis of variance (ANOVA) to assess which indicator/variable that had different characteristics between clusters. The variables with different characteristics were determined as the main construct of the cluster.

Based on the P values, indicators constructing cariogenic profile in children were 1) caries experience (P = 0.000), 2) toothbrushing after breakfast and before sleeping at night (P = 0.001), 3) snacking between main meals during the COVID-19 pandemic (P = 0.006), 4) Frequency of sweet beverages consumption during the COVID-19 pandemic (P = 0.000), 5) regular dental visit during the COVID-19 pandemic (P = 0.021), 6) family income during

the COVID-19 pandemic (P = 0.007), 7) free time activities during the COVID-19 pandemic (P = 0.007).

Variable	Categories	Cariogenic profile in children				*P* value
		Low risk		High risk		
		Count	Row N %	Count	Row N %	
Mother's education	Elementary – junior high school	14	73.7%	5	26.3%	0.226
	Senior high school	170	71.1%	69	28.9%	
	Diploma – PhD	304	65.1%	163	34.9%	
Mother's age	> 30 years	442	66.7%	221	33.3%	0.188
	≤ 30 years	35	76.1%	11	23.9%	
Mother's employment	Unemployed	295	70.1%	126	29.9%	0.062
	Employed	193	63.5%	111	36.5%	

Table 3. Bivariate analysis of characteristics with cariogenic profile.

Independent variables	B	S.E.	*P*	OR	95%CI	
					Lower	Upper
Mother's education:						
Senior high school	0.164	0.542	0.763	1.178	0.407	3.406
Diploma – PhD	0.405	0.532	0.447	1.500	0.528	4.257
Mother's age (≤30 years)	-0.482	0.356	0.177	0.618	0.307	1.242
Mother's employment status (employed)	0.180	0.171	0.291	1.197	0.857	1.673
Constant	-1.088	0.524	0.038	0.337		

Table 4. Multivariate analysis of the association between characteristics and cariogenic profile.

Cariogenic profile of each group according to the cluster analysis was as the following:

Group 1 (high risk): Caries experience was common before the pandemic, similar frequency of toothbrushing before and during the pandemic, snacking habit, consumption of sweet beverages was often, higher family income before the pandemic, tended to spend free time by snacking.

Group 2 (low risk): caries experience before and during the pandemic was not frequent, toothbrushing was more often during the pandemic, less often to snack and drink sweet beverages, no regular dental checkups, similar family income before and during the pandemic, free time was spent with some activities rather than snacking.

Table 2 indicates that 67.3 % of the participants had low risk for dental caries, while the other 32.7% had high risk for dental caries. Bivariate analysis in Table 3 shows no significant association between mothers' characteristics (education, age, and employment status) and cariogenic profile. According to the multivariate analysis in Table 4, characteristics were not significantly associated with the risk of dental caries in children during the pandemic (senior high school, *P* = 0.76; education level at diploma – PhD, *P* = 0.447; mother's age, *P* = 0.177; mother's employment status, *P* = 0.29).

Discussion

The present study aimed to assess cariogenic profile among Indonesian children during the COVID-19 pandemic. We measured their dietary habits and several associated factors (such as caries experience, tooth brushing, regular dental visits, orthodontic appliances, and family income), and parental characteristics (mother's age, education, and employment status). Thereafter, the results were compared with relevant previous studies in various countries.

Based on the collected data, the behavior of the study participants varied. For instance, some participants only answered the research indicator questions, or some participants did not completely fill out the data of parental characteristics. This was a limitation of online survey; namely close monitoring of data collection is rather not feasible. Nevertheless, most participants filled out the questionnaire completely (n = 709).

During the COVID-19 pandemic, vast literature assessed the association between change in dietary habits and general health, weight status, or body mass index (BMI). Only a few studies have investigated the effect of changes in dietary habits on oral health. Moreover, most of those studies focused on the adult population. Little is known about whether change in dietary habits and physical activities in children is associated with cariogenic profile. To date, dental caries is still the most common oral and dental disease in many countries worldwide. Therefore, the present study was conducted to provide evidence on how pediatric cariogenic profile during the pandemic has been.

Previous studies found general health was affected by some dietary-behavior-associated-factors, such as snacking and lack of physical activities. These factors were also likely

to increase cariogenic risk and excess adiposity. Two profiles constructed in the present study were low risk and high risk. Risk is defined as the probability for an individual to have a disease before the disease onset. Cut-off between low risk and high risk was determined. There was no indeterminate group that ambiguity or unclarity could be avoided.

In the present study, the research indicators reflecting the cariogenic profile groups included 1) caries experience, 2) tooth brushing, 3) snacking habits, 4) consumption of sweet beverages, 5) regular dental visits, 6) family income, and 7) free time activities during the stay-at-home period. These indicators differentiated the low risk and high risk groups. As dental caries pathology is multifactorial, predicting caries is rather challenging. No single variable has been able to predict future risk for dental caries accurately.

Caries experience has been shown as a strong predictor for future dental caries. Literature found that caries in primary second molars in children aged 3-5 years was a clinically relevant predictor for future dentin caries development on surfaces of the first permanent molars in the following five years.[20] Moreover, previous study has reported a prediction model for incidence of permanent teeth caries using the experience of primary teeth as the main predictor.[21]

Literatures show that in the young children population, regular tooth brushing is effective as plaque prevention and treatment. During tooth brushing, plaque is removed mechanically, and teeth are exposed with fluoride toothpaste. Then also said that oral health education and instructions for proper tooth brushing are effective to improve oral health in school-aged children.[22,23] During the COVID-19 pandemic, parents tended to put more concern on the oral and dental health of their children. This was because access to healthcare facilities was so limited that parents tended to be more attentive to their children's oral health. For example, by instructing the children to brush their teeth more often to prevent caries.

During the lockdown period, children spent most of their time at home. They had digital education, limited outdoor physical activities, and had more free time. These might lead children to snack and drink beverages more often. Dental caries have indeed a microbial etiology, yet sugar intake is the most important risk factor.[24] Our study showed that children in the high risk group were more likely to have higher sweets and high carbohydrate intake.

Regular dental visits in the present study were an important indicator that distinguished the low risk and high risk groups. American Academy of Pediatric Dentistry (AAPD) Caries Management guidelines for children aged 3-5 years recommends dental checkups to be performed every 3 months among children with high risk for caries, every 6 months among children with moderate risk, and annually among children with low risk.[25] On the other hand, Jain et al (2014) found that although most mothers agreed on a regular dental visit, only few complied. This might be due to fear, expensive treatment cost, and/ or lack of motivation and willingness.[26] Particularly during the COVID-19 pandemic, parents were generally more cautious in visiting healthcare facilities, unless for emergency or urgent cases.

The other indicator that differentiated the clusters was family income. COVID-19 pandemic had a significant impact on most aspects in life, including health, education, culture, transportation, tourism, and finance. A few companies, offices, factories, and other business entities have been affected. Indeed, the COVID-19 pandemic is not only a global health crisis. In 2020 the pandemic contributed to 3.3 billion workers worldwide in risk of unemployment.[27]

The participants in this study were from families of government employees who received fixed monthly salaries. The spouse or other family member might have other incomes. The pandemic circumstances might to some extent affect family income. Several factors can be used as a parameter socioeconomic level such as occupation, income, and education, or other variations of these socioeconomic indicators. Many studies show that there is a significant correlation between socioeconomic status and caries prevalence in children. When family income was reduced, the opportunity to access healthcare facilities could also be reduced. This hence might affect oral and dental health. Families with reduced income were reported to eat less and choose cheaper foods with low nutritional quality and high sugar. This diet change does not only affect general health, but also increases the risk for caries development.[28,29]

Our study showed that 67.3% of the children had low risk for caries and 32.7% had high risk. It is possible that parents participating in this study had good knowledge, attitude, and practice on children's oral health. In addition, there might be an increased awareness in pediatric oral health as an effort to avoid toothache during the pandemic.

In the present study, we observed no association between cariogenic profile and parental characteristics (such as mothers' education, age, and employment status). This is in line with research by Sasmita et al (2017) that there was no correlation between family economic status and dental caries risk aged 6-12 years.[30] Other factors beyond the study indicators, including those concerning the COVID-19 pandemic, might also affect the risk for caries in children.

Conclusions

This study found that most children in Indonesia have low risk for caries during the COVID-19 pandemic. Cariogenic profile in children was not associated with parental characteristics (i.e., mothers' age, education, and employment), but with five indicators distinguishing low risk and high risk groups. These indicators are caries experience, tooth brushing, snacking, consumption of sweet beverages, regular dental visit, family income, and activities during free time. Understanding the risk of caries in children will guide us to perform proper management.

Declaration of Interest

The authors report no conflict of interest.

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