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Submission date: 26-Jan-2021 10:28AM (UTC+0800)
Submission ID: 1494449649
File name: aged_6-8_years_research_observations_in_Bangkalan_district.pdf (274.71K)
Word count: 3059
Character count: 16232

EurAsian Journal of BioSciences
Eurasia J Biosci 14, 3247-3250 (2020)

Relationship of fluoride and calcium levels in drinking water on periodontal diseases in children aged 6-8 years (Research observations in Bangkalan district)

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Abstract

Background: Plaques undergoing remineralization and becoming rigid can cause periodontal disease. The hardened plaque is called calculus. The occurrence of calculus formation can increase along with the amount of calcium and other minerals in saliva. Minerals in saliva contain calcium, phosphor, and fluoride. Fluoride is a mineral coming from natural sources, which is mostly obtained from drinking water. Indonesia, as a maritime country with a large coastal community, has a population that majority uses well water as drinking water. Well water can contain fluoride and calcium.

Purpose: To analyze the relationship between fluoride and calcium levels in drinking water on periodontal responses in children.

Methods: This study was an analytic observational study with a cross-sectional approach. Total sampling was carried out in Bangkalan District with a total of 140 parents and children as respondents. Informed consent and questionnaires were given to parents for data collection. Furthermore, the clinical examination on students was done by using a disclosing agent, then measured by OHI-S assessment. The results were analyzed using the Kolmogorov-Smirnov test and the Spearman test.

Results: The results showed there was a relationship between regions with OHI-S scores, OHI-S scores with fluoride levels, and OHI-S scores with calcium levels.

Conclusion: The calcium levels in drinking water can affect salivary levels and increase plaques and calculus formation. Plaque accumulation is a major factor in the occurrence of periodontal disease.

Keywords: periodontal disease, calculus, fluoride, calcium storage

Nabila ZS, Mega Moeharyono P, Wahluyo S (2020) Relationship of fluoride and calcium levels in drinking water on periodontal diseases in children aged 6-8 years (Research observations in Bangkalan district). Eurasia J Biosci 14: 3247-3250.

INTRODUCTION

Periodontal disease is a disease characterized by gingival inflammation, periodontal pocket, and gingival recession. Periodontal disease conditions are caused by plaque accumulation. Plaque accumulation in the gingiva can cause gingivitis. In the clinical finding of gingivitis, the gingiva is inflamed, red to bluish, increased vascularity, and hyperplasia.(Newman, et al. 2011) Gingivitis does not always become periodontitis but can also develop into periodontitis. Periodontitis is an infection of microorganisms that cause infection and inflammation of the supporting tissues of the teeth (Newman, Takei, & Klokkevold, 2006). This is characterized by the formation of abnormal pockets or sulcus and attachment loss (Nisa, Primartha, 2013; Bazzi, 2015) Based on the results of the 2007 Basic Health Research (RISKESDAS) data, the prevalence of periodontal disease in children increased from 62% - 72% in urban areas, whereas in rural areas, the prevalence of periodontal disease in children increased from 68% - 89% (Isrofah NEM, 2010).

Plaque accumulation is a major factor in the occurrence of periodontal disease. Plaques that are continuously left will turn into calculus. Calculus is an irritant factor that occurs continuously on the gingiva so that it can cause inflammation of the gingiva. If it is not removed, it will cause damage to the tooth-supporting tissues. Calculus consists of minerals such as Ca, Fe, Cu, Zn, and Nitrate, which are firmly attached to the teeth. Calculus is formed due to the formation of Ca in alkaline plaques that calcify and harden (Artawa IMB, Swastini IP(2011). Plaque formation in children aged 8-12 years is faster than adults so it causes various

Received: July 2019
Accepted: April 2020
Printed: September 2020

periodontal diseases in children (Tin, et al. 2015). However, there is still little research that discusses the correlation of the presence of plaque and gingivitis in children with mixed dentition stage. During the mixed dentition stage, gingival inflammation often occurs in primary and permanent teeth (Pertiwi ASP, 2009).

Fluoride (F) is a chemical that is found in nature and is a material that affects the environment from natural and industrial sources. The main source of fluoride is drinking water. Moreover, other sources are found in food, dental products, dust, and smoke from industries that use salts containing fluoride and hydrofluoric acid (Chattopadhyay, et al. 2011). Many studies have shown that fluoride exposure can increase the risk of periodontal disease, especially for people who live in coastal areas. Coastal communities generally consume drinking water from well water containing fluoride, in which it also contains phosphate and calcium that is quite high (Artawa IMB, Swastini IP, 2011). Mineral calcium and phosphate used to form calculus can be obtained from food and beverages. Calculus formation can increase if there is an addition of calcium and other minerals in saliva (Wungkana, Kepe, Wicaksono, 2014). Based on the description above, this study is needed to analyze the relationship between fluoride and calcium levels in drinking water on periodontal responses in children.

METHODS

This study was an analytic observational study with cross-sectional approach. The population of this study were children aged 6-8 years in SDN Demangan 01 and SDN Pangerangan 05 in Bangkalan District. Those children were in a healthy condition. The subjects of this study were natives born, domiciled, and consumed drinking water both from well water and PDAM water, did not have systemic diseases, healthy, cooperative and willing to be the subject of research.

This study examined the concentration of fluoride and calcium in drinking water. Drinking water samples were carried out in Bangkalan District and tested at the Great Hall of Health Laboratory of Surabaya City. In this study, 140 subjects were divided into two groups consisting of a control group and a treatment group. Each group consisted of 70 subjects. Each subject was given informed consent and a questionnaire that had been filled in and signed by the parents of the subject. This research has been approved by the ethics committee of the Faculty of Dentistry, Universitas Airlangga.

The clinical examination results entered into the OHI-S observation sheet with the OHI-S formula were as follows:

$$\mathrm{DI} = \frac{Total\ score}{Number\ of\ teeth\ examined}$$

$$\mathrm{CI} = \frac{Total\ score}{Number\ of\ teeth\ examined}$$

$$\mathrm{OHI-S} = \mathrm{DI} + \mathrm{CI}$$

Clinical degree of oral hygiene associated with the OHI-S score was as follows:

1. Good score : 0.0 - 1.2
2. Medium score : 1.3 - 3.0
3. Bad score : 3.1 - 6.0

The analysis used the Kolmogorov-Smirnov test and the Spearman test.

RESULTS

This study took place at SDN Demangan 01 and SDN Pangerangan 05 of Bangkalan District with 140 respondents aged 6-8 years as subjects. The subjects consisted of male and female children. The collected data was then analyzed to find out the correlation between fluoride and calcium levels in drinking water and periodontal responses in children aged 6-8 years in Bangkalan District. Based on measurements of fluoride and calcium levels in Table 1, it was concluded that fluoride and calcium levels in well water are higher than PDAM water. Drinking water from well water showed that it had a fluoride level of 0.072 mg/L and a calcium level of 168.1 mg/L. Meanwhile, drinking water from PDAM water contained a fluoride level of 0.058 mg/L and a calcium level of 103.3 mg/L.

According to data in Table 2, it was found that the OHI-S average score in the urban area was higher than the coastal area. In the urban area, the OHI-S average score was 0.508, while in the coastal area, it was 1,687. It showed that the OHI-S score in the urban area was in good criteria (ranged 0.0-1.2), whereas the coastal area was in medium criteria (ranged 1.3-3.0).

Based on a statistical analysis (table 3) of the correlation of OHI-S score with a fluoride level using the Spearman method, it was found that the correlation coefficient value was 0.725 ($r > 0.2$) with a P-value of 0.000 (p-value <0.05). So, it showed a correlation between OHI-S score and the fluoride level in drinking water.

Furthermore, based on a statistical analysis (table 4) of the correlation of OHI-S score with a calcium level using the Spearman method, it was found that the correlation coefficient value was 0.725 ($r > 0.2$), and P-value was 0.0000 (p-value <0.05). Thus, it showed a correlation between OHI-S score and the calcium level in drinking water.

DISCUSSION

Based on the Regulation of the Minister of Health Number 429/Menkes/Per/IV/2010 concerning Requirements for Drinking Water Quality, the maximum level of fluoride that can be consumed is 1.5 mg/L. Based on Government Regulation No. 82 of 2001 concerning Management of Water Quality and Water

Pollution Control of Class One (I), namely water used for drinking water consumption and other needs, the maximum level of fluoride is 0.5 mg/L. The results of the research showed that there was a correlation between OHI-S scores and fluoride levels in drinking water. The fluoride level obtained in urban areas with PDAM water consumption was 0.058 mg/L with an OHI-S average score of 0.508, and in coastal areas with well water consumption was 0.072 mg/L with an OHI-S average score of 1.687. There was a difference in the average score of OHI-S in urban and coastal areas. Most coastal communities work as fishermen so that the results of marine resources are used as food sources (Astuti, 2018).

Foods that contain lots of fluorides are marine fish. Marine fish have an average total fluoride level of 2.59 ppm, which is higher than total fluoride levels in other than fish ranging from 0.86 ppm. (Ganta, et al. 2015). Based on the results of the questionnaire filled out by respondents, around 86% of the people living on the coastline consumed marine fish 2-3 times a day. This result was higher than the people who lived in cities, because only 55% of them consuming marine fish 2-3 times a day. Tooth brushing behavior also affected the OHI-S score. In urban areas, it was found that 95% of respondents brushed their teeth regularly in the morning and evening. These results are 10% higher than the coastal communities. This led to a difference in the OHI-S average score in urban and coastal areas.

Calculus is formed from dental plaques undergoing calcification and remineralization that will cause periodontal disease if left untreated (Sehkarin, 2017). The formation of calculus can increase if there is an addition of calcium and other minerals in saliva and plaque (Manson, Eley, 2004). The increase in salivary pH can lead to deposition of calcium phosphate salts by decreasing the deposition constant. Elevated pH can occur due to the loss of carbon dioxide and ammonia formation by bacteria in plaque or protein degradation during the stagnant phase. Colloidal protein in saliva binds calcium and phosphate and maintains an unsaturated solution along with calcium phosphate salts. During the stagnant salivary phase, the colloids will come out and the saturated state is no longer maintained which causes the deposition of calcium phosphate salts. Phosphatase is released from plaque, desquamation of epithelial cells, or bacteria that deposit calcium phosphate by hydrolyzing organic phosphate in saliva, thereby increasing the concentration of free phosphate ions.

Esterases are other enzymes found in cocci and filamentous organisms, leukocytes, macrophages, and desquamation of epithelial cells in plaque. Esterases can hydrolyze fat esters to free fatty acids. Soap-forming fatty acids are added with calcium and magnesium, which are then converted to calcium phosphate salts that are more water-insoluble. Complex carbohydrates-protein can be calcified by removing calcium from saliva and binding it to form the nucleus and cause mineral deposition (Newman, Takei, & Klokkevold, 2006). Increased calcium and minerals in saliva and plaque are caused by the consumption of water with a high calcium content (Tin, et al. 2015). Normal calcium content in drinking water is 100 mg/L (Wungkana, Kepe,l Wicaksono, 2014). There is a theory which states that if the calcium levels in well water is more than 30 mg/L can reduce fluoride levels to less than 1 mg/L is due to the negative interaction between calcium and fluoride (Shaji, Viju, & Thambi, 2007). This is evidenced by research on fluoride and calcium levels in drinking water originating from two sources, namely PDAM (Regional Drinking Water Company) water and groundwater. Both of these waters have calcium levels above 30 mg/L and fluoride levels below 1 mg/L. Based on statistical tests, it can be concluded that there is a relationship between OHI-S scores with calcium levels. In addition, based on the results of the questionnaire, not only from drinking water, but almost all respondents from both urban and coastal areas also consumed milk.

Based on the results of the questionnaire, children in the study often consume high-sugar foods, especially for children who live in coastal areas. Nearly 25% of those respondents consume high-sugar foods 3 times a day. This percentage is higher compared to children who live in urban areas, in which only 10% of them consume high-sugar foods 3 times a day. This case affects the oral hygiene of children. Hygiene in the oral cavity can be assessed using an OHI-S score assessment. According to Ambarawati's study in 2010 regarding the relationship between behavior and mother's attitude in toddler's dental and mouth care in Kadokan Grogol Village Sukoharjo, it was said that if cleaning process was neglected after a person consumed food, food debris would be left on the surface of the teeth so that it led to the debris index to increase (Sukanti, 2018). Therefore, the OHI-S average score in urban area is lower than the coastal area. This difference is due to the high consumption of fluoride and calcium in communities in the coastal area of Bangkalan in their daily life. In the questionnaire data, it was stated that in coastal areas 43% of respondents in coastal areas often experienced bleeding gums when brushing their teeth. This is lower compared to respondents in urban areas, in which only 4% of respondents experienced bleeding gums when brushing their teeth.

Bleeding gums can be caused by persistent plaque that is mineralized into calculus. Plaque and calculus that cause bleeding gums, swell, or turn into gingivitis, will be able to become periodontitis if the damage has reached the alveolar bone. Furthermore, questionnaire data shows that from 140 respondents in the two regions studied, in terms of dental consultations in one year, only 48 respondents had never visited a dentist. This figure shows that there are still many people from both regions who consult with dentists within one year, either only once, twice, or even three times a year. In both areas, it was also shown that if the respondents had a toothache, more than 50% of their parents decided to visit the dentists.

CONCLUSION

Based on this study, periodontal responses in children can be influenced by drinking water consumption and other consumption. The calcium content in drinking water can affect salivary content, increase plaque, and the occurrence of calculus formation. Plaque accumulation is a major factor in the occurrence of periodontal disease. In excess fluoride exposure, there is an increased risk of periodontal disease.

REFERENCES

Artawa IMB, Swastini IP (2011). Differences in the Occurrence of Tooth Tartar in the Community that consumes Well Water and Non Well Water. J SKALA HUSADA.;167.

Astuti, T. P. (2018). Analisis Faktor-Faktor Yang Mempengaruhi Pola Konsumsi Mahasiswa (Studi Kasus: Mahasiswa Pendidikan IPS FITK UIN Jakarta) (Bachelor's thesis, Jakarta: FITK UIN Syarif Hidayatullah Jakarta).

Bazzi, K. (2015). Expanded of Informal Jobs in Iranian Border Cities, Case: Zabol-Iran. International Journal of Geography and Geology, 4(3), 47-56.

Chattopadhyay, A., Podder, S., Agarwal, S., & Bhattacharya, S. (2011). Fluoride-induced histopathology and synthesis of stress protein in liver and kidney of mice. Archives of toxicology, 85(4), 327-335.

Ganta, S., Yousuf, A., Nagaraj, A., Pareek, S., Sidiq, M., Singh, K., & Vishnani, P. (2015). Evaluation of fluoride retention due to most commonly consumed estuarine fishes among fish consuming population of Andhra Pradesh as a contributing factor to dental fluorosis: A cross-sectional study. Journal of clinical and diagnostic research: JCDR, 9(6), ZC11.

Isrofah NEM (2010). Effects of Dental Health Education on Knowledge and Attitudes of School Age Children at SD Boto Kembang Kulonprogo Yogyakarta. Pena Med J Kesehat.;1(1).

Manson, J.D, Eley, B.M. (2004) Periodontics, Edinburgh London New York etc: Wright. An Impr Elsevier Ltd.;55–81.

Newman, M. G., Takei, H. H., & Klokkevold, P. R. (2006). Carranza's clinical periodontology 10th ed. St. Louis: Saunders Elsevier, 1075.

Newman, M. G., Takei, H., Klokkevold, P. R., & Carranza, F. A. (2011). Carranza's clinical periodontology. Elsevier health sciences.

Nisa, T.D, Primartha, R. (2013). The diagnosis of periodontal dental disease uses a fuzzy expert system. J Generic.;8(1).

Pertiwi ASP. (2009). Correlation of Mouth Health Status between Mother and Children in Sukapura Elementary School, Sukaraja sub-district, Tasikmalaya district. Maj Ilmu Kedokt Gigi. 2009;11.

Sehkarin, R.K. (2017). Effect of Calcium Saliva Levels on the Formation of Calculus for Gingivitis Patients Who Smoke in the Periodontia Installation of RSGM FKG USU.

Shaji, E., Viju, J., & Thambi, D. S. (2007). High fluoride in groundwater of Palghat District, Kerala. Current Science, 240-245.

Sukanti, E. (2018). Corelation Behavior of Maintaining Oral and Dental Health With OHI-S Index in SDN 06 Gadut Agam District. Jurnal Kesehatan Masyarakat Andalas, 12(1), 39-43.

Tin, M. H., Mohamed Ali, S., Ardini, Y. D., & Taib, M. N. A. (2015). Periodontal health status of Malaysian diabetic children and adolescent: a hospital based case-control study in Kuala Lumpur and Kuantan. Malaysian Family Physician, 10(2), 24-25.

Wulandari, D., & Suharjono, S. H. THE CONCEPTION OF PLAQUE SCORE ON 7TH GRADE STUDENTS OF SMP MUHAMMADIYAH 1 GODEAN SLEMAN.

Wungkana, W.S, Kepe,I B.J, Wicaksono, D.A(2014). Overview of Calculus in Coastal Communities that Use Dug Well Water in Gangga II Village. e-GiGi.;2(2).

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