

The relationship between dental caries and carbohydrates intake among preschool-aged children in rural and urban areas

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ABSTRACT

Introduction: The prevalence of dental caries among children has increased in the past decades. Dental caries has a multifactorial aetiology, including host (saliva and teeth), microbiology (plaque), substrate (diet), and time. The role of fermentable carbohydrates intake as a risk factor in the initiation and progression of dental caries. The purpose of this study was to determine the relationship between dental caries and carbohydrates intake among preschool-aged children in rural and urban areas of the city of Cimahi, Indonesia. **Methods:** The method used was an analytical cross-sectional study with pathfinder survey based on the WHO basic methods of oral health surveys. The data were collected through intraoral examination, and nutritional status measurement was done by using food frequency questionnaire. Statistical analysis used was the chi-square test. **Results:** From the study towards 100 preschool children resulted the prevalence of dental caries in rural and urban area respectively was 96 and 92%. The average value of deft index in urban area was 8.46 (95% CI:7.00-9.91) and was 7.98 (95% CI:6.50-9.45) in rural area. The average value of sucrose intake frequency in urban area was 237.14 (95% CI:204.95-269.32), whilst in rural area was 177.54 (95% CI:155.66-199.41). **Conclusion:** There was a relationship between dental caries and carbohydrates intake among preschool-aged children in the rural and urban area of the city of Cimahi, Indonesia.

Keywords: Dental caries, carbohydrates intake, preschool-aged children.

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INTRODUCTION

Oral diseases are a threat to the general health of society and will be able to affects directly to the whole body systems. According to World Health Organization (WHO)¹, oral health was defined as the state of absence of tooth decay (dental caries), oral, facial, throat, periodontal, tooth loss, and other diseases and restrictions individuals in chewing, smiling, talking, and psychosocial well-being. Based on the epidemiological data taken from various countries indicating that there was an increased prevalence of dental caries. According to WHO², the high prevalence of dental caries mainly occurred in children, by the rate of 60-90%.

Based on the Atlas of Oral Health¹ in 2015 showed that the dental caries experience index (DMFT/deft index) in India, Saudi Arabia, Gabon, and Indonesia were very high, with DMFT/deft index values were above 3.5.¹ The prevalence of dental caries in Indonesia was included in the very high category which was above 3.5 with percentage rate of 89.4%.^{1,3} A research conducted in the city of Ferozepur showed that the prevalence of dental caries in the rural area was higher than the urban area, which was at the rate of 53.8%, while the urban area was only at the rate of 39.8%. It was similar to the previous research conducted in the rural and urban areas of the city of Cimahi in 2015, which showed that the prevalence of dental caries in children aged 5-6 years old was at the rate of 92.9% with the value of index deft was as much as 8.94.

Dental caries as an oral disease with the highest prevalence is caused by various contributing factors, one of them is a dietary habit. Previous research has shown that there was a relationship between dietary habit, especially the frequency of sugar consumption that contained carbohydrates, with the occurrence of dental caries. The frequency of carbohydrates consumption contained in sugar was able to increase the risk of dental caries up to four times.⁴ The proper dietary habit is needed for proper growth and development of children. This is important as a support for general and oral health, as well as an increasing the substance of cells and tissues for the body of children. WHO has recommended that dietary habit has an important

role in the prevention of oral disease, including dental caries.⁵

Dental caries can cause the loss of various functions of food mastication. Even though there are various methods of dental caries prevention, such as systemic and topical fluoride application, and also reduction of extrinsic sugar consumption, the prevalence of dental caries in children is still high.⁶ The intake of foods that contain carbohydrates is one of the oral and dental health issues that should receive special attention because it can affect the oral and dental health status of a person, especially in the children.^{7,8} According to WHO in 2015, the frequency of sugar consumption allowed in order to prevent the occurrence of dental caries was only three times a day.¹ The purpose of this study was to determine the relationship between dental caries with carbohydrates intake among pre-school aged children in urban and rural areas of the city of Cimahi, Indonesia.

METHODS

The research method used in this research was an analytical cross-sectional study. The population and sample in this research were taken from pre-school aged children in the city of Cimahi, and sampling technique used was the WHO basic methods of oral health survey which was known as the pathfinder survey. The pathfinder survey was a stratified cluster sampling technique. The cluster consisted of groups taken from geographical units (rural-village, sub-district, urban-village, or regency).⁹

Based on the WHO basic methods of the oral health survey, two sub-districts will be taken from each area, which will represent rural and urban areas and then two urban villages will be selected. The city of Cimahi consisted of three sub-districts, selected two sub-districts that represented the rural and urban areas. The rural area of the city of Cimahi is located in the sub-district of North Cimahi, while the urban area is located in the sub-district of South Cimahi. Based on these two sub-districts, each selected one urban-village that will represent the rural and urban area. From each urban-village randomly selected 25-50 men and women for every age group.⁹

The sample of this research was preschool-aged children of 5-6 years old age group in both rural and urban kindergartens in the city of Cimahi. The inclusion criteria were: 1) Children of 5-6 years old group who was accompanied by their mother; 2) Children of 5-6 years old group with completely erupted deciduous teeth; and 3) Willing to get participated until the end of the research. The exclusion criteria were children of 5-6 years old group with the first permanent molar eruption.

The measurement of dental caries on deciduous teeth were performed by the researchers using the deft index, which was the average amount of decayed or caries affected deciduous teeth (d), indicated for extraction (e), and teeth that have been filled due to dental caries (f), divided by the total amount of examined sample.¹⁰ WHO has given the classification categories for the calculation of DMFT and deft index value in the degree of interval as follows: At the range of 0.0-1.1 was categorized as very low; At the range of 1.2-2.6 was categorized as low; At the range of 2.7-4.4 was categorized as moderate; At the range of 4.5-6.5 was categorized as high; and at the range above 6.6 was categorized as very high.

The measurement of carbohydrates intake used was the food frequency questionnaire (FFQ). FFQ is one of the methods used in determining the frequency of food intake either individually or in groups within a specified period. In this study, the assessment of the children's carbohydrates intake in a day was expressed in grams, then adjusted to the size of an individual portion through the pattern of carbohydrates intake in the form of sucrose, that was converted into the Recommended Dietary Allowances (RDA/ AKG in Indonesian) of children aged 5-6 years old group. List of foods in FFQ was based on foods often consumed by children both at school and home. Subjects in this study were pre-school children aged 5-6 years old, so the frequency of food consumed information was obtained by their mother. The mother of the children was then interviewed by researchers about the frequency of carbohydrates consumption based on the list of foods obtained previously. In order to facilitate the information delivery, researchers use food models and print out of food images.

According to AKG of 2012, the recommended dietary allowances of sugar contained in carbohydrates for children aged 5-6 years old was 220 grams in a day.¹¹ To obtain gram unit, each type of food was filling in the Nutrisurvey program (2007). If the results of carbohydrates intake measurement in this study were less or equal to the AKG will be included as low category, whilst if the results were more than AKG will be included as a high category.

To valued the relationship between dental caries and carbohydrates intake among preschool-aged children in the rural and urban area, the data obtained were analyzed by using chi-square test. The results of the study will be counted as significant if the value of $p < 0.05$. All analysis was done by using SPSS® v.22.0. This research has obtained agreement from Medical Ethics Board of Universitas Padjadjaran with Registration Number of 0816101040. All research subjects have been given informed consent before the research process was done.

RESULTS

The results were obtained from a study conducted towards 100 preschool-aged children of 5-6 years old group, with every 50 children were representing both rural and urban areas of the city of Cimahi. Respondents of this research were classified in four characteristics category as presented in Table 1 below.

Table 1. Respondents characteristic of urban and rural areas in the city of Cimahi at the year of 2016

Characteristic	Numbers	Percentage
1. Gender		
Male	49	49
Female	51	51
2. Age		
5 years old	58	58
6 years old	42	42
3. Mother's Education		
Low	54	54
High	46	46
4. Parental Income		
< Regional Minimum Wage (UMR)	62	62
≥ Regional Minimum Wage (UMR)	38	38

Table 1 shows the number of respondent in this research was 100 children of both rural and urban areas of the city of Cimahi, accompanied by their mother. Most of the respondent's gender were a female child, which covered 51% of all respondent. Most age group of the respondent were 5-years-old group, which covered 58% of all respondent. Most education level of the respondent's mother were the low-level education level, covered 54% of all respondent. The low-level education category was included ungraduated from elementary school and junior high school, whilst the high-level education category was included graduated from senior high school and college. Most parental income level were below Regional Minimum Wage (UMR), which covered 62% of all respondent. Description of dental caries and carbohydrates intake on children of 5-6 years old group in the rural and urban areas in the city of Cimahi is shown in Table 2 and Table 3

The results shows that the average value of decayed teeth (dt) was found higher in the urban

Table 2. Description of dental caries on children of 5-6 years old group in the rural and urban areas in the city of Cimahi

Dental caries index of children aged 5-6 years old	Respondent	
	Urban area	Rural area
d-t	7.58	6.6
e-t/m-t	0.86	1.32
f-t	0.02	0.06
def-t index	8.46	7.98
Dental caries prevalence	96	92

Table 3. Carbohydrates intake of children aged 5-6 years old in the rural and urban areas in the city of Cimahi

Carbohydrates intake	Respondent	
	Urban	Rural
< AKG*	27(54%)	36(72%)
≥ AKG*	23(46%)	14(28%)

Table 4. The relationship between dental caries and carbohydrates intake among children of 5-6 years old group in the rural and urban areas of the city of Cimahi

Carbohydrates intake	Dental Caries		P-value
	Negative f(%)	Positive f(%)	
< AKG*	6(9.7%)	56(90.3%)	0.0438**
≥ AKG*	0(0%)	38(100%)	

area, which was 7.58, compared to the value of the urban area was 6.6. The average value of decayed teeth from all areas was 7 teeth. The deft index was the measurement index used to discovered the average value of decayed teeth, indicated for extraction, and filled teeth due to caries. The results of the study showed that the value of the deft index of the urban area was higher, which was 8.46, compared to the rural area was 7.98.

The results above showed that the carbohydrates intake on children of 5-6 years old group in both areas were mostly below the Recommended Dietary Allowances (RDA/AKG in Indonesian), which was 54% in the urban area, and 72% in the rural area. The relationship between dental caries and carbohydrates intake among children of 5-6 years old group was presented in Table 4.

A negative value of dental caries was the condition where decayed tooth (dt), missing teeth/indication for extraction (et), or filled teeth due to caries (ft), were not found at all. Whilst the positive value of dental caries was the condition where there was found one of the component of decayed tooth (dt), missing teeth/indication for extraction (et), or filled teeth due to caries (ft). The result of this study showed that the higher level of carbohydrates intake, the higher risk of dental caries occurrence. This study also found a relationship between dental caries and high level of carbohydrates, with p-value<0.05.

DISCUSSION

Dental caries is a disease caused by various risk and supporting factors (multifactorial). The high prevalence of dental caries in children is increasing every year, including in Indonesia. Many research has been conducted in rural and urban areas of the city of Cimahi to found out the description of dental and oral health status in the 5-6 years old, 12 years old, and 15-19 years old group of age. The results of these research showed the high prevalence of in 5-6 years old group of age children both in rural and urban areas of the city of Cimahi.¹²

The result of this study showed that the prevalence of dental caries on 5-6 years old children was 96% in rural area and 92% in the urban area of the city of Cimahi. The caries experience

index on this research showed a very high value in both areas, which was as much as 8.46 in the urban area, and as much as 7.98 in the rural area. This condition showed that the average value of decayed tooth (dt), missing teeth/indication for extraction (et), or filled teeth due to caries (ft) in 5-6 years old children, both in rural and urban areas were 8 teeth. However, on a research conducted in Northern Russia by Gorbatova et al at 2012 showed that a very high caries experience index (the def-t index) both in the rural and urban areas (consecutively were as much as 6.52 and 6.41).¹³

Geographically, the rural area is located in the urban-village of Cipageran, whilst the urban area is located in the urban-village of Baros, in the city of Cimahi. The urban-village of Cipageran is geographically consisted of as much as 80% of the residential land and 20% of the agricultural land. The residential land has the characteristics of slopes until hilly ground, with the height of $\pm 850-1,050$ metres above the sea level, mostly consisted of the green open space and people habitation with a degree of tilt $\pm 10\%$, inclining from the north into the south side. The water sources are generally obtained from natural water springs and groundwater from entrenchment wells and drilled wells.¹⁴ The urban area of the city of Cimahi is located in the urban-village of Baros, sub-districts of South Cimahi. Geographically, Geographically, the urban-village of Baros is the area with high population density and mobility, passed by national road and highway, and having a wide industrial area.

From the result of this study, the prevalence of dental caries in the rural area was slightly lower than in the urban area of the city of Cimahi. Dental caries is a multifactorial disease, with the environment as one of the risk factors. The results above was assumed due to the location of the rural area that was closer to the mountain area with natural water springs, that possibly made the water of the rural area were having more fluorine content compared to the water of the urban area.

The risk factors of dental caries also come from the oral cavity environment, included sugar consumption, dental plaque bacteria, host and teeth. The reduction of acid in the tooth enamel can attained by reducing the amount and frequency of sugar consumption. Host and

teeth are the most contributing risk factor of dental caries, which included the salivary flow and acidity degree, and also the tooth surface structure. Dental plaque bacteria is also able to increases the occurrence of dental caries if the oral hygiene is less maintained, and with the high quantity of microbes.¹

The results of this study showed that there was a significant relationship between the occurrence of dental caries and carbohydrates intake in the 5-6 years old children. Based on many contributing factors of dental caries occurrence, the dietary habit was one of the most important factor. Sugar as the fermentation result of carbohydrates was the risk factor of the initiation and development of dental caries.¹⁵ The high frequency of carbohydrate consumption, especially in the form of high sugar (group of sucrose) content, is significantly related with the increased of dental caries risk.⁷

A research conducted by Mwakayoka et al in 2016 showed that there was a relationship between more than once-a-day consumption of sugar and dental caries occurrence.¹⁶ This condition was consistent with another research that showed a relationship between the consumption of sugar sweeten soft drinks with dental caries occurrence.¹⁷

There was a difference in the average proportion of the amount of beverages taken by dental caries affected and dental caries-free individual. Sugary supplementary food and beverages consumption frequency, such as juices, energy drinks, and other sweeten beverages were significantly higher in dental caries affected children than in caries-free children.¹⁸

Carbohydrates intake that measured by the food frequency questionnaire was the children's daily frequency and amount of carbohydrates from sugar consumption. There was an epidemiological relationship between the amount and frequency of carbohydrates from sugar consumption and dental caries occurrence.¹⁹ This was consistent with previous research that discovered the higher consumption of sugar (more than 10% of the energy intake), the higher average value of dental caries occurrence (the value of DMF-T index was as much as 3.9). Also, the lower consumption of sugar (less than 7% of energy intake), the lower average value dental caries occurrence (the value

of DMF-T index was as much as 1.9).¹⁹ Based on the global guidelines, sugar consumption must not be more than 10% of the energy intake.

Carbohydrates intake of the 5-6 years old children in the rural and the urban areas of the city of Cimahi was at the amount of 237.14 grams a day. This research also showed that the higher carbohydrates intake, the higher risk of dental caries occurrence. Previous research had shown that the increase of dental caries of five of the tooth surface in the two years of the childhood period, on the children with sugar consumption at the amount above 193 grams a day. Whilst the children with sugar consumption less than 78 grams a day were having lower dental caries occurrence, which was only covering the three of the tooth surfaces.²⁰

Dental caries is developing over time and was triggered by the production of acids came from the breaks down of digestible carbohydrates into sugar. However, many other factors are able to affect the development and the severity of dental caries. These factors are playing each role of developing dental caries over time, in a different level of dental caries affected individuals.

CONCLUSION

There was a relationship between dental caries and carbohydrates intake among preschool-aged children in the rural and urban area of the city of Cimahi, Indonesia.

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REFERENCES

1. FDI World dental federation. 2nd ed of The oral health atlas. Bangkok: Annual world dental congress; 2015.
2. WHO. Oral health fact sheet No. 318. Geneva: WHO Media Centre; 2012.
3. Bagramian RA, Garcia-Godoy F, Volpe AR. The global increase in dental caries. A pending public health crisis. *Am J Dent*. Feb 2009;22(1):3-8.
4. Arcella D, Ottolenghi L, Polimeni A, Leclercq C. The relationship between frequency of carbohydrates intake and dental caries: a cross-sectional study in Italian teenagers. *Public Health Nutr*. Aug 2002;5(4):553-60. DOI: 10.1079/PHN2001319.
5. Moynihan PJ. The role of diet and nutrition in the etiology and prevention of oral diseases. *Bulletin of the World Health Organization*. 2005;83:494-699.
6. Moynihan P. Sugars and dental caries: evidence for setting a recommended threshold for intake. *Adv Nutr*. Jan 2016;7(1):149-56. DOI: 10.3945/an.115.009365.
7. Moynihan P, Petersen PE. Diet, nutrition and the prevention of dental diseases. *Public Health Nutr*. Feb 2004;7(1A):201-26.
8. Doichinova L, Bakardjiev P, Peneva M. Assessment of food habits in children aged 6-12 years and the risk of caries. *Biotechnol Biotechnol Equipment*. Jan 2 2015;29(1):200-4. DOI: 10.1080/13102818.2014.989180.
9. WHO. Oral health surveys: basic methods - 5th ed. Geneva: WHO Library; 2013.
10. Hiremath S. Textbook of Preventive and Community Dentistry. 2nd ed. New Delhi: Reed Elsevier India Private Ltd.; 2011.
11. Ministry of Health of Republic of Indonesia. Peraturan Menteri Kesehatan Republik Indonesia Nomor 75 Tahun 2013 Tentang Angka Kecukupan Gizi yang dianjurkan Bagi Bangsa Indonesia. Jakarta: Ministry of Health of Republic of Indonesia; 2013.
12. Fadilah RPN, Nawawi AP, Widyasari R. Determinants Social Health Affecting Dental Caries at Rural and Urban Areas. *International Association Dental Research*, Seoul, South Korea. 2016.
13. GorbatoVA MA, GorbatoVA LN, Pastbin MU, Grjibovski AM. Urban-rural differences in dental caries experience among 6-year-old children in the Russian north. *Rural Remote Health*. Jun 14 2012;12:1999.
14. Dinas Kesehatan Kota Cimahi. Profil Puskesmas Cipageran Tahun 2016. Cimahi: Data Puskesmas Dinas Kesehatan Pemerintahan Kota Cimahi; 2016.
15. Gupta P, Gupta N, Pawar AP, Birajdar SS, Natt AS, Singh HP. Role of sugar and sugar

- Substitutes in Dental Caries: A Review. *ISRN Dentistry*. Nov 6 2013;2013: p. 1-5 DOI: <http://dx.doi.org/10.1155/2013/519421>.
16. Mwakayoka H, Masalu JR, Namakuka Kikwilu E. Dental Caries and Associated Factors in Children Aged 2-4 Years Old in Mbeya City, Tanzania. *J Dent (Shiraz)*. Jun 2017;18(2):104-11.
 17. Kunitomo M, Ekuni D, Mizutani S, Tomofuji T, Irie K, Azuma T, et. al. Association between knowledge about comprehensive food education and increase in dental caries in Japanese university students: a prospective cohort study. *Nutrients*. Feb 25 2016;8(3): p. 114. DOI: 10.3390/nu8030114.
 18. Warren JJ, Blanchette D, Dawson DV, Marshall TA, Phipps KR, Starr D, et.al. Factors Associated with Dental Caries in a Group of American Indian Children at age 36 Months. *Community Dent Oral Epidemiol*. Apr 2016;44(2): p. 154-61. DOI: 10.1111/cdoe.12200.
 19. Limeback H. *Comprehensive Preventive Dentistry*. Hoboken: Wiley-Blackwell; 2012.
 20. Touger-Decker R, van Loveren C. Sugars and dental caries. *Am J Clin Nutr*. Oct 2003;78(4):881S-92S.