

DENTAL HEALTH STATUS AND ORAL PIGMENTATION OF EAST BELITUNG REGENCY RESIDENTS (STUDY ON COMMUNITY SERVICE PROGRAM “MERAJUT NUSANTARA 2018”)

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ABSTRAK

Latar Belakang: prevalensi karies di Indonesia sebesar 57,6% dan 45,9% khususnya di Provinsi Bangka Belitung menurut Riskesdas 2018. Provinsi Bangka Belitung terkenal dengan sumber daya alam berupa timbal. Penambangan timbal mempengaruhi lingkungan termasuk air. Sebagian besar penduduk di Bangka Belitung sering mengkonsumsi air tanah. **Tujuan:** mengumpulkan status kesehatan gigi dan pigmentasi rongga mulut warga, data level logam dan keasaman air minum 3 desa di Kabupaten Belitung Timur pada saat diselenggarakan Kuliah Kerja Nyata 2018. **Metode:** deskriptif dengan pendekatan potong lintang dengan memeriksa DMFT, pigmentasi rongga mulut, kadar Pb, Fe, F, Cd dan pH air minum. **Hasil:** 98 penduduk memiliki usia rata-rata 18.949 ± 13.626 tahun. Rerata kadar Pb dan Cd air minum di 3 desa lebih tinggi dari batas maksimum, sedangkan kadar Fe dan F lebih rendah dari batas maksimum, pH lebih rendah dari 7, nilai rata-rata DMFT adalah $5,59 \pm 4,20$, 8 penduduk memiliki pigmentasi fisiologis. Berdasarkan Analisis korelasi non parametrik *Spearman* antara konsentrasi Pb, Fe, F, Cd dan pH air minum dengan skor DMFT sangat buruk. **Kesimpulan:** kesehatan gigi penduduk kabupaten Belitung Timur sangat rendah, frekuensi pigmentasi oral rendah. Terjadinya karies gigi dan pigmentasi oral tidak dipengaruhi oleh kandungan logam pada air minum.

Kata kunci: DMFT, pigmentasi, Timbal, Besi, Fluorida, Kadmium, pH air.

ABSTRACT

Background: the prevalence of caries in Indonesia is 57.6% and 45.9% in Bangka Belitung Province according to the Riskesdas 2018. Bangka Belitung Province is known for its natural resources in the form of lead. Lead mining affects the environment including water. Most of the population in Bangka Belitung consume groundwater. **Purpose:** to collect dental health status, oral pigmentation of residents, score of metal, acidity of drinking water of 3 villages East Belitung District at Kuliah Kerja Nyata 2018. **Method:** descriptive cross-sectional conducted by examine DMFT, macula, concentration level of Pb, Fe, F, Cd and pH of drinking water. **Results:** the average age of 98 residents was $18,949 \pm 13,626$ years. The mean level of Pb and Cd in drinking water were higher, while Fe and F were lower than the maximum limit, $\text{pH} < 7$, the mean score of DMFT was 5.59 ± 4.20 , 8 residents had physiological pigmentation. Analysis of Spearman's non parametric correlation between concentration of Pb, Fe, F, Cd, pH of drinking water and DMFT score were very poor. **Conclusion:** the dental health of the residents of East Belitung district is very low, low frequency of oral pigmentation, dental caries and oral pigmentation are not influenced by the metal contents in drinking water.

Keywords: DMFT, pigmentation, Lead, Iron, Fluoride, Cadmium, pH of water.

INTRODUCTION

Bangka Belitung Province is well known for its metal resources in the form of lead. Mineral mining affects the environment including water and remains a significant pollutant after being abandoned. The majority of Bangka Belitung Islanders suffer from tooth decay and they often consume groundwater.^{1,2}

The prevalence of caries in Indonesia is 57.6% and 45.9% particularly in Bangka Belitung Province according to the Riskesdas 2018.³ Riset Kesehatan Dasar (Riskesdas 2013) reported the prevalence of dental and oral disease problems in Indonesia increased from 23.2% in 2007 to 25.9% in 2013. The Decay, Missed, Filled Tooth (DMFT) Index of Bangka Belitung Province was 8.5 which means that tooth decay is 850 teeth per 100 people. The

number of dentists in the province of Belitung has not yet reached the healthy indicator target of Indonesia. The ratio of dentists serving in Bangka Belitung is only 5 dentists per 100,000 population with an ideal number of 11 dentists per 100,000 population.⁴

Drinking water consumed must fulfill chemical, physical and health requirements. Teeth are a good indicator of exposure to heavy metals in the environment, especially in drinking water.^{5,6} Teeth that are exposed to heavy metals such as lead can undergo changes in tooth structure which results in being more susceptible to caries,^{5,7,8} iron can decrease caries development teeth.⁹ In adults, the most common cause of increased levels of heavy metals is through occupational exposure to heavy metal vapors. In children, possible sources of

exposure include water or paint containing lead.¹⁰

Studies of the dental health status, oral pigmentation of people in East Belitung Regency, Indonesia and also level of iron, lead, cadmium, fluoride and acidity of drinking are still scarce, therefore the aim of this is to collect the dental health status and oral pigmentation of residents, level of lead (Pb), iron (Fe), fluoride (F), Cadmium (Cd), the acidity (pH) of drinking water, of East Belitung District when Kuliah Kerja Nyata 2018 was held.

METHOD

A cross-sectional study was performed in 3 districts of East Belitung regency (Baru Village, Buku Limau Island, Manggar city) on February 2018. This study was approved by the University of Prof Dr Moestopo (Beragama) Research Ethics Board. The sample of this study is the participants of community service program of Merajut Nusantara 2018. Data were collected on a large number of variables including demographics, education, socioeconomic, dietary, frequency of smoking, oral hygiene routine and utilization of dental services. Participants were given written informed consent before joining the survey and intraoral examination.

The intraoral examination included recording of decay, missing and fillings (DMFT) in permanent teeth, Löe and Sillness's gingival index and oral pigmentation. Teeth were dried before the dental caries assessment followed by detection of macula and inflammation of gingiva by probing on buccal gingiva of first maxilla molar teeth, lingual gingiva of first mandibular molar teeth, labial gingiva of maxilla and mandibular of central incisor. The quality control was maintained by various procedures including training and calibration of staff, the use of a standard examiner, and ongoing monitoring of interexaminer reliability and consistency with the standard examiner.^{7,11}

The collection of drinking water samples from 20 different locations in 3 districts for laboratory analyses in Jakarta to detect a concentration of Pb, Fe, F, Cd and pH of drinking water in accordance to standard analytic practices guidelines set forth in ISO 17025:2005. All the data were entered into an Excel database and analyzed including descriptive statistics and Mann-Whitney analyses, a p value ≤ 0.05 was statistically significant.

RESULTS

Total of 98 residents were recruited, the mean age of all residents was 18.949 ± 13.626 years. Most of the residents were male, with 63.3% of them were students. Only 4 residents had a frequent visit to dentist, while 66 of the them never visited dentist. Table 1 presents descriptive information about residents.

Table 2 presents the result of intra oral examination of the participants including DMFT and gingivitis score, the mean DMFT score was 5.59 ± 4.20 (mean of decay was 3.74 and missing teeth was 1.83) and gingivitis score was 0.79 ± 0.74 . Eight residents have generalized gingival pigmentation and 11 residents have dark brown pigmentation on anterior gingiva (Picture 1).

Table 1. Characteristics of Residents of East Belitung District (Merajut Nusantara 2018)

Characteristics of residents	n	%
Mean Age (years) \pm SD	18.949 ± 13.626	
Sex		
Male	52	53,1
Female	46	46,9
Village		
Baru	31	31,6
Manggar	30	30,2
Buku Limau	37	37,8
Educational Background		
No education	2	2
Drop out / currently studying elementary school	63	64,3
Complete elementary school	20	20,4
Complete junior high school	5	5,1
Complete senior /vocational high school	5	5,1
Complete bachelor	3	3,1
Occupation		
Student	62	63,3
Housewife	12	12,2
Fisherman	19	19,4
Security officer	1	1
Honorary worker	3	3,1
Goverment employees	1	1
Frequency of visits to dentist		
6 – 12 month	4	4,1
1 – 2 year	15	15,3
2 – 5 year	8	8,2
> 5 year	5	5,1
Never	66	67,3
Reason for visit the dentist		
Consultation	4	12,5
Pain / dental / gum problems	28	87,5
Wear denture		

Yes	5	5.1
No	93	94.9
Tooth brushing		
Tooth brush + tooth paste	95	96.94
Tooth brush	2	2.04
Never	1	1.02
Frequency of tooth brushing / day		
0	1	1
1x/day	5	5.1
2x/day	77	78.6
3x/day	15	15.3
Smoking		
Yes	20	20.4
No	78	79.6

Table 2. Result of Intra Oral Examinations

Intra Oral Examinations	n	%
DMFT	5.59 ± 4.20	
Criteria of Gingivitis		
Normal	32	32.7
Mild	29	29.6
Moderate	35	35.7
Severe	2	2
Score of Gingivitis		
Mean \pm SD	0.79 ± 0.74	
Pigmentation		
Labial	Maxilla	2
	Mandible	2
Dorsum of tongue		2
Gingiva	Generalized	8
	Upper and Lower Anterior	11
	None	79
		80.6

Table 3. Laboratory Result of Metal Concentration and Acidity in Drinking Water

Parameter	Mean	Maximum Limit
pH	5.56	6.5 - 8.5
Fe (mg/L)	< 0.01	0.3
Pb (mg/L)	<0.1	0.01
F (mg/L)	0.053	1.5
Cd (mg/L)	<0.01	0.003



Picture 1. Dark brown oral pigmentation on anterior gingiva (a,b,c) and dorsum of tongue (d)

Only 2 participants had free caries, 34 of them had lost their teeth, only 5 participants had wear dentures, 5 participants had normal gingiva according Löe dan Silness gingivitis criteria. The mean concentration of Pb, Fe, F, Cd and pH in drinking water from 20 sources located in 3 villages can be seen in table 3. The concentration of Pb and Cd were above the allowed maximum limit of drinking water. Contrarily, the concentration of Fe and F were below the allowed maximum limit. Only the drinking water in Buku Limau had pH above 6.5 (the limit range is 6.5 – 8.5) while two other villages had pH above 6.5.

Bivariat analysis between incidence of caries and independent variables cannot be done because only 2 participants were free of caries. According to Mann-Whitney analysis, there is no significant difference

obtained for all independent variables: completed/not completed junior high school, frequency of tooth brushing, smoking with DMFT score (0.212; 0.446; 0.140). Analysis of Spearman's non parametric correlation between concentration of Pb, Fe, F, Cd and pH of drinking water and DMFT score were very poor.

DISCUSSION

Male participants more contribute to this study compared with female in accordance with the ratio of the total population of men to more than women in East Belitung Regency. There are 9 dentists in Belitung Timur District and some dentists concurrently become structural employees.¹² The number of participants

who have never been to a dentist is 67.3%, but the reasons for not seeing a dentist were not asked. While study conducted by Sintawati in 2011 showed that majority of residents had toothache did not know of any dental health facilities that can provide dental health services. There was no dental restoration found in this study and most of the teeth were extracted because of extensive decay. These conditions probably were caused by delayed of dental treatment.¹ The awareness to examine, restore decayed tooth is low, if decayed tooth can be restored before become more extensive, extraction can be prevented.¹³

In this study, the mean level of lead and Cadmium are higher than maximum limit. Exposure to Lead and Cadmium from cigarette smoke, mining areas, vegetables can increase the risk of dental caries. Cadmium concentration can be checked through urine which is a marker of accumulation of cadmium in the body but no urine examination was performed in this study. Exposure to cadmium in studies of neonatal rats showed an increase in severe caries, salivary gland damage and cannot be eliminated by drinking water fluoridation.⁸

The limit of fluoride in drinking water that reduces caries is 1 mg / L, whereas more than 1.5 mg / L results in fluorosis. Fluorine contained in 3 drinking water sources in this study is very low namely

0.04, 0.05 and 0, 07mg / L. Fluorine and Calcium contained in drinking water reduce the value of DMFS. The degree of acidity of water sources that are used as drinking water has a pH below 7 which is acidic. Drinking water with a high degree of acidity (low pH) has a significant relationship with dental caries.^{12,14}

Iron can reduce caries development in studies in rats and iron added to cariogenic foods can reduce the incidence of dental caries in animals and humans. Whereas children with low caries have low levels of ferritin, iron and hemoglobin.⁸ On contrary with this study, the level of iron in drinking water is below maximum limit. Heavy metals such as lead are assimilated into enamel teeth during mineralization and after eruption. Lead is reported to be absorbed into baby teeth from 4 months prenatally to the time of tooth exfoliation.⁶

Dental caries is a multifactorial disease and environmental risk factors such as dental plaque, cariogenic food, insufficient exposure to fluoride, poor oral hygiene, cariogenic bacteria in large quantities, and inadequate salivary flow can affect the development of dental caries.^{15,16}

Primary accumulation of metals in the body is found in the bones. Teeth are known to be the location of concentrations of heavy metal deposits associated with exposure at the time of dentin or enamel

formation and are biological markers for determining metal exposure. Epidemiologists showed an increased susceptibility of children's teeth to caries that live in highly contaminated areas of heavy metals.¹⁷

Email crystals are not deposited into the collagen matrix but grow along with the loss of most of the enamel matrix protein. The initial enamel crystal looks like a long thin band extending from the amelodentinal junction to the surface of the enamel. When the secretory phase has been completed, the matrix protein will be degraded, resorbed and replaced by liquid. This liquid is then substituted with minerals with an increase in crystallites that expand and widen. Email protein is responsible for the degradation of the organic matrix into low molecular weight proteins that will leave the matrix. Abnormal post-secretory protein matrix processes result in the hypomaturation and hypocalcification of amelogenesis imperfecta.¹⁷

Blood lead levels are a clear indication of near-term lead exposure, although they do not accurately indicate a history of lead exposure. Because the effect of lead resembles the effect of calcium in some ways joined in calcified tissue such as bones and teeth. Enamel and dentin generally do not undergo significant remodeling but lead levels in these tissues (particularly the circumpulpal dentin) are

more frequently measured to assess lead exposure in children. Studies by Needleman et al on lead are related to psychological deficits and class-related learning abilities related to lead levels in dentin as a result of evidence of lead exposure.^{18,19}

Lead affects bone cell function through changes of 1,2,5 dehydroxyvitamin D3; interferes with the cell's ability to respond to hormone regulation. Lead interferes with the cell's ability to synthesize bone collagen or sialoproteins and directly affects or substitutes calcium in the active location of calcium and the messenger cAMP system.¹⁷ Lead in divalent conditions substitutes the isovalent calcium position in dentin hydroxyapatite. Exposure to lead and dental caries has a time relationship that is antenatal and early exposure which results in teeth being more susceptible to caries development.⁷

Iron is a cofactor for salivary lactoferrin protein (LTF), the main protein with antibacterial activity. This protein can bind very strongly with 2 iron atoms and bicarbonate, which enhances bacteriostatic by cariostatic ability by limiting the availability of iron for bacterial cells.²⁰

Caries prevention is carried out through fluoridation of drinking water, fissure sealants, patient education, dietary advice, and visits dentist. Iron added to cariogenic foods can reduce the incidence

of dental caries. Iron ion is a strong inhibitor of the enzyme glucosetransferase, is karyostatic, protects teeth against the pathogenicity of *S. mutans* by forming a protective layer that binds to the tooth enamel as hydrous iron oxides and has a high affinity for organic material. Gel and crystals from hydrous iron oxides can absorb various ions (including calcium and phosphate) and various atoms of crystalline. Iron can have the ability to replace minerals dissolved during the acidic phase of the caries process. Iron ions also mediate the fixation of remineralization particles on the organic part of tooth enamel.⁹

Total pigmentation in gingiva was found in 8 participants who smoked, the majority smoked filters, and only 6 smokers without oral pigmentation. Physiological pigmentation is more common in people with dark skin. The color of pigmentation can vary from light brown to black.^{10,21} Physiological pigmentation increases with age and the color intensity can be influenced by smoking, hormones, and systemic treatment.²¹ The most common location of this pigmentation is in the attached gingiva but can be found in various locations of the mouth including the tip of the papillae filiform in the dorsum of the tongue.^{10,21}

CONCLUSION

The dental health status of the population of East Belitung Regency is very low, with low drinking water acidity and the mean level of Pb and Cd in drinking water were higher, while Fe and F were lower than the maximum limit. We suggest because of lack of dentist and low frequency visit to the dentist could cause dental caries. The occurrence of dental caries is not influenced by the metal contents of drinking water. Further studies about the concentration of trace elements in enamel and dentine with other factors affect dental caries for example diet, microflora, the form, susceptible and arrangement of teeth, salivary flow and oral hygiene.

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