Dental Caries and Associated Factors among Primary School Children in Metropolitan City with the Largest Javanese Race Population: A Cross-sectional Study

Abstract

Background: Dental caries is the most prevalent and chronic oral disease, particularly in childhood age. Dental caries is a progressive infectious process with multifactorial etiology. Aim: The aim of this study was to examine the prevalence of dental caries and its associated factors among primary school children at Surabaya, as the metropolitan city with the largest Javanese race population in Indonesia. Materials and Methods: A school-based cross-sectional study was conducted at Surabaya in August 2017. Cluster random sampling technique was used to select the children. Structured questionnaire by the World Health Organization (WHO) was used to interview children and/or parents to collect sociodemographic variables. Clinical dental information was obtained by experienced dentist using dental caries criteria set by the WHO. Binary and multiple logistic regression analyses were computed to investigate the factors associated with dental caries. Results: Of 213 children, 50.4% were boys. Majority (99%) of the children cleaned their teeth using toothbrush. The proportion of children having dental caries was 53%. Decay-Missing-Filled (DMF) score was 1, decayed-extracted-filled (def) score was 1.08, and total DMF and def score were 2.07. Toothbrush usage, soda consumption, and educational level of fathers were the associated factors for dental caries. Conclusion: Toothbrush usage, soda consumption, and educational level of fathers were the associated factors for dental caries. Therefore, prevention measures, such as health education on oral hygiene, dietary habits, and importance of dental visit, are obligatory for children.

Keywords: Children, dental caries, dental plaque

Introduction

Dental caries is the most prevalent and chronic oral disease, particularly in childhood age. Carious lesion constitutes a progressive infectious process with multifactorial etiology. Dietary habits, oral microorganisms that ferment sugars, and host susceptibility have to coexist for dental caries to initiate and develop. Dental caries has high morbidity potential. Thus, it has been the main focus of dental health professionals.

Dental caries is caused by dental plaque deposits on the tooth surface. Frequency and timing of fermentable carbohydrates intake, which will be metabolized by a certain bacteria, such as Streptococcus mutans, lead to fermentation and therefore produce copious amount of acid and lower the local pH to a level where the minerals of enamel and dentine dissolve. The frequent intake of sweets, dry mouth, and poor oral hygiene may increase the chances for developing new carious lesion. Besides, some risk factors, such as sex, age, dietary habits, socioeconomic, and oral hygiene status, are also associated with increased prevalence and incidence of dental caries in population.

Dental caries in children may cause pain, discomfort, eating disorder, tooth loss, and delayed speech. Furthermore, dental caries also affects children’s concentration in school, and at times, dental treatment expense may become certain financial burden on the families.

Although the trend is not clear in developing countries, the number of dental caries has been increasing among children due to the uncontrolled intake of sugary substances, poor oral care practices, and inadequate health service utilization. Studies revealed that the prevalence of dental caries was higher among urban children.

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Indonesia faces significant challenges in relation to poor oral health in children that remain untreated until they reach teenage and even adulthood, in which more than 70% are affected by experiences related to dental caries. In a review of early childhood caries in Indonesia, according to a study conducted in five urban communities of special capital region of Jakarta in 2008, it was recorded that the prevalence of early childhood caries was 52.7%. Another study showed that the prevalence of early childhood caries in a group of children aged 6 months–3 years was 30.8%. Indonesia is a tropical archipelago located at Southeast Asian with more than 13,000 islands. The number of Indonesian population reaches 260 million that makes Indonesia as the fifth country with the most population in the world. Indonesia is characterized by enormous cultural diversity with more than 300 ethnic groups that have been described. Javanese constitutes as the largest ethnic group in Indonesia that occupies 41% of the total population. The majority of Javanese lives in Java Island and most are concentrated in Central and East Java. The capital city of East Java is Surabaya which is the second-largest city in Indonesia. There are various ethnic groups live in Surabaya, yet the most of it is Javanese. Those backgrounds encouraged the authors to focus the study in Surabaya.

Although dental caries is more prevalent in school-age children to date, however, there has been no well-documented data on prevailing prevalence and associated factors in primary school children in Surabaya. Therefore, the current study was carried out to examine the prevalence of dental caries and its associated factors among primary school children in Surabaya as the metropolitan city with the largest Javanese race population in Indonesia.

Materials and Methods

Study design and area

A school-based cross-sectional study was conducted from August 2017 among primary schoolchildren in Surabaya. Surabaya is the second biggest city in Indonesia. According to the 2017 Central Statistical Agency of Indonesia’s estimation, the city had a total population of 2,843,000. Urban primary school children under 12 years were accounted for 241,906. The town had a total of 2,843 urban primary schools spread into five areas, South, North, West, East, and Center of Surabaya.

Study participants

Students of primary schools aged 10–12 years old and living in Surabaya were included in the study. Children aged 12 years old or above were excluded from the study.

Table 1: Sociodemographic variables associated with caries

| Sociodemographic variables                                      | Dental caries | COR | P       |
|-----------------------------------------------------------------|---------------|-----|---------|
|                                                                 | Negative (%)  | Positive (%) |       |
| Age (years)                                                     |               |     |         |
| <10                                                             | 22.535        | 26.291 | 1.082  |
| >10                                                             | 24.413        | 26.761 | 0.940  |
| Sex                                                             |               |     |         |
| Male                                                            | 23.786        | 26.699 | 1.000  |
| Female                                                          | 21.359        | 28.155 | 1.174  |
| Family financial status                                        |               |     |         |
| Wealth                                                          | 0.000         | 0.469 | 1.000  |
| Poor                                                            | 46.948        | 52.582 | 0.373  |
| Father education                                                |               |     |         |
| No school                                                       | 8.920         | 6.573 | 1.000  |
| Did not pass elementary school                                  | 0.000         | 0.469 | 4.034  |
| Graduated from elementary school or equivalent                  | 2.817         | 5.164 | 2.379  |
| Graduated junior high school/equivalent                         | 1.878         | 4.225 | 2.839  |
| High school graduation/equivalent                               | 11.737        | 15.023 | 1.714  |
| Graduated higher education (diploma, S1, S2, and S3)            | 15.962        | 17.840 | 1.501  |
| There are no adult men in the house                              | 5.634         | 3.756 | 0.914  |
| Mother education                                                |               |     |         |
| No school                                                       | 6.103         | 5.634 | 1.000  |
| Did not pass elementary school                                  | 0.469         | 1.408 | 3.250  |
| Graduated from elementary school or equivalent                  | 2.347         | 4.225 | 1.950  |
| Graduated Junior high school/equivalent                         | 2.347         | 6.573 | 3.033  |
| High school graduation/equivalent                               | 16.432        | 18.779 | 1.238  |
| Graduated higher education (diploma, S1, S2, and S3)            | 15.493        | 14.554 | 1.018  |
| There are no adult women in the house                            | 3.756         | 1.878 | 0.542  |

*Significant; COR: Crude odds ratio
Sample size and sampling

The sample size was calculated using single population proportion formula with assumption of 95% confidence level, 5% degree of precision, and proportion of dental caries as much as 30.8%\textsuperscript{[18]} to make the final sample size of 80. However, we obtained 213 students that provided complete response. Systematic random sampling technique was used to select the study participants. Among five areas

| Practices to oral hygiene variables | Dental caries | COR | P   |
|------------------------------------|--------------|-----|-----|
|                                    | Negative (%) | Positive (%) |     |     |
| Tothache frequency                  |              |                |     |     |
| Often                              | 2.817        | 2.347          | 1   | 0.855 |
| Sometimes                          | 10.798       | 14.085         | 1.565 |    |
| Rarely                             | 15.962       | 20.188         | 1.518 |    |
| Never                              | 15.962       | 15.023         | 1.129 |    |
| Do not know                        | 1.408        | 1.408          | 1.200 |    |
| Dental visit                       |              |                |     |     |
| Once                               | 10.329       | 10.798         | 1   | 0.566 |
| Twice                              | 6.573        | 7.981          | 1.161 |    |
| Three times                        | 2.347        | 3.756          | 1.530 |    |
| Four times                         | 2.817        | 0.469          | 0.159 |    |
| More than four times               | 2.347        | 1.878          | 0.765 |    |
| Never been to a dentist for the last 12 months | 12.676    | 17.371         | 1.311 |    |
| Never received dental treatment from a dentist | 3.286     | 2.347          | 0.683 |    |
| Do not know/do not remember        | 6.573        | 8.451          | 1.230 |    |
| Dental visit caution               |              |                |     |     |
| Pain or there are problems with the teeth, gums, or mouth | 18.994 | 14.525 | 1 | 0.332 |
| Advanced care or treatment         | 3.352        | 3.352          | 1.308 |    |
| Regular tooth control              | 8.380        | 10.615         | 1.656 |    |
| Do not know/do not remember        | 16.760       | 24.022         | 1.874 |    |
| Toothbrushing frequency            |              |                |     |     |
| Never                              | 0.939        | 1.408          | 1   | 0.993 |
| Several times a month (2-3 times)  | 6.573        | 6.103          | 0.619 |    |
| Once a week                        | 0.469        | 0.469          | 0.667 |    |
| Several times a week (2-6 times)   | 3.286        | 4.225          | 0.857 |    |
| Once a day                         | 7.042        | 7.512          | 0.711 |    |
| Two or more in a day               | 28.638       | 33.333         | 0.776 |    |
| Toothbrush user                    |              |                |     |     |
| Yes                                | 0.469        | 0.000          | 1   | 0.003* |
| No                                 | 46.479       | 53.052         | 3.422 |    |
| Toothpick user                     |              |                |     |     |
| Yes                                | 38.498       | 47.418         | 1   | 0.122 |
| No                                 | 8.451        | 5.634          | 0.541 |    |
| Dental floss user                  |              |                |     |     |
| Yes                                | 45.540       | 52.582         | 1   | 0.249 |
| No                                 | 1.408        | 0.469          | 0.289 |    |
| Siwak user                         |              |                |     |     |
| Yes                                | 46.479       | 52.582         | 1   | 0.931 |
| No                                 | 0.469        | 0.469          | 0.884 |    |
| Toothpaste usage                   |              |                |     |     |
| Yes                                | 0.939        | 0.469          | 1   | 0.488 |
| No                                 | 46.099       | 52.582         | 2.286 |    |
| Fluoride usage                     |              |                |     |     |
| Yes                                | 1.878        | 5.164          | 1   | 0.112 |
| No                                 | 15.493       | 20.657         | 0.485 |    |
| Do not know                        | 29.577       | 27.230         | 0.335 |    |

*Significant; COR: Crude odds ratio
of Surabaya, two primary schools per area were selected using systematic random sampling technique. The sample size was allocated proportionally based on the number of children in each selected school. Children were selected randomly based on their name lists taken from their rosters in the respective class.

**Data collection**

A structured questionnaire was used to collect sociodemographic characteristics, dietary habits, oral health problems, and oral care practices. Dental examination was carried out for all selected children by one trained dental doctor using the World Health Organization (WHO) dental caries diagnosis guideline under natural daylight. Disposable wooden spatulas were used for intraoral examination. Prior to the study, data collectors were given with intensive training on dental caries assessment based on the WHO guideline and also how to interview the children and fill the questionnaire for 2 days. Incomplete questionnaires were rejected during the data analysis. Dental caries was defined as the presence of lesion in a pit or fissure or on smooth tooth surface, detectable softened floor, and undermined enamel or softened wall. When any doubt existed, dental caries was not recorded as present. The tooth was considered missing because of caries if a person gave a history of pain and/or presence of cavity before extraction.

The presence of dental plaque was assessed by direct visual inspection and palpation of the buccal and lingual surfaces of all teeth using clean glove and spatula.[22] The plaque was recorded as being present when visible deposits were detected and then following palpation of the teeth was removed by clean-gloved hand. Moreover, the presence of both hypocalcification and incipient caries type of white spot lesions were examined by conventional diagnostic technique.[22] First, the wet teeth were inspected for the presence of hypocalcification type of white spot lesion, then the teeth were allowed to wipe cleaned and dried with gauze and compressed air to inspect incipient caries type of white spot lesion. White spot lesion was recorded as being present when a white chalky appearance spot was revealed either in dehydrated or desiccated or both types of the upper and lower anterior of enamel.

**Data analysis**

Data were entered and analyzed using the Statistical Package for the Social Sciences version 25 (IBM, New York, USA). Frequency and percentage were computed from univariate analysis to get summary values. Odds ratio with 95% confidence interval was computed using logistic regression analysis to assess the presence and degree of association between dental caries and independent variables. Statistical significance was set at $P < 0.05$ (significance level 95%). For those variables that had a $P < 0.05$ on binary logistic regression, binary multiple logistic regression analysis was computed.

**Ethical considerations**

Ethical clearance was obtained from the Ethical Review Committee (certificate number: 211/HRECC.FODM/IX/2017). Written consent was obtained from children’s parents before the interview and dental examination. Cases of dental caries were advised to attend the nearby dental clinic.

**Results**

**Sociodemographic characteristics**

A total of 213 children participated in the study. Of these, 50.4% were male. The majority of children (51%) were aged more than 10 years old. About 99% of respondents came from wealthy families based on Badan Pusat Statistik indicators. Approximately, 33% of respondents had high-educated fathers and 35% of respondents had mothers with secondary education level [Table 1].

**Practices related to oral hygiene**

About 36% of respondents stated that they rarely had toothache, 30% of respondents had never visited a dentist in the past year, 33% of respondents came to the dentist due to complaints on their oral cavity, 61% admitted to brushing teeth twice or more a day, 99% of respondents used toothbrush to clean their teeth, 98% used toothpaste, and 36% of them used fluoridated toothpaste [Table 2].

**Food consumption pattern and dietary habits**

About 30% of respondents consumed fruit, 23% consumed sweets and sweet foods, and 27% consumed tea several times a week. As many as 36% of respondents consumed biscuits and 39% consumed milk everyday. As many as 30% of respondents consumed fruit, 23% consumed sweets and sweet foods, and 27% consume tea several times a week. As many as 36% of respondents consumed biscuits, 39% consumed milk, and 5% of respondents consumed soda everyday [Table 3].

**Dental caries**

About 53% of respondents suffered from dental caries. The average decay-missing-filled (DMF) score was 1, decayed-extracted-filled (def) was 1.08, and the total average DMF and def score were 2.07. The most missing permanent tooth was the first molar of the entire region, respectively. The most abundant primary tooth was the central incisors throughout the region, respectively [Table 4].

**Risk factors associated with dental caries**

Based on bivariate analysis, there was a significant relationship between caries and father education, soda consumption, and the use of toothbrush to clean teeth.
Table 3: Consumption habit variables associated with caries

| Consumption habit variables | Dental caries | COR | P |
|-----------------------------|--------------|-----|---|
|                            | Negative (%) | Positive (%) |     |
| Fruits consumption frequency |              |     |   |
| Never                      | 2.817        | 3.756 | 1  | 0.823 |
| Several times a month      | 6.573        | 7.042 | 0.804 |
| Once in a week             | 8.920        | 7.512 | 0.632 |
| Several times a week       | 12.676       | 17.371 | 1.028 |
| Everyday                   | 8.920        | 7.981 | 0.671 |
| Several times a day        | 7.042        | 9.390 | 1.000 |
| Honey consumption frequency |              |     |   |
| Never                      | 15.023       | 15.962 | 1  | 0.990 |
| Several times a month      | 11.268       | 12.676 | 1.059 |
| Once in a week             | 6.103        | 6.103 | 0.941 |
| Several times a week       | 5.634        | 7.981 | 1.333 |
| Everyday                   | 4.695        | 5.164 | 1.035 |
| Several times a day        | 4.225        | 5.164 | 1.150 |
| Gum consumption frequency  |              |     |   |
| Never                      | 17.371       | 18.310 | 1  | 0.691 |
| Several times a month      | 11.737       | 10.798 | 0.873 |
| Once in a week             | 4.225        | 8.451 | 1.897 |
| Several times a week       | 6.103        | 7.981 | 1.241 |
| Everyday                   | 4.225        | 3.756 | 0.843 |
| Several times a day        | 3.286        | 3.756 | 1.084 |
| Candy consumption frequency |              |     |   |
| Never                      | 8.920        | 11.268 | 1  | 0.437 |
| Several times a month      | 8.451        | 9.390 | 0.880 |
| Once in a week             | 6.573        | 6.573 | 0.792 |
| Several times a week       | 10.798       | 12.207 | 0.895 |
| Everyday                   | 8.920        | 6.103 | 0.542 |
| Several times a day        | 3.286        | 7.512 | 1.810 |
| Milk consumption frequency |              |     |   |
| Never                      | 2.817        | 1.408 | 1  | 0.778 |
| Several times a month      | 5.164        | 6.103 | 2.364 |
| Once in a week             | 4.695        | 3.756 | 1.600 |
| Several times a week       | 7.981        | 11.268 | 2.824 |
| Everyday                   | 18.310       | 21.127 | 2.308 |
| Several times a day        | 7.981        | 9.390 | 2.353 |
| Soda consumption frequency |              |     |   |
| Never                      | 27.700       | 29.577 | 1  | <0.0001* |
| Several times a month      | 11.737       | 10.329 | 0.827 |
| Once in a week             | 2.817        | 6.103 | 1.946 |
| Several times a week       | 2.817        | 2.817 | 0.937 |
| Everyday                   | 1.408        | 4.225 | 2.543 |
| Several times a day        | 0.469        | 0.000 | 0.312 |
| Coffee consumption frequency |          |     |   |
| Never                      | 31.455       | 35.681 | 1  | 0.164 |
| Several times a month      | 5.634        | 5.634 | 0.882 |
| Once in a week             | 4.695        | 2.347 | 0.441 |
| Several times a week       | 2.347        | 5.634 | 2.116 |
| Everyday                   | 2.347        | 1.408 | 0.529 |
| Several times a day        | 0.469        | 2.347 | 4.408 |
| Tea consumption frequency  |              |     |   |
| Never                      | 4.695        | 5.164 | 1  | 0.824 |

Contd...
Based on multivariate analysis, the three variables showed a significant relationship with \( P = 0.0001 \). Based on multivariate analysis, the three variables showed a significant relationship with \( P = 0.0001 \). Respondents, who did not brush their teeth using toothbrush, were at least 1.6 times as likely to suffer from caries compared to those who did not use toothbrushes. Respondents with daily soda consumption were at risk for caries 3.3 times compared with those who did not consume soda. Respondents with fathers who had graduated from elementary school were at risk for caries 4.5 times compared with those who did not complete primary school [Table 5].

**Discussion**

Surabaya is the second-most populous city in Indonesia with 2,848,583 people recorded in the chartered city limits in the 2015 census with the extended metropolitan development area called Gerbangkertosusila (derived from Gresik-Bangkalan-Mojokerto-Surabaya-Sidoarjo-Lamongan). It adds more than 12 million inhabitants in several cities and around 50 districts spread over noncontiguous urban areas, including Gresik, Sidoarjo, Mojokerto, and Pasuruan regencies. Although the central government of Indonesia recognizes only the metropolitan area (Surabaya, Gresik, and Sidoarjo) as greater Surabaya (Zona Surabaya Raya) with a population of 8,319,229, Surabaya is now the second-largest metropolitan area in Indonesia. The city is highly urbanized with industries centralized in the city, and it contains slums. Surabaya is an old city that has expanded overtime, and its population continues to grow at roughly 0.52% per year.[23]

In Surabaya, there is a scarcity of data on dental caries in primary schoolchildren. Dental caries is a common health problem among primary schoolchildren. The prevalence of dental caries found in the present study was 53%. The caries prevalence was higher than studies carried out in Gunung Anyar Surabaya in 2014 (30.8%).[24] However, the caries prevalence was equal to the results of a study conducted in Nepal (52%)[25] but higher than the study conducted in Tanzania (17.6%),[26] Ethiopia (36.3%–48.1%),[8,27] and Nigeria (35.5%).[14] yet lower than India (77%).[28] The difference could be due to difference in knowledge, attitude, and practices (KAPs) on oral hygiene as our study was undertaken among urban school children.

The data collected in this study showed that low educational level of either parent was related to the presence of children’s caries. These results corresponded to the results of similar studies which revealed an association between the presence of children’s caries and the socioeconomic level of parents.[29,30] The adoption of good oral health habits in childhood often leads to positive results in the quality of the health and life of the children.[31] Previous studies have proved that children live in poverty had infrequent dental visit, therefore, had higher prevalence of dental caries.[7,32,33] However, in this study, a clear association between family income and dental caries was not observed. This was comparable with a study done in Sri Lanka.[34] Parents and responsible adults are the principal actors in the children’s development in the 1st year of life. Thus, the interventions directed at parents’ beliefs and attitudes about oral health may be beneficial in the prevention of oral problems such as dental caries. Sufia et al. (2009)[34] in their study stated that the younger age of the parents, higher level of educational attainment, higher income due to better occupational status and urban residence all had strong association with dental caries, and positive influence on dental health practices of the children. This can be attributed to the increased awareness regarding dental health among younger parents with higher level of educational attainment. Furthermore, better occupational status of the parents provides better accessibility to dental care.

Moreover, the usage of toothbrush for cleaning was significantly associated with dental caries. Children who had cleaned their teeth with toothbrush revealed a lower prevalence of dental caries. This may be attributed to the fact that toothbrush is more effective for the removal
### Table 4: Decay, missing, and filling distribution by tooth

| Tooth region | Tooth type   | Decay (%) | Missing (%) | Filling (%) | Mean DMF/def | Mean DMF and def |
|--------------|--------------|-----------|-------------|-------------|--------------|-----------------|
| Right maxilla | Central incisive | 1.16 | 0 | 0 | 1 | 2.07 |
|              | Lateral incisive | 1.73 | 2.86 | 0 |  |
|              | Canine | 2.89 | 2.86 | 0 |  |
|              | First premolar | 1.73 | 14.29 | 0 |  |
|              | Second premolar | 1.73 | 0 | 0 |  |
|              | First molar | 10.4 | 2.86 | 0 |  |
|              | Second molar | 1.16 | 0 | 0 |  |
|              | Third molar | 0 | 0 | 0 |  |

| Left maxilla | Central incisive | 0.58 | 0 | 0 |  |
|              | Lateral incisive | 2.89 | 2.86 | 0 |  |
|              | Canine | 3.47 | 0 | 0 |  |
|              | First premolar | 1.73 | 11.43 | 0 |  |
|              | Second premolar | 1.16 | 8.57 | 0 |  |
|              | First molar | 12.14 | 5.71 | 0 |  |
|              | Second molar | 0.58 | 0 | 0 |  |
|              | Third molar | 0 | 0 | 0 |  |

| Left mandibular | Central incisive | 0 | 0 | 0 |  |
|                 | Lateral incisive | 0.58 | 0 | 0 |  |
|                 | Canine | 0.58 | 0 | 0 |  |
|                 | First premolar | 0.58 | 11.43 | 0 |  |
|                 | Second premolar | 3.47 | 5.71 | 0 |  |
|                 | First molar | 23.12 | 8.57 | 16.67 |  |
|                 | Second molar | 0.58 | 0 | 16.67 |  |
|                 | Third molar | 0 | 0 | 0 |  |

| Right mandibular | Central incisive | 0 | 0 | 0 |  |
|                 | Lateral incisive | 0 | 0 | 0 |  |
|                 | Canine | 1.16 | 0 | 0 |  |
|                 | First premolar | 2.89 | 17.14 | 0 |  |
|                 | Second premolar | 2.89 | 0 | 0 |  |
|                 | First molar | 19.65 | 5.71 | 50 |  |
|                 | Second molar | 1.16 | 0 | 16.67 |  |
|                 | Third molar | 0 | 0 | 0 |  |

| Primary teeth | Right maxilla | 28.63 | 0 | 0 | 1.08 |  |
|               | Lateral incisive | 0.4 | 4.35 | 0 |  |
|               | Canine | 1.61 | 0 | 0 |  |
|               | First molar | 4.84 | 8.7 | 0 |  |
|               | Second molar | 7.26 | 8.7 | 100 |  |

| Left maxilla | Central incisive | 11.69 | 0 | 0 |  |
|              | Lateral incisive | 0.4 | 4.35 | 0 |  |
|              | Canine | 0.4 | 8.7 | 0 |  |
|              | First molar | 4.03 | 8.7 | 0 |  |
|              | Second molar | 6.05 | 0 | 0 |  |

| Left mandibular | Central incisive | 10.89 | 0 | 0 |  |
|                | Lateral incisive | 0 | 0 | 0 |  |
|                | Canine | 0 | 0 | 0 |  |

*Contd...*
of plaque from the tooth surface. The low prevalence of dental caries in toothbrush users may be due to the fact that the bristles of a toothbrush could reach and clean those inaccessible areas of the oral cavity that might not be accessible to the finger and other materials. It is generally true that cleaning teeth will remove the food debris away from the oral cavity. Therefore, *S. mutans* cannot get enough nutrient and time for growth so that there is no acid production which causes dental caries development.\[22,35]\n
In this study, we confirmed that children with daily consumption of soda or soft drinks were at risk for caries 3.3 times higher compared with those who did not consume soda. In addition to the effect of soft drinks on caries development, frequent soft drink consumption may also lead to the erosion of enamel.\[36]\n
The acidic nature of soft drinks does not apply only to those containing sugar but also to sugar-free (diet)-labeled soft drinks.\[37]\n
Both soft drinks and sports drinks have been proved to have a pH between 2.5 and 3.5.\[38]\n
The chronic exposure of tooth structure to beverages with a low pH may result in enamel wearing away over time.\[38]\n
An increase in consumption results in more frequent exposure to low salivary pH which may accelerate the caries process. The ideal pH of the oral cavity is neutral which ranges from 6.5 to 7.5.\[39]\n
As mentioned earlier, a pH of 5.5 or lower may result in the development of caries lesions. Various studies have evaluated the impact of pH levels on enamel. *In vivo* studies have shown that the oral cavity has the ability to recuperate once the pH has gone below the optimal levels.\[33]\n
However, the repeated reduction in pH levels is still significant regarding enamel demineralization.

This study has the following main limitations. The detection of dental caries using diagnostic instrument and radiology was not possible because of lack of instruments and laboratory setup. Therefore, dental caries was identified using clinical diagnosis only.

**Conclusion**

Dental caries is a common public health problem among primary school children in Surabaya. Toothbrush usage,
soda consumption, and educational level of fathers were the associated factors for dental caries. Therefore, health education on oral hygiene, dietary habits, and dental visit should be given for children to prevent and control dental caries. Moreover, further studies, including private and rural schoolchildren using all methods of diagnosis of dental caries and assessment of KAPs of children and their parents on oral hygiene should be recommended.

Conflicts of interest

There are no conflicts of interest.

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