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Drinking Water's Consumption in West Borneo's Peatlands Area: Causal Factors of Caries?

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ABSTRACT

West Borneo has 1.73 million hectares of peatland areas. Therefore, people consume drinking water derived from rainwater or mountain water. In line with that, they also have a high caries rate. This water consumption might have a role in caries incidence. Besides, substrate, agent, host, and time could become other influence factors. This study aims to determine the factors that affect dental caries in West Borneo's peat areas based on drinking water consumption.The research method was the facto exposé research. The population was children aged 12-14 years and taken by Cluster random sampling. The data were analyzed with correlation tests related to drinking water consumption which causing dental caries numbers.The study showed a significant difference in the Fluoride content of the four water types (p-value = 0.018).The influence of water consumption on caries was only 2%. However, the caries incidence among respondents who consumed mountain water was higher.Behavioral and tooth brushing activities significantly impacted respondents with different drinking water consumption.
Keywords: caries, drinking water,peatland

Introduction

Indonesia's Peatland area is about 20.6 million hectares or 10.8 percent of Indonesia's land area. In Borneo, there are about 5.7 million ha or 27.8%. The spread of peatland in West Borneo Province is an area of 1.73 million ha. Peatlands are always associated with fires and smoke that repeat every year in the summer. This condition happened due to increased toxic volume and CO2 production [1]. There has been an average annual increase in PM2.5 concentrations due to forest fires in Central Borneo of 26 μg/m3. It is more than twice the amount recommendedby the World Health Organization's Air Quality Guidelines. This increase in PM2.5 increases air pollution-related diseases and premature death such as chronic breathing, cardiovascular, and lung cancer [2]. Due to this condition, West Borneo's people could only consume rainwater, river water, or mountain water [3]. The fulfillment of clean water needs in Pontianak city, the capital of West Borneo, is provided by nature through rainwater, river water, mountain water, and treated water by the Regional Drinking Water Company (PDAM).

The teeth demineralization process occurs that cause caries happens at a low pH or acidic atmosphere[4]. The ecological imbalance between dental minerals and oral biofilms is characterized by microbial activity. The acid resulting from bacterial metabolism could fluctuate plaque pH on the teeth' surface. Besides, drinking water with low pH, such as rainwater, might amplify oral pH and trigger caries incidences. In this condition, saliva performs buffering action to protect the surrounding tooth structure [5].

According to the West Borneo Central Statistical Bureau [6], in 2020, 87.25% of people in Kubu Raya and 55.64% in Pontianak use drinking water sources from rainwater reservoirs. On the other hand, 30-44% of people use mountain water as their drinking water, and only 2.38% used treated water (PDAM).The results of Health National Research 2018 [7] showed that people in west Borneo suffered from caries (49.55%), teeth lost due to removal (22.28%), and filling teeth (3.83%).Many factors influence the incidences of caries, and water intake might cause caries in West Borneo province. Moreover, there is no research about the relation of Fluoride and Calcium content of water consumption and caries incidences conducted in this area before. It became the aim of this study.

Methodology

The method in this study was quantitative observational research with cross-sectional data retrieval. The research was conducted in SMPN1 Samalantan Bengkayang Subdistrict (122 students) and SMPN4 Selakau subdistrict (112 students). These two subdistricts are located in West Borneo. Salamantan subdistrict is located in a hilly area where the population consumesmountain water. On the other hand, the Selakau subdistrict, where the population consumes rainwater, is located on the coast of the Natunaocean.The samples of this study were a total sampling of 13-15 years old students.

Respondents were given knowledge, attitudes, and behaviors questionnaires and conducted a clinical observation to get DMFT scores/index. DMFT index is an instrument to assess dental status for permanent teeth:the decay, missing and filling of permanent teeth. The higher the score is, the higher the incidence of caries and the worse the dental health is.

Samples of consumable water were taken from the main shelter and viewed calcium and flour content using Spectrophotometry. It is an instrument to determine the concentration of a solution through the intensity of absorption at a given wavelength. It uses the basis of energy and material interaction. Spectrophotometry with SPADNS-zirconyl acid was used to identify Fluoride levels. On the other hand, calcium level testing was done through Spectrophotometry titrimetric method. Besides, the degree of acidity of the water consumption was checked with a pH meter - an electronic device that measures the pH (degree of acidity or wetness) of a liquid.

The data were analyzed with a statistical program. The data were analyzed with the Mann Whitney U test and Odds Ratio. Simple Regression Linear Test was also used to analyze the influence of drinking water on caries (DMFT index).

All the students agreed to be respondents, and Ethics Commission has approved the research (058/KEPK-PK.PKP/II/2020).

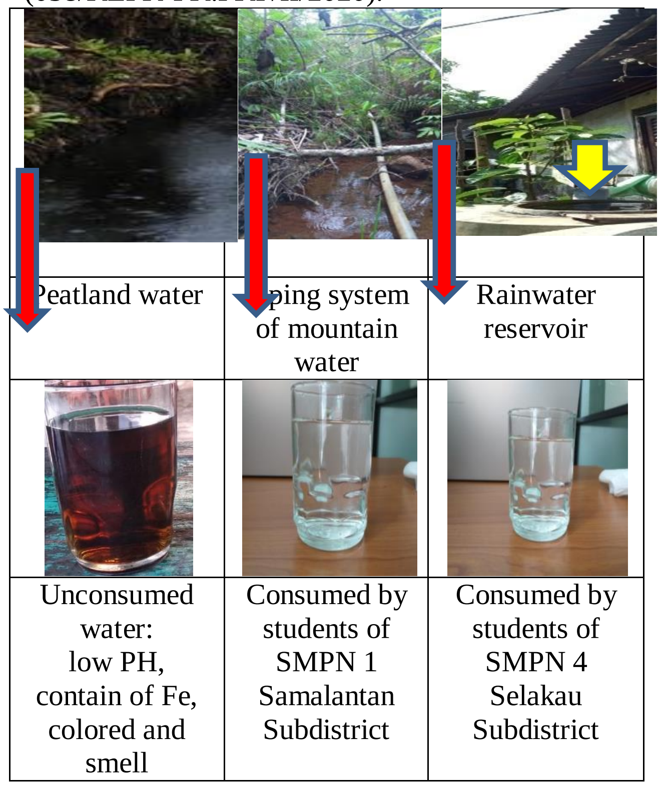

Fig 1 – Consumed water of the Respondents

Result and Discussion

Table 1.
Distribution of Flouride, Calcium, Ph

	STANDARD of HEALTH MINISTRY	MOUNTAIN WATER	RAIN WATER	RIVER WATER	TREATED WATER	*p-value*
Flouride	1.5 mg/l	0.33±0.35	0.028±0.01	0.017±0.02	0.05±0.07	0.018
Calsium	500 mg/l	29.75±5.62	0.70±0.40	12.63±3.19	11.50±6.26	0.110
pH	6.5-8.5	6.68±0.39	6.41±0.27	5.86±0.48	4.49±1.19	0.708

Table 2.
Frequency Distribution of DMFT index and Causal Factors of Caries

No	Variable	Category	Mountain water's consumption (%)	Rain water's consumption (%)	*p-value*
	DMFT Index	Low	56.6	60.7	0.24
	(R square: 0.02)	High	43.4	39.3	
		Causal Factors of Caries			
1	Gender	Male	50,8	42	0.48
		Female	49,2	58	
2	Diet	Noncariogenic	46,7	15,2	0,00
		Cariogenik	53,3	84,8	
3	Tooth-brushing	Not everyday	28,7	27,7	0,43
		Everyday	71,3	72,3	
4	Frequency of Tooth-brushing	Not twice a day	48,4	53,6	0,24
		Twice a day	51,6	46,4	
5	Toothbrush ownership	Individual	82	90,2	0,04
		Together	18	9,8	
6	Technic of Tooth-brushing	Correct	32,8	37,5	0,23
		Not correct	67,2	62,5	
7	Go to health center for medication	Never	70,5	63,4	0,13
		Always	29,5	36,6	
8	Knowledge	Good	72.1	48.2	0.00
		Poor	27.9	51.8	
9	Attitude	Good	68	71.4	0.31
		Poor	32	28.6	
10	Behavior	Good	50	61.6	0.01
		Poor	50	38.4	

Table 3.
The Correlation of Causal Factors with DMFT based on Mountain water and Rainwater Consumption

CAUSAL FACTOR - DMFT	MOUNTAIN WATER'S CONSUMPTION		RAIN WATER'S CONSUMPTION	
	p value	OR	*p value*	OR
Behavior	0.000	58.188	0.000	17.400
Toothbrushing's technique	0.000	19.271	0.000	18.379
Toothbrushing's frequency	0.000	4.940	0.000	13.242
Gender	0.011	2.620	0.834	1.086
Diet	0.237	1.545	0.862	1.097
Attitude	0.982	1.009	0.807	0.900
Go to Health Center for Medication	0.586	0.805	0.020	0.278
Knowledge	0.127	0.424	0.490	0.765

Based on the study results (Table 1), the content of Fluoride and Calcium of the four types of water was still below the standard of healthy water according to the Ministry of Health of the Republic of Indonesia. The rainwater was more acidic than mountain water.

The study showed a significant difference in the Fluoride content of the four water types (Table 1). There was a lack of Calcium and Fluoride found in the consumption water: mountain water and rainwater. However, the content of Fluoride and Calcium in rainwater was lower than in mountain water. The fluoride levels on both water consumption were less than 0.5 mg/L. Some researchers stated that the fluoride levels should be between 0.7-1.2 mg/L [8] and not more than 1,5 mg/L(Permenkes 2010). Freshwater with high Fluoride is usually found in highland or seawater areas. Fluoride water content obtained from lakes, rivers, or artesian wells is, for the most part, below 0.5 mg/1[9].This research was in line with our study.

Fluoride could prevent caries incidence. Fluoride and Calcium values maintain a balance between demineralization and remineralization of the email structure[9]. Low fluoride levels affect teeth strength that can withstand the demineralization process by chemical processes between bacteria and sucrose. A research stated that if the level of Flouride during tooth formation were good enough, the teeth would be robust[10], and there would be an increase in dental caries after the termination of the CWF (community water fluoridation) program [11].

Fluoride prevents the occurrence of demineralization and increases remineralization. Together with calcium and phosphate ions derived from saliva, fluoride ions could form fluorapatite on teeth structure. The mineral of the tooth (email, cementum, dentine), which occurs during the formation of teeth, is hydroxyapatite carbonation with the formulation Of $Ca10(PO4)6(OH)F2$, which is composed of atoms and carbonate ions (CO3). Carbonate is lost during the demineralization and does not exist in the remineralization process. Fluoride ions will replace Carbonate ions during the remineralization process. As a result, fluorapatite formed, and it is more resistant to insoluble acids. This fluorapatite mineral is more stable and acid-resistant [12]. Besides, Fluoride has antimicrobial substances that can inhibit the metabolism of bacteria [13]. Also, fluoride ions can inhibit enzyme production from glucosyltransferase. Bacteria require this enzyme in forming extracellular polysaccharides as bacterial adherence power [14].

This study showed that the high DMFT index happened among the respondents' consumed mountain water. Using the Linear Regression test, there was little influence of drinking water toward DMFT index (2%). On the other hand, the significant causal factors were diet, knowledge, and behavior (Table 2). The lower content of Fluoride could be the risk factor of caries. This study showed that most of the respondents had caries incidences due to the low content of Fluoride in their drinking water. Some researchers said that minimum Fluoride in their drinking water became the health risk factor [15], [16]. Interestingly, even the pH of rainwater was lower or more acid than the mountain water, the incidences of caries were higher among respondents who consumed mountain water. Diet, knowledge, and behavior were significant factors that cause caries. Some researchers stated that diet, behavior, and awareness were related to poor oral health [10], [17], [18]. A healthy and non-cariogenic or free sugar diet could help prevent caries and oral disease[5], [19].

Based on Table 3, there weresome dominant factors in influencing caries incidences. The behavior and tooth brushing activitieshad a significant impact on the incidences of caries. There was a relationship between maintaining dental and oral health to the number of dental caries. In this study, gender did not have a significant role as the causal factor of caries incidences.

Behavior and toothbrushing activities have a significant influence on caries incidences (Table-3). Behavior could affect the incidence of caries among school-age children. Techniques and timing of toothbrushing are the most important things to maintain good oral hygiene and prevent caries [20].

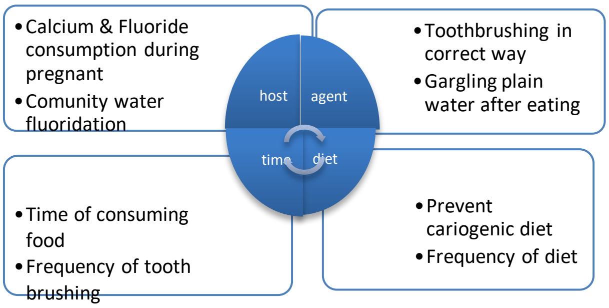

Fig2. Caries Prevention for Peatlands' Community

Due to the teeth' flawed structure and the lack of fluoride intake from water, the respondents should anticipate efforts to defend their caries. To anticipate the micro bacteria's existence, they must maintain continuous dental hygiene and reduce the cariogenic foods. Caries Prevention Behavior Patterns that occur in poor peatland can be concluded as follows:

Conclusion

The population in the Peatland area consumes water with low Fluoride and Calcium. This condition could impact the development of bone and teeth, especially become a trigger of caries incidence. Due to this condition, mothers should increase Fluor and Calcium intake from any food during their pregnancy. Besides, the prevention of caries in this community should increase the behavior in maintaining dental hygiene by brushing teeth with the correct techniques and frequencies and avoiding cariogenic or sugar diets.

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