# The Association between Sweet Food Consumption, Time of Tooth Brushing and Dental Caries Experience in 12- to 15-Year-old Children in Indonesia (Analysis of Indonesian Health Basic Research Data, 2013)

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**Abstract**

Dental caries is a global public health problem and the most prevalent oral disease. Oral hygiene and sweet food consumption are acknowledged causes of dental caries, among others. The purpose of this study was to determine the magnitude of the association between dental caries and oral health care behavior. The study design was *cross-sectional,* using Riskesdas 2013 data. The sample size was 18,415 Indonesian children aged 12–15years. Result: The dental caries prevalence was 51.4%. When compared with children with good oral health care behaviors, children with a combination of poor behaviors showed a 2.26 fold higher association with caries (95% CI: 1.39-3.68). By contrast, children who brushed their teeth at inappropriate times or consumed sweet foods more frequently had 1.92 times (1.13-3.26) and 2.03 times (95% CI: 1.24-3.32) higher risks of getting dental caries, respectively. Thus, the combination of poor oral health behavior and sweet food consumption can increase the magnitude of the associated risk of getting dental caries.

## Introduction

Dental caries is a pathologic process of dental tissue damage caused by micro organisms[1] and has existed as a disease throughout human history. Dental caries can be found in every prehistoric population for the past million years, with the exception of the Paleolithic and Mesolithic eras, where the prevalence was only 1% due to differences in eating patterns. A gradual increase occurred after that period, and then rapidly grew in the middle and modern ages.[2] A decrease in dental caries incidence has occurred since early 1960s in developed countries, such as the Netherlands and Switzerland. The decline in dental caries in the 12-year-old age group, indicated by the average of DMF-T of 8 in 1965, was only 1 in 1993 for the Netherlands. The average of DMFT-T of 7.9 in 1964 became 0.8 in 1996, and 62% was caries-free in Switzerland.[3] This decrease in the average DMF-T still continues in developed countries.

The WHO collected dental caries disease data for the12-year-old age group from 188 countries in 2004 and 2011. For European countries, the DMF-T decreased from 2.57 to 1.95, while in America, the decline was from 2.76 to 2.35.[4] By contrast, in developing countries, a similar comparison of WHO global data for 2004 and 2011 showed an increase in the DMF-T average. For example, the DMF-T average for Southeast Asia (SEARO) increased from 1.12 (very low category) in 2004 to 1.87 (low category) in 2011. Indonesia, which is included in SEARO countries, has a medium average value category, as did Thailand, India, and Korea in 1990–2000.[5]

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The DMF-T average for12-year-olds in Indonesia from1970 to 1995 increased from the low to the medium category (0.7–2.7). However, the average DMF-T value in each age group decreased in a national survey conducted from 1995 until 2007, but this was followed by an increase in 2013.

Many research reported that the largest contributor to the dental caries decrease is the extent of fluoride use.[3] Other contributing factors include increased awareness, socialization, sugar consumption decreases, prevention program improvements, and diagnostic change. On the contrary, the increase in dental caries disease in developing countries reflects the lifestyle in developing countries, which includes the consumption of sweet and non-fibrous foods.[3] As a multifactorial disease, one of the most important factors related to dental caries is dental health maintenance behavior. Therefore, the aim of the present research was to determine the relationship between dental caries and dental health maintenance behavior in 12-year-olds in Indonesia.

Dental caries is a multifactorial disease, with both direct and indirect causative factors. The factors directly related to dental disease include environmental factors such as the form and dental construction, microorganisms, saliva, diet, and time.[1] The indirect factors are illustrated in the chart shown in Figure 1.
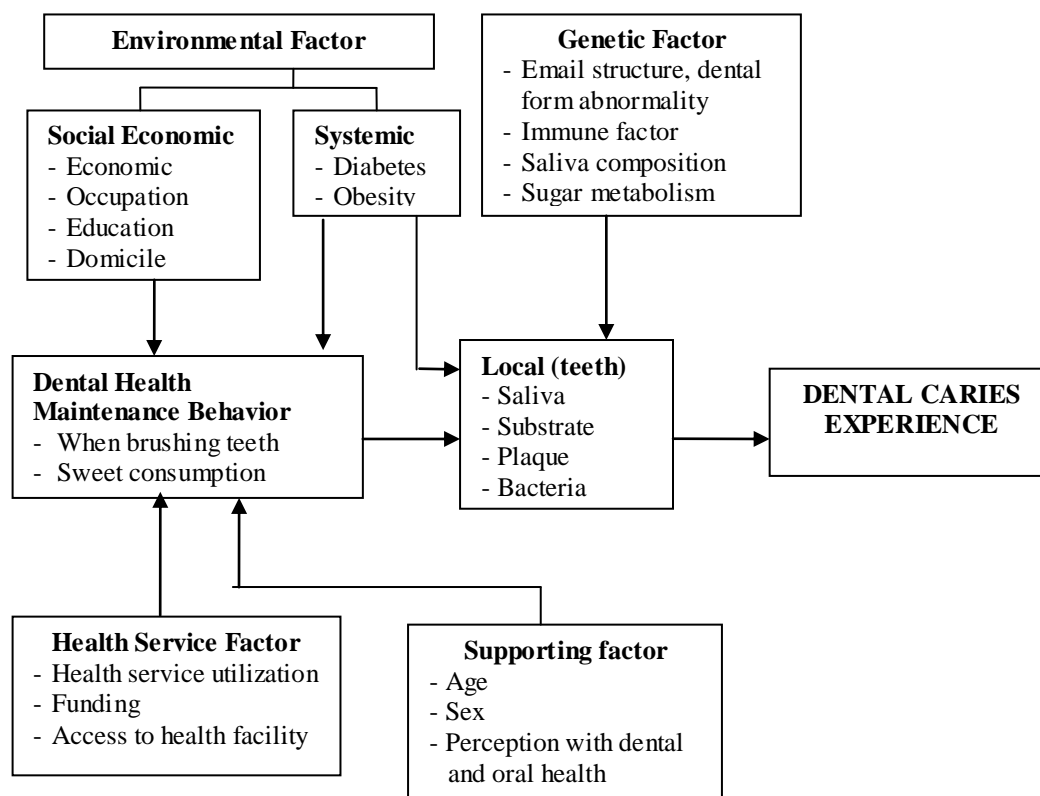


**Figure 1**. Factors related to dental caries (modification of Blum)[6]

The behavior of dental caries disease prevention involves actions related to maintaining oral hygiene and consumption of non-cariogenic foods or beverages.[7,8] The Indonesian Health Basic Research, or Riskesdas, is a national survey conducted by the Center for Health Research and Development of the Indonesian Health Ministry. The Riskesdas 2013 examined dental healthcare behavior in an individual questionnaire as tooth brushing behavior and sweet food consumption.Therefore, the aim of the present study was to investigate the association between the behavioral factors and dental caries experience of children 12–15 years of age included in the national data of Basic Health Research (Riskesdas) 2013.[8]

**Method**

This was a cross-sectional study with observational analytics that used secondary data from the 2013 Basic Health Research (Riskesdas). The oral health examinations for Riskesdas 2013 were carried out in in 33 provinces and 497 regencies/cities in Indonesia in May–June 2013. The sample size of children aged 12–15 years old was 86,951 after the electoral processing of samples. The inclusion criteria for this study were the completeness of the data on the variables that were analyzed and one child to represent each household. The selected sample size of 18,415 was calculated based on inclusion criteria. The dependent variable was the experience of dental caries. The primary independent variable was the time of tooth brushing and the frequency of sweet food consumption.[8]

**Statistical analyses**

Dental caries were categorized as existent and non-existent. Behavioral factors were categorized separately and made into composite variables. Data tabulation and statistical tests were performed using Stata9, and differences were considered statistically significant when $p<0.05$.

**Results**

The number of children aged12–15 years included in the analysis were 18,415 children with complete data.

**Table 1.** Characteristics of subjects

| Variable | N = 18,415 | % |
|---|---|---|
| Gender | | |
| Female | 9,138 | 49.6 |
| Male | 9,277 | 50.4 |
| Parents occupation | | |
| Unemployed | 17,987 | 97.7 |
| Employed | 428 | 2.3 |
| Economic Status | | |
| Low | 7,408 | 40.2 |
| High | 11,007 | 59.8 |
| Regional domicile | | |
| Village | 10,327 | 56.1 |
| City | 8,088 | 43.9 |
| Perception of dental disease | | |
| Not good | 13,803 | 75.0 |
| Good | 4,612 | 25.0 |
| Utilization of dental services | | |
| No | 17,351 | 94.2 |
| Yes | 1,064 | 5.8 |
| Insurance | | |
| Does not have | 7,848 | 42.6 |
| Does have | 10,567 | 57.4 |
| Access to health services | | |
| No | 904 | 5.9 |
| Yes | 17,060 | 95.0 |

The proportion of males and females was balanced in this study. The parents with regular jobs accounted for only 2.3%, with jobs listed as civil servant, military, police, public enterprise employee, private employee, self-employed, farmer, worker, fisherman and others. The proportion of children living in villages (56.1%) is greater than that in the city (43.9%). The proportion with low economic status was 40.2%. Economic status is a composite index of housing conditions and economic variables based on ownership of durable goods. The proportion of

children who were aware of having oral health problems is one-fourth (25.0%), whereas 51.4% had dental caries on clinical examination. More than half (57.4%) had health insurance. Utilization of the nearest health care facilities accessible from home was 95.0%. Health Care Facilities, in this case, were government hospitals/private clinics or doctors who had

clinics with dental health care facilities. Access to health care was a combination of factors that included modes of transport, the cost of transportation, and travel time to get to the Health Care Facilities. Respondents were said to have good access when the available modes of self or public transport had an average cost of less than 50,000 rupiahs and less than 1 hour.

**Table 2**. Distribution of Dental Caries and Oral Health Behavioral Factors

| Variable | N = 18,415 | % |
|---|---|---|
| Dental caries | | |
| Existed | 9,459 | 51.4 |
| Non-existed | 8,956 | 48.6 |
| Time to brush teeth | | |
| Wrong | 13,361 | 72.6 |
| Right | 5,054 | 27.4 |
| Frequency of sweet consumption | | |
| Often | 14,856 | 80.7 |
| Rarely | 3,559 | 19.3 |
| Composite behavior | | |
| Time of brushing teeth wrong Sweet foods eaten often | 14,481 | 78.7 |
| Time of brushing teeth wrong Sweet foods eaten rarely | 3,485 | 18.9 |
| Time of brushing teeth right Sweet foods eaten often | 375 | 2.0 |
| Time of brushing teeth right Sweet foods eaten rarely | 74 | 0.4 |

The prevalence of dental caries in this study was 51.4%, with a mean of DMF-T of 1.48 teeth (95%CI:1.44 to 1.51). Based on the classification of the dental caries experience level at the age of 12 years according to the WHO, the mean DMF-T for the group of children aged 12 years in the Riskesdas 2013 was categorized as low category. In this study, the proportion of children who answered with the wrong time for brushing teeth was 72.6%, whereas the proportion of children who often ate sweet foods (more than once a day) was 80.7%.

The proportion of children who brushed their teeth at the wrong time and often ate sweet foods was 78.7%. The proportion who answered with a combination of rarely eating sweet foods and brushing their teeth at the wrong time was 0.4%.

The relation between dental caries experience and the time of brushing teeth or sweet food consumption showed a weak association when analyzed separately, although the association was statistically significant.

This association became stronger when the factors were analyzed as a composite. The relation between dental caries experience and the composite variable of this behavior was statistically significant. The POR value was calculated using the criteria of having good dental health behavior as a reference.

The results showed that children who had a combination of poor dental health behavior for both variables had a 2.3 time higher risk (95% CI:1.3 to 3.7) of getting caries when compared with children who had a combination of good dental health behaviors.

Children who did not brush their teeth at the right time or who often consumed sweet foods had 2.0 (95% CI:1.2 to 3.3) or 1.9 (95% CI:1.1 to 3.3) higher risks, respectively, of getting dental caries when compared those with combined good behaviors.

**Table 3.** The Relation between Dental Caries Experience and Oral Health Behavioral Factors

| Variable | Dental Caries | | | |
|---|---|---|---|---|
| | % | POR | 95% CI | P - value |
| Time of brushing teeth | | 0,86 | (0,80-0,92) | 0.001 |
| Wrong | 71,1 | | | |
| Right | 28,9 | | | |
| Frequency of sweets consumption | | 1,12 | (1,04-1,21) | 0.001 |
| Often | 81,6 | | | |
| Rarely | 18,4 | | | |
| Time of brushing teeth wrong Sweet foods eaten often | 79,7 | 2,3 | (1,3-3,7) | 0.001 |
| Time of brushing teeth wrong Sweet foods eaten rarely | 18,2 | 2,0 | (1,2-3,3) | 0.001 |
| Time of brushing teeth right Sweet foods eaten often | 1,9 | 1,9 | (1,1-3,3) | 0.001 |
| Time of brushing teeth right Sweet foods eaten rarely | 0,2 | 1 | - | - |

**Discussion**

The tooth brushing habit is a behavioral component that is closely related to dental hygiene factors. It can eliminate the agent factors or the pathogens that are one of the main causes of dental caries due to production of acid from carbohydrate substances.  Some of contributing factors include brushing method, proper brush selection, brushing duration, brushing time, brushing frequency, and the use of toothpaste with fluoride.

The results of Riskesdas 2007 showed that the children with irregular brushing habits had a dental caries risk 1.2 times higher than children who brushed their teeth regularly (p=0.001).[9,10] Budisuari also analyzed the data from Riskesdas 2007 and found a risk difference between brushing teeth in the morning after a meal and in the evening before bed.[7] The risk for dental caries from not brushing the teeth after breakfast was 7.94 times higher than in those who brushed their teeth, with a proportion of 87.2% to 11%, respectively. The risk of not brushing the teeth in the evening before bed was 1.04.

This study revealed differences in the results of the analysis of the relation between dental caries experience with tooth brushing time when not combined or merged with sweet food consumption. Separate analysis of tooth brushing variables gave a POR value of 0.86 (95% CI: 0.8-0.92), which then increased to 2.0 (95% CI: 1.2-3.3) when combined with the sweet food consumption variable. This is because the separate analysis of the effects of wrong tooth brushing time was mixed with the analysis of the frequency of sweet food consumption.  When the variables were combined, the effect of the incorrect brushing teeth time was clearly evident because it was separated from the effects of sweet food consumption.

Consumption of sweet foods is also a habit that is closely linked to environmental factors in the oral cavity around the teeth. Frequent sweet food consumption ensures the availability of food for pathogenic bacteria. The behavior of consuming cariogenic foods or beverages can be viewed from several aspects, such as the frequency, the types of fibrous foods or beverages consumed, the time of consumption between meals, and the sweetness level of the food or beverage.[7] The time of consumption between common meals, known as snacking[11], was taken into consideration due to the proportion of 76.9% of children who snacked. This habit showed significant differences between the groups with high and low sweet food eating habits (p=0.022). Budisuari, using data from Riskesdas 2007, found a significant difference in the relationship of caries and cariogenic consumption but the risk value was not strong (1.16 times).[7]

The Riskesdas 2013 data included a cariogenic consumption factor in a form of sweet food consumption frequency. Several studies have found the frequency of eating sweet foods affects the occurrence of dental caries.[12] Some organizations recommend the a frequency of sugary consumption ofnot more than 4 times a day.[13] Therefore the frequency on the answers in Riskesdas 2013 are grouped into 'often' when the frequency of sweet food consumption is more than once per day.

In this study, like the tooth brushing time, sweet food consumption variable also showed different results when analyzed separately and as a composite variable. When the sweet food consumption variable was analyzed separately, the POR value was1.12 (95% CI: 1.04-1.21), and this increased to 1.9 (95% CI: 1.1-3.3) as a composite variable. The effect of the sweet food consumption can be seen clearly as a composite variable because it was separated from the effects of tooth brushing.

The consumption of carbohydrates that are easily fermented, if not followed by good oral hygiene, can cause a prolonged acid condition around the teeth and a continuous process of enamel dissolution. In the case of poor oral hygiene conditions, the consumption frequency is more closely associated with caries than is the amount of sweet foods consumed.[12] Duggal found that brushing twice a day can neutralize the acidic conditions in the mouth caused by a consumption frequency of cariogenic foods as much as 4–7 times a day.[14] However, with the same frequency, they found a relationship with caries in children who brushed their teeth only once a day or not at all.[15]

The two dental health maintenance behaviors cannot be separated from one another, due to their mutual influences. This is called a biological interaction and can occur between more than one independent variable. This biological interaction causes a great risk of any combination of both variables.[16] The two main behaviors were analyzed both for their individual effects and the joint effect of both behaviors. This study showed that when compared to children with good oral health care behaviors for both factors, children with a combination of poor behaviors had 2.26 times higher risk of caries (95%CI:1.39-3.68). Children who brushed their teeth at the inappropriate time or who consumed sweet foods more often had a 1.92 times (1.13-3.26) and 2.03 times (95%CI:1.24-3.32) higher risk, respectively.

The covariate variables analyzed were gender, parental education, parental occupation, economic status, area of residence, perception of dental disease, utilization of health services, finances, and access to health services. Dental caries had no statistical correlation with any ofthese covariates, except for perception of dental disease.The relation between the experience of dental caries and perceptions about dental disease was statistically significant. Using the data of Riskesdas 2007, Ariningrum found that people tended to go to dentist when their daily activities were already disrupted because of toothache (p=0.026). This means that a toothache still at the mild stage would be ignored.[9]

## Conclusion

The magnitudes of the associations between tooth brushing timing and sweet consumption differed if they were analyzed separately or combined. As part of a composite behavioral variable, tooth brushing was controlled to show the sweet consumption effect, and vice versa. Children who had a combination of tooth brushing behavior at the wrong time and frequent consumption of sweet foods will have the greatest risk because of the combined effects(joint effect)for both these practices, and this relation is statistically significant.

## Research permission and ethical considerations

## Acknowledgment

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