Correlation between dental caries severity and oral health knowledge in children aged 9-12 years in the agroindustrial area: an analytical observational study

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ABSTRACT

Introduction: Dental caries is a disease of hard tooth tissues that is often found in children, particularly those aged 9–12 years at the elementary school level. According to Riskesdas 2018, around 57.6% of Indonesia's population experiences dental and oral health problems, with a high prevalence of caries in school-age children. This condition is exacerbated by limited awareness of the importance of oral hygiene, leading to neglectful behaviors. This study aims to analyze the correlation between the severity of dental caries and oral health knowledge in children aged 9-12 years in the agro-industrial area. **Methods:** This research used an analytical observational design with a cross-sectional approach and included a total sample of 35 students selected using a total sampling method. Data was collected through direct observation of oral cavity conditions and a self-developed questionnaire with questions about dental and oral health. **Results:** The sample included 14 male students and 21 female students, with the highest number of participants recorded in fifth-grade, totalling sixteen. The severity of dental caries, assessed using the CSI (Caries Severity Index), showed that the most frequent score was in the moderate category, with 31 cases across all grades. Knowledge of dental and oral health, measured using a questionnaire, showed that the most frequent score was in the good category, with 27 students across all grades. The Spearman correlation test showed no statistically significant relationship between dental caries severity and oral health knowledge in children aged 9-12 years, with a p-value of 0.180. **Conclusion:** There is no significant correlation found between dental caries severity and oral health knowledge in children aged 9-12 years in the agroindustrial area.

Keywords

dental caries, caries severity, children, oral health knowledge, agro-industry.

Korelasi keparahan karies gigi dengan pengetahuan kesehatan gigi dan mulut pada anak usia 9-12 tahun di kawasan agroindustri: studi observasional analitik

ABSTRAK

Pendahuluan: *Karies gigi merupakan penyakit pada jaringan keras gigi yang banyak ditemukan pada anak-anak, terutama pada tingkat sekolah dasar usia 9-12 tahun. Menurut Riskesdas 2018, sekitar 57,6% penduduk Indonesia mengalami masalah kesehatan gigi dan mulut, dengan prevalensi karies yang tinggi pada anak-anak usia sekolah. Kondisi ini diperparah dengan kurangnya pengetahuan mengenai pentingnya perawatan gigi dan mulut, yang dapat menyebabkan sikap abai terhadap kebersihan gigi. Penelitian ini bertujuan untuk menganalisis korelasi keparahan karies gigi dengan pengetahuan kesehatan gigi dan mulut pada anak usia 9-12 tahun yang berada di kawasan agroindustri.* ***Metode:*** *Jenis penelitian desain observasional analitik dengan pendekatan potong lintang (cross-sectional) dan melibatkan total sampel sebanyak 55 siswa, dengan metode total sampling. Data dikumpulkan melalui observasi langsung kondisi rongga mulut dan pengisian kuesioner dengan pertanyaan tentang kesehatan gigi dan mulut yang di kembangkan sendiri.* ***Hasil****: Terdapat 14 siswa laki-laki dan 21 siswa perempuan. Jumlah subjek terbanyak pada kasus kelas V dengan jumlah 16 siswa. Tingkat keparahan karies gigi dengan menggunakan CSI (Caries Severity Index) memiliki skor terbanyak adalah kriteria sedang sebanyak 31 pada semua kelas, pengetahuan kesehatan gigi dan mulut dengan menggunakan kuesioner memiliki skor terbanyak adalah kriteria baik dengan jumlah sebanyak 27 pada semua kelas. Hasil uji korelasi Spearman menunjukkan tidak terdapat korelasi yang signifikan antara keparahan karies gigi dan pengetahuan kesehatan gigi dan mulut pada anak usia 9-12 tahun, dengan p-value sebesar 0,180.* ***Simpulan****: Tidak terdapat korelasi keparahan karies gigi dengan pengetahuan kesehatan gigi dan mulut pada anak usia 9-12 tahun di kawasan agroindustri.*

Kata kunci

karies gigi, keparahan karies, anak, kesehatan gigi, agroindustri

INTRODUCTION

Oral and dental health is a public health concern that requires comprehensive management due to its broad impact. Dental caries remain a prevalent complaint in Indonesia.[1] It is a disease affecting the tooth structure, characterized by the proggresive destruction of tissues, beginning on the surface (pits, fissures, and interproximal areas) and progressing toward the pulp. Dental caries are particularly common among elementary school children, who tend to favor sugary foods, a condition further triggered by bacteria interacting with plaque and exhibiting cariogenic properties.[2,3] In children, dental caries represent one of the most common oral health issues in recent years.[4] The frequent consumption of cariogenic foods—such as candy, chocolate, cakes, syrups, sodas, and other sugary beverages—without proper dental hygiene significantly accelerates the development of caries. The risk increases further when sweet foods are consumed outside regular meal times.[5]

The etiology of dental caries involves both internal and external factors. Internal factors include the host (such as tooth size and shape, enamel structure, and saliva), fermentable carbohydrate-metabolizing microorganisms, substrate, and time. In contrast, external factors involve socioeconomic status, access to dental care services, and educational attainment—all of which influence oral health behaviors.[6]

According to the 2018 National Basic Health Research report, the prevalence of dental caries in Indonesia reached 57.6%, with East Java showing a relatively high prevalence at 42.4%.[7] Elementary school-aged children are especially vulnerable to caries due to their dietary habits involving cariogenic foods and beverages. During this developmental stage, children rely heavily on adults, and their habits are shaped by familial cultural values. At ages 10–12, many children begin to exhibit neglectful behaviors toward oral hygiene, exacerbating caries severity due to factors such as malnutrition, genetic predispositions, poor health practices, age, sex, and place of residence.[8-10]

Jember Regency is known for its strong agricultural and plantation industries, with a significant portion of the population employed as farmers or agricultural laborers. According to the Central Bureau of Statistics of Jember Regency,[11] approximately 20% of the population works in the agroindustrial sector, typically earning below the regional minimum wage. Economic and educational constraints often limit community access to adequate health information, including dental care.[11,12]

This lack of access contributes to low public awareness regarding oral hygiene, thereby potentially worsening the incidence of dental caries in the region. Knowledge is a crucial determinant in the development of health-related behaviors. Actions driven by informed awareness tend to be more sustainable than behaviors lacking sufficient understanding. Conversely, inadequate knowledge about dental care can lead to neglect of oral hygiene.[13,14]

In this context, Mangaran 2 State Elementary School, located in the Kebun Renteng agroindustrial area, presents a suitable setting to examine the relationship between oral health knowledge and the severity of dental caries among children aged 9–12 years. Public health issues, particularly in oral health, are heavily influenced by socio-cultural and environmental factors. Economic limitations often impede access to dental health services, thereby contributing to poor oral health conditions among children.[15] These factors collectively influence the mindset and behaviors of the community, particularly those in agroindustrial regions. The novelty of this study lies in its setting within an agroindustrial area—an environment rarely explored in similar research. Furthermore, the study employs an analytical observational design, enabling the collection of real-world field data. The objective of this research is to analyze the correlation between the severity of dental caries and oral health knowledge among children aged 9–12 years living in an agroindustrial region.

METHODS

This research was an analytical observational study with a cross-sectional design, conducted from February to March 2022 at Mangaran 2 Elementary School, Jember Regency. The cross-sectional design enabled the simultaneous measurement of independent and dependent variables—specifically, the severity of dental caries and the level of oral health knowledge among children aged 9 to 12 years. As an analytical study, it was constructed based on a hypothesis aimed at identifying a potential correlation between the two variables.[16] The inclusion criteria encompassed individuals who were active students in grades IV to VI at Mangaran 2 Elementary School in Ajung District, were present at the research site and willing to participate by completing a written informed consent, completed the questionnaire provided by the researchers, demonstrated cooperative behavior, and exhibited no symptoms of cough or cold, had a body temperature below 37°C at the time of examination, and oxygen saturation between 95% and 100%. Dental examinations included both anterior and posterior teeth, including both primary and permanent, across all surfaces: facial/buccal, lingual/palatal, mesial, distal, and occlusal. Exclusion criteria included students who were absent during data collection or unable to undergo caries severity assessment due to symptoms consistent with COVID-19. A total sampling technique was used to recruit all eligible participants.

The study was conducted in multiple stages with strict adherence to health protocols during the COVID-19 pandemic. It began with the researchers providing an explanation of the study's objectives and procedures to the students who would serve as participants. Informed consent forms were then distributed to each student to obtain formal approval from their guardians or schoool authorities. After consent was secured, students completed a questionnaire assessing their knowledge of oral and dental health, followed by a clinical dental examination to assess the severity of dental caries. Data collection was organized in group sessions of 10 to 15 students per session to ensure compliance with pandemic-related health measures. The data gathered from all sessions were subsequently analyzed to test the initial hypothesis, which posited a correlation between the severity of dental caries and the level of oral health knowledge among children aged 9 to 12 years in an agroindustrial region.

Throughout all phases, this study strictly adhered to ethical research principles, ensuring the confidentiality of participant data and the protection of participant welfare. All students who participated in the study provided written informed consent, affirming their agreement with the procedures and objectives of the research. This process ensured that both the students and school representatives fully understood their rights and responsibilities as research participants.

Data on oral health knowledge were collected using a questionnaire consisting of 12 multiple-choice questions. Prior to its use in the study, the questionnaire underwent validity and reliability testing to ensure accuracy and consistency of measurement. The validity test was conducted on a sample of 35 respondents, with a critical r-value of 0.334. All 12 questions were deemed valid, as their item-total correlation values exceeded the threshold, with results as follows: P1 (0.368), P2 (0.529), P3 (0.365), P4 (0.387), P5 (0.386), P6 (0.576), P7 (0.651), P8 (0.398), P9 (0.354), P10 (0.482), P11 (0.387), and P12 (0.368). The reliability analysis yielded a Cronbach's alpha of 0.704, indicating that the instrument was internally consistent and therefore reliable.

The questionnaire scores were classified into three categories: "Poor" for scores below 24, "Moderate" for scores between 24 and 28, and "Good" for scores above 28. Each response was scored according to its degree of correctness, with 3 points assigned for the most accurate answer, 2 points for a correct answer, and 1 point for an incorrect answer. Based on these scores, participants' oral health knowledge levels were categorized accordingly as Good (score >28), Moderate (score 24–28), and Poor (score <24).

The severity of dental caries among students was assessed using the Caries Severity Index (CSI), with examinations conducted directly by the researcher. A single trained examiner—namely, the researcher—performed all assessments to ensure consistency and eliminate the need for inter-rater reliability testing. The dental examination included all tooth surfaces—facial/buccal, lingual/palatal, mesial, distal, and occlusal—on both primary and permanent teeth. CSI scores were classified as follows: a score of 0 indicated healthy teeth, a score below 1 indicated mild caries, scores between 1 and 3 indicated moderate caries, and scores above 3 indicated severe caries. The CSI was chosen because it does not differentiate between decayed, filled, or extracted teeth due to caries, making it especially suitable for populations with limited awareness of dental care.

The data obtained from the questionnaire and CSI examinations were analyzed using the non-parametric Spearman correlation test to evaluate the relationship between the severity of dental caries and the level of oral health knowledge among the students. The Spearman test was selected due to the non-normal distribution of the data.

RESULTS

This study aimed to analyze the correlation between the severity of dental caries and oral health knowledge among children aged 9 to 12 years at Mangaran 2 Elementary School, Ajung District, Jember Regency. From a total of 55 students, 35 were included in the final sample. Twenty students were excluded due to being absent during data collection or exhibiting symptoms consistent with COVID-19. Primary data were collected using a questionnaire assessing oral health knowledge and a clinical dental examination utilizing the Caries Severity Index (CSI).

Table 1. Distribution of study subjects by age and gender in the agroindustrial area

Age	Gender		Total (n)	Percentage (%)
	Male	Female		
9 years	1	0	1	3
10 years	2	3	5	14
11 years	9	15	24	69
12 years	2	3	5	14
Total	**14**	**21**	**35**	**100**

As shown in Table 1, the majority of participants were 11 years old, accounting for 24 students (68.57%). The fewest participants were aged 9, represented by only 1 student (3%). This age range is considered significants as it corresponds to a critical period of development in which students' risk exposure and understanding of oral health are increasing. A histogram was generated to provide visual clarity regarding the distribution by age and sex (see Figure 2, not included here).

Students' oral health knowledge was assessed using a 12-item multiple-choice questionnaire. The items covered key topics such as suitable toothbrush characteristics, appropriate brushing times, consequences of poor brushing habits, cariogenic foods, cavity prevention methods, brushing technique, toothbrush replacement frequency, and the importance of dental visits. This instrument was designed to evaluate the students' comprehensive understanding of oral health. Responses were scored according to accuracy, and overall scores were categorized into three levels: Poor (score <24), Moderate (score 24–28), and Good (score >28).

Table 2. Oral health knowledge and dental caries severity in the agroindustrial area.

Knowledge Level	Caries Severity				Total	(%)
	Healthy	Mild	Moderate	Severe		
Poor	0	0	0	0	0	0
Moderate	2	0	6	0	8	22,86
Good	2	0	25	0	27	77,14
Total	4	0	31	0	35	100
(%)	11,43	0	88,57	0	100	

The majority of students, totaling 27 individuals (77.14%), demonstrated oral health knowledge classified as "Good." This indicates that most students possessed an adequate understanding of dental and oral care (see Table 2).

The severity of dental caries was assessed using the Caries Severity Index (CSI), which classifies dental conditions into four categories: healthy, mild, moderate, and severe. The distribution of CSI scores is also shown in Table 2, revealing that the majority of students were classified in the "Moderate" category, comprising 31 students (88.57%), while the remaining 4 students (11.43%) fell into the "Healthy" category. No participants were found in the mild or severe categories.

Table 3. Correlation between dental caries severity and oral health knowledge in the agroindustrial area

	Oral health knowledge	Caries severity index
Correlation coefficient	1,000	0,232
Significance (2-tailed)		0,180
n	35	35

Statistical analysis was performed using the non-parametric Spearman correlation test to assess the relationship between CSI scores and oral health knowledge. As shown in Table 3, the Spearman correlation coefficient was 0.232, with a two-tailed significance value of 0.180 ($p > 0.05$). These results indicate that there was no statistically significant correlation between students' oral health knowledge and the severity of their dental caries.

In other words, while the majority of students demonstrated a high level of knowledge regarding oral health, this was not directly associated with reduced caries severity. This finding suggests that factors beyond knowledge-such as behavioral habits, access to dental care, and socioeconomic conditions—may also play a substantial role in caries development among children in agroindustrial regions.

DISCUSSION

This study aimed to identify the relationship between the severity of dental caries and oral health knowledge among elementary school children aged 9 to 12 years at Mangaran 2 Elementary School, located in an agroindustrial area of Jember Regency. This location is of particular importance, as agroindustrial regions such as Mangaran tend to have populations composed predominantly of workers with lower levels of education and income, which can significantly affect access to health information, including oral and dental health.[11,12] Low socioeconomic status is often associated with an increased risk of health problems, including oral health issues, due to limited access to care and low awareness of the importance of dental and oral hygiene.[17]

Based on the questionnaire results illustrated in Figure 3 regarding oral health knowledge, the majority of students (77.14%) demonstrated a good level of knowledge.

This finding is consistent with the study conducted by Mariati, Vonny, and Maria Tasya, in which questionnaire responses from 153 participants (100%) showed that 90 respondents (58.82%) had good oral health knowledge, while 63 respondents (41.18%) had poor knowledge.[18] In contrast, a study conducted by Ani Rahmadhani Kaban, Muflih, and Setiaji involving 56 respondents (100%) from Al-Fakhri Private Elementary School found that 40 respondents (71.4%) had low levels of oral health knowledge, while only 16 respondents (28.6%) demonstrated high levels of knowledge.[19]

However, despite the fact that most students demonstrated a reasonably good level of understanding, the application of this knowledge in daily practice may still be suboptimal, as reflected in the Caries Severity Index (CSI) results, where 88.57% of students were found to have moderate caries severity (see Figure 2). This indicates that a high level of knowledge does not necessarily correlate with lower caries severity. On the contrary, various other factors such as dietary habits, brushing patterns, and environmental influences also contribute to the severity of dental caries among students.[20]

Table 3 presents the results of the Spearman correlation test between oral health knowledge and dental caries severity (CSI) among students. With a significance value of 0.180 ($p > 0.05$), the findings indicate that there is no statistically significant correlation between the level of knowledge and caries severity. This result aligns with previous studies suggesting that oral health knowledge alone is insufficient to reduce caries severity if not accompanied by supportive behaviors and habits.[18] External factors—such as the frequent consumption of cariogenic foods, which is common in agroindustrial areas, and limited access to adequate dental health facilities—may be key contributors to the high caries severity among students, even when their knowledge levels are relatively high.[8]

This finding is consistent with the study by Mariati, Vonny, and Maria Tasya, which also reported no significant relationship between the level of knowledge and the incidence of dental caries among school-aged children in Wori Village. Although most children demonstrated good knowledge of oral and dental health, a high number of them still had dental caries. This was attributed to the respondents' perception that tooth brushing does not necessarily need to be performed at the recommended times—namely, after breakfast and before bedtime. In fact, brushing at these specific times is crucial for removing food debris and preventing plaque accumulation on the teeth.[19]

Children who possess good knowledge must also be supported by parental guidance to ensure that this knowledge is translated into daily habits. Given the substantial influence of behavior on oral health outcomes, targeted approaches are necessary to cultivate positive dental health practices. Knowledge acts as a psychological driver that shapes attitudes and daily actions, and thus can be regarded as a stimulus for behavior. While knowledge of oral health is a critical factor in determining future dental health status, it is not sufficient on its own—appropriate attitudes and behaviors must accompany it to produce meaningful and lasting effects.[21]

This study differs from the findings of Ani Rahmadhani Kaban, Muflih, and Setiaji, who reported a significant relationship between oral health knowledge and the incidence of dental caries among students at Al-Fakhri Private Elementary School. Their results suggest that several factors—such as educational level, access to information, cultural influences, and prior experiences—may contribute to this correlation. Knowledge is understood as the recall of information that has been previously learned or acquired. Such knowledge can be imparted by parents or teachers, enabling children to model appropriate dental hygiene behaviors, particularly proper tooth brushing techniques at the recommended times. This approach may help prevent dental caries among children, as observed in the context of students at Al-Fakhri Private Elementary School.[21]

The suboptimal application of knowledge in promoting consistent oral hygiene habits is often due to a limited and superficial understanding of the importance of maintaining oral health. Furthermore, not all knowledge acquired can be effectively translated into practice, as its application is influenced by several supporting factors, including parental involvement,

teacher guidance, environmental context, socioeconomic conditions, and other external variables. While oral health education can lead to improved knowledge, such improvements do not necessarily have a direct impact on caries status. This underscores the need for behavioral reinforcement and environmental support to bridge the gap between knowledge and sustained oral health outcomes.[22]

The prevalence of dental caries in agroindustrial areas may be higher, as children living in these regions often have easier access to locally produced sugary foods and beverages, such as snacks and sweetened drinks, which contribute to caries development. In communities with low educational and economic levels, parents may have limited awareness of the importance of oral health care, leading to suboptimal dental hygiene practices at home. Previous research has shown that socioeconomic factors play a significant role in oral health behaviors, with individuals from lower economic backgrounds tending to have more limited access to healthcare and oral health education.[18] Globally, approximately 60–90% of school-aged children experience dental caries, with higher prevalence observed among families of lower socioeconomic status who frequently neglect preventive and therapeutic dental services.[23,24]

Limited maternal knowledge about dental caries contributes to a high incidence of caries among children. Knowledge—both theoretical and practical—is a crucial aspect of an individual's cognitive capacity. It can be preserved through traditions, practices, technologies, and literature, and may transform when applied appropriately. The occurrence of dental caries is often influenced by inadequate awareness related to oral and dental health. Knowledge gaps persist regarding the role of fibrous foods, appropriate treatments for dental caries, and the significance of addressing cavities in children. Many parents still perceive dental caries in children as a minor and common issue, rather than a serious health concern.[25]

Therefore, it is essential to strengthen oral health education programs both in schools and at the family level to optimize students' oral hygiene behaviors. Programs such as the School Dental Health Program (*Usaha Kesehatan Gigi Sekolah*, UKGS) can be enhanced in terms of frequency and coverage to provide more comprehensive knowledge and support for students in maintaining their oral health. In addition, active involvement of parents and the wider community is necessary to reinforce children's understanding of the importance of maintaining good oral hygiene practices at home.[26]

Preventing dental caries in children requires significant parental involvement, as parents are the individuals who interact most frequently with their children and therefore play a crucial role in maintaining their oral hygiene and health.[27] Parental education on the importance of children's oral health is essential an d can be delivered by various stakeholders, including early childhood education institutions and healthcare providers.[28] The development of behaviors that support or hinder children's oral hygiene is highly dependent on parents' understanding, which may be acquired either informally or through structured education. Parents with limited access to oral health information are more likely to engage in behaviors that negatively impact their children's dental health [29]

The severity of dental caries was found to have no correlation with oral health knowledge among children aged 9–12 years in agroindustrial areas. This may be attributed to the multifactorial nature of dental caries, which is not solely influenced by knowledge. These findings indicate that knowledge alone is insufficient to prevent caries in primary school-aged children. External factors such as dietary habits, access to dental health services, and environmental conditions in agroindustrial regions also play a significant role in shaping students' oral health status. Therefore, strengthening school-based oral health education programs, along with active support from families and communities, is essential to promote better dental care practices at home. Such collaborative efforts are expected to raise awareness and foster healthy habits among students to maintain optimal oral hygiene.

This study has several limitations, primarily related to the relatively small sample size of 55 students and the inclusion of only one school, which may limit the generalizability of the

findings to a broader population. Additionally, the study focused solely on the relationship between the severity of dental caries and oral health knowledge, without considering other potential influencing factors such as dietary patterns, tooth brushing habits, and access to dental care facilities.

Future research is recommended to include a larger number of schools and a more diverse population to obtain a more comprehensive understanding of the relationship between oral health knowledge and the severity of dental caries among children from various socioeconomic and educational backgrounds. Further studies may also incorporate additional variables such as dietary patterns, tooth brushing habits, family socioeconomic status, and access to dental care services, or adopt a more in-depth qualitative approach to explore the underlying causes of dental caries.

CONCLUSION

There was no correlation between the severity of dental caries and oral health knowledge among children aged 9–12 years in agroindustrial areas. This finding highlights that knowledge alone is insufficient to prevent dental caries, given its multifactorial nature. The study provides valuable insights for policymakers and school administrators to enhance the reach and effectiveness of the School Dental Health Program (*Usaha Kesehatan Gigi Sekolah*, UKGS), while also promoting greater involvement of parents and the community in caries prevention efforts. Furthermore, these findings may serve as a foundation for future studies aimed at exploring additional contributing factors such as behavioral, environmental, and socioeconomic influences on oral health outcomes in children.

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