CAMBRA Factors Correlated with Dental Caries in Children

Quroti A'yun[*], *Herastuti Sulistyani*[*], *Dewi Risnawati*[*], *Ika Fitri Dilianti**

[*] *Dental Health Department Poltekkes Kemenkes Yogyakarta*

Correspondence: herastutisulistyani@gmail.com

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ABSTRACT

Background: Recent data show that the prevalence of dental caries in children aged 10 to 14 years is almost 41.4%. Several methods for managing caries include Caries Management by Risk Assessment (CAMBRA). The CAMBRA method assists doctors in identifying causes of dental caries by identifying risk factors in each patient. Based on research, the etiology of dental caries was discovered by identifying risk factors in each participant. This study aims to identify what factors influence dental caries in children based on CAMBRA.
Methods: This research uses observational analysis with cross-sectional data. The respondents are students from Kadipiro I Elementary School, Bantul, Yogyakarta, Indonesia. Purposive sampling was used to create the sample, which included 82 children between the ages of 10 and 12. The study was conducted by discovering dental caries risk factors with the CAMBRA method: 1. new cavity or lesion to dentine, 2. white spot, 3. restorations within the last three years, 4. volume of saliva, 5. plaque index, 6. pH saliva, and 7. frequency of sweet foods consumption. The scale of the data was nominal and analysed using the SPSS version 25.0 program, which included frequency analysis and logistic regression.
Results: The results of the logistic regression analysis showed that five variables have a significant ($p<0.05$) correlation with the occurrence of dental caries: new cavity or lesion to dentine, white spot, restorations with the last three years, pH of saliva, and the plaque existence.
Conclusion: The use of the CAMBRA method revealed five indicators of disease that are related to the risk of dental caries in children: lesion to dentine, white spot, restorations within the last three years, pH of saliva, and plaque existence.

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INTRODUCTION

According to the Indonesian Basic Health Research in 2018, 45.3% of Indonesia's population experienced oral health concerns, with 41.4% suffering from dental caries.[1] The high incidence of dental caries in children remains a critical public health issue that must be addressed immediately, as untreated dental caries and extractions can cause tooth persistence, malocclusion, phonetic issues, and low self-esteem. Previous studies stated that the percentage of vulnerable groups to dental caries increases as they grow up.[2] Preventive treatment of dental caries is an ongoing challenge for dental and medical professionals because most actions implemented so far have been curative treatment. The recent treatment is carried out by removing carious lesions and restorations so that they do not affect the pathological plaque biofilm, which highly contributes to the incidence of caries; consequently, future treatment required caries risk assessment methods to reduce invasive treatment prevalence.[3]

Caries Management by Risk Assessment (CAMBRA) is one of the various management strategies for assessing dental caries. By assessing risk variables in each patient, the CAMBRA technique assists dentists in determining the causes of caries. The etiology of dental caries was obtained based on previous research by managing each patient's risk variables. Additionally, particular therapy recommendations that account for consideration such as behavior modification, pharmacologic, and non-invasive methods. CAMBRA developed a concept of dental caries, which is a disease caused by complex biofilms (not just one pathogen) that change dynamically with the environment and local chemical variables on the tooth surface, pellicle, and saliva.[3] A similar study by Rizki, *et al* focused on determining the validity of the Indonesian version of CAMBRA. The findings of their study revealed that the Indonesian version of the CAMBRA instrument was valid for measuring the risk of dental caries in children aged 0 to 5 years old, with a confidence level of 94.4%. Based on these circumstances, this study aims to identify the factors associated with dental caries in children applying CAMBRA in Indonesia.[4]

RESEARCH METHODS

This research is an observational analytic study with a cross-sectional design. Students from SD Negeri Kadipiro I in Bantul, Yogyakarta, Indonesia, participated in the survey and used purposive sampling to collect samples from 82 children. The inclusion criteria for respondents were young children between the ages of 10 and 12 who volunteered to be part of the research sample, while the exclusion criteria were that respondents could not be absent or unwell during the survey. This study only measured the following significant variables of caries risk factors from CAMBRA[3]: 1. new cavities or lesions up to dentin, 2. white spot lesions, 3. dental restorations within the past three years, 4. salivary volume, 5. number of plaques/Personal Hygiene Performanced (PHPM) index, 6. salivary pH, and 7. frequency of sweet food consumption. Dental caries is the dependent variable. Following examination methods were implemented: 1) Checklist that included new cavities/lesions to dentin, white spot lesions, and restoration for the past three years, with a score of 0 if there are no lesions up to the dentin, white spots, or filling conditions for the past three years are in good condition, and a score of 1 if there are lesions to the dentin, white spot, and restoration, 2) Measurement sheets for the volume of saliva. If the volume of saliva is

greater than 1ml/minute, it obtains a score of 0, and vice versa; 3) Sheets for measuring plaque/PHPM index, with a score of 0 for plaque 27 and a score of 1 if >27, 4) Sheets for measuring pH of saliva, with a score of 0 if pH >6.5 and a score of 1 if pH >6.5, 5) Sheets for measuring the frequency of consuming sweet foods, with a score of 0 if consumed 0-3 times per day and a score of 1 if consumed more than three times per day. The research instruments included are diagnostic kits, saliva cups, measuring pipettes, pH strips, gel plaques, and checklist sheets. This research used nominal data scale and assessed by SPSS version 25.0, specifically the frequency test and logistic regression. This study was conducted after getting approval from the Ethics and Research Commission of the Health Ministry of Yogyakarta No.DP.04.03/eKEPK.1/130/2023.

RESULTS

Study result of the frequency distribution of respondent and parent characteristics was represented on the table below:

Table 1. Distribution of Respondent Characteristics

Characteristics of respondent	n	%
Gender		
Male	44	53,7
Female	38	46,3
Mother's education		
Elementary School (SD)	13	15,9
Junior High School (SMP)	23	28,0
Senior High School (SMU)	36	43,9
Bachelor (S1)	10	12,2
Occupation		
Government employee	2	2,4
Private employee	23	28
Entrepreneur	19	23,2
Labor	35	42,7
Small merchant	2	2,4
Big merchant	1	1,2
Income		
IDR 0-Rp.1.999.999	26	31.4
IDR 2.000.000-Rp.4.999.999	36	43,9
IDR >Rp.5.000.000	18	22,0
Dental Health Facilitation		
Private dental clinic	15	18,3
Central Health Center	61	74,4
Hospital	6	7,3
Dental visit in the past one year		
0-1 times	65	79,3
>1 times	17	20,7

According to Table.1, forty-four respondents were male (53.7%), thirty-six of the mother's education was senior high school (43.9%), thirty-five parent's occupation was laborer (42.7%), and the income range of 36 parents was between IDR 2,000,000 and IDR 2,500,000 (43.9%). The Community Health Centre was the most visited health facility, with 61 visits (74.4%), followed by dental health facilities with 65 (79.3%).

Table 2. Description of CAMBRA factors with dental caries

Risk factor	Criteria	Dental caries			
		Caries free		Caries exists	
		n	%	n	%
New cavity or lesion to dentine	none	11	13,42	16	19,51
	yes	6	7,31	47	57,32
White spot	none	11	13,42	22	28,18
	yes	8	9,76	41	50,00
Restorations with the last 3 years	none	18	21,95	57	69,51
	yes	1	1,22	6	7,32
Volume of saliva	≥1 ml /minute	7	8,54	25	30,48
	<1 minute	12	14,63	38	46,35
pH of saliva	≥6.5	7	8,54	17	20,73
	<6.5	12	14,63	46	56,10
Plaque accumulation	≤27	15	18,29	29	35,37
	>27	4	4,88	34	41,46
Frequency of sweet foods consumption	0-3x per day	11	13,42	16	19,51
	>3x per day	8	9,76	47	58,32

Based on the Table. 2, forty-seven respondents had new cavities (57.32%), forty-one respondents had white spots (50%), fifty-seven respondents had restoration in the last three years (69.51%), thirty-eight respondents had saliva volume with 1 ml/min (46.35%), forty-six respondents had pH of saliva <6.5 (56.10%), thirty-four respondents had plaque score >27 (41.46%). Forty-seven respondents consumed sweets more than three times each day (58.32%).

Table 3. Logistic regression analysis of the relationship between CAMBRA factors and dental caries

Variable	p-value
New cavity or lesion to dentine	0,001*
White spot	0,034*
Restorations with the last 3 years	0,024*
Volume of Saliva	0,198
pH of saliva	0,040*
Frequency of sweet foods consumption	0,848
Plaque accumulation	0,030*

*There is a significant relationship

According to the logistic regression analysis results, five variables had a significant relationship with the incidence of dental caries: new cavities (lesion to dentin), white spots, restoration in the past three years, pH of saliva, and plaque amount.

DISCUSSION

Along with CAMBRA, similar measurement tools have been developed to assess caries risks, such as the American Dental Association (ADA) Tool, the American Academy of Paediatric Dentistry (AAPD) Tool, the Caries-Risk Assessment Tool (CAT), the Cariogram Model, and the Traffic Light Matrix, and so on.[5,6] This research concentrates mainly on the CAMBRA method for detecting caries risk in Indonesia. The results of the study indicate that not all risk factors influence caries. Among the significant ($p<0.05$) indicators were new cavities or lesions extending to dentin, white spots, restoration in the last three years, pH of saliva, and plaque quantity.

The presence of new cavities or lesions extending to the dentin indicates that dental caries are progressing. This is consistent with the

findings of Warreth, who examined 211 children aged 5 -15 years.[7] It was found that almost 50% of radiolucent images of respondents extended to the outside of the dentin, while 100% extended to the inside of the dentin. In other words, most children have cavities that are defined by the expansion of the lesion at the enamel-dentin border. Dental caries lesions are generally apparent on radiography if the hole has reached the outer third of the dentin compared to interproximal images.[8] Duncan *et al.* added that due to the structural distinctions between dentin and enamel, lesions that have reached dentin are more vulnerable to demineralization.[9] This process worsens the tissue damage that leads to dental caries because the weaker dentin layer makes it easier for bacterial infiltration. Although there is a strategy to strengthen tooth surface roughness caused by the demineralization process, its damaged enamel structure can be restored by the application of additional agent such as gel theobromine.[10] The analysis of these research data using the CAMBRA instrument revealed p=0.01, indicating that discovering new cavities or lesions up to the dentin layer could be an early indicator of the risk of dental caries.

With a significance level of p-value = 0.034, the results of this research analysis showed that white spots play a role in the risk of caries. White spot lesions are the first clinical signs the eye can see in white chalk-like stains that reflect the demineralization of the tooth enamel layer.[11] Data showed that children with white spots tend to have a higher risk of caries because they have pre-cavitating lesions that indicate caries activity. This occurrence is an early warning because the appearance of white spots in children can persist until permanent teeth grow.[5] On the other hand, according to Congiu, Campus, and Lugliè, the prevalence of white spots in children can be caused by several factors, such as race, culture, ethnicity, socioeconomic level, diet, and lifestyle.[12] Although the results of research using the CAMBRA method show significance, the presence of white spots on the teeth of early childhood is not necessarily the leading indicator of ongoing caries because the primary triggers can come from many factors.

Plaque accumulation and dental caries are inseparable. Despite plaque could not be seen directly with unaided-eye, it has high contribution on damaging tooth structure and dental tissues.[13] A systematic review by Parisotto *et al.* indicated that a high number of Streptococcus mutans bacteria in plaque is a significant predictor of the development of caries in children.[14] In addition, some plaque components, such as acid-producing bacteria, alkaline phosphatase, and proteases, accelerate the caries formation process. Other research added that caries does not occur just because one type of bacteria invades tissue but rather because of the accumulation of cariogenic dental plaque biofilm.[15] According to a book from Elizabeth and Megan, the continued accumulation of dental plaque causes caries, gingivitis, and periodontitis.[16] This occurs because the bacteria within the plaque biofilm cause damage to the supporting gum tissue and ligaments. Preventive actions are required, such as determining the pH of the plaque to prevent the demineralization process.[17] In accordance with the analysis results of Table. 3, where the p-value is 0.03, if dental plaque is discovered during a clinical examination with the CAMBRA instrument, there is a chance that a caries process has occurred.

Besides plaque, there is a strong correlation between saliva's pH and dental caries risk. The risk of dental caries increases with decreasing buffer pH.[18] However, only specific

pH ranges affect the oral environment and promote the development of cavities in teeth. This process begins with microbes converting carbohydrates from sucrose to glucans and fructans using glycosyl or fructosyltransferase (FTase) enzymes. This processed substance becomes a food reserve for the biofilm, broken down when hungry, causing an acidic environment in the mouth. In this condition, the acidity level of salivary pH can reach 5.5 (critical pH) and, over time, causes tooth enamel to decay.[19] The demineralization process begins when the pH of the oral cavity falls below 5.5. This process occurs because when the oral environment is acidic, calcium and phosphate-rich saliva is converted to hydroxyapatite.[20]

In contrast, alkaline oral conditions have no impact on the prevalence of cavities. This condition is consistent with the findings of Lely, who surveyed 564 preschool-aged children in Yogyakarta and Banten Province and found that 75% of children had an alkaline saliva pH within the range of 6.8 to 8.0.[21] Other research confirms that each person's saliva has unique characteristics, likely due to genetic factors.[22] These differences in saliva characteristics do not invalidate the prospect that they will also influence changes in the pH of each individual's saliva. Therefore, the previous information supports the conclusion of this study that there is a significant correlation between the acidic pH of saliva and the risk of dental caries.

According to this study's analysis (p-value = 0.024), restoration in the past three years may indicate the occurrence of cavities. During an objective examination of the patient's oral cavity, secondary caries findings may indicate the presence of caries. Several studies supported this by El-bialy *et. al* who stated that although the results of filling glass-ionomer materials with hybrid and conventional technology have proven clinically acceptable, secondary caries on filled teeth can still occur.[23] Several experts are also debating the best action plan to take if secondary caries are detected. Study findings by Schwendicke *et al* stated that the appearance of secondary lesions is a kind of early warning of the occurrence of dental caries that require follow-up re-placements to avoid the expansion of cariogenic tissue.[8] In contrast, Blum and Ozcan demonstrate some disadvantages to re-filling previously filled teeth, such as decreased patient confidence in the operator's competence for re-filling and being vulnerable to caries expansion due to removing the residual poor fillings.[24]

Using the CAMBRA measuring instrument to prevent caries in children is typically more manageable and less complex than other methods.[25] CAMBRA has been proven to measure caries accurately in terms of sensitivity of 47.62% and specificity of 80%.[26] Amalia, Rizal, and Suadi found that the CAMBRA instrument is valid and reliable as a standard for diagnosing caries risk in children aged 0-5 years in Indonesia.[4] The CAMBRA instrument has three primary characteristic focuses, including biological risk factors, disease indicators, and protection factors. The greater the number of disease indicators, the higher the risk of caries, and the greater the number of protective factors, the healthier the teeth.[27] Risk assessment using the CAMBRA method is an alternative approach to preventing further caries through early detection. This is consistent with the principles of minimally invasive dentistry (MID), the philosophy of caries management, which concentrates on assessing the risk of each patient to identify disease indicators, risk factors, and protective factors.

CONCLUSION

Through the advancement of science and technology, caries management has shifted from invasive to non-invasive measures, with early detection of caries being one of them. Using the CAMBRA method, five disease indicators were associated with the risk of developing decay in early childhood. These indicators were dentin lesions, fillings within the past three years, plaque amount, salivary pH, and white spots. Future research must concentrate on the relationship between protective factors and caries risk reduction to obtain more accurate data on caries balance and imbalance.

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