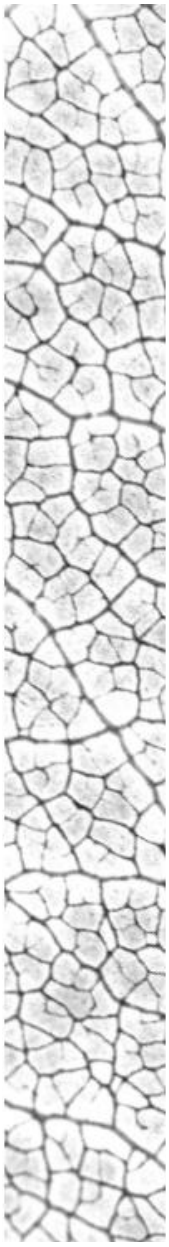

EurAsian Journal of BioSciences
Eurasia J Biosci 14, 3683-3687 (2020)

The fluoride and calcium effect of drink water on dental caries prevalence in children of 6-8 years old (Observational research in Bangkalan regency)

Ajeng Sminingrat [1], Soegeng Wahluyo [2*], Tania Saskianti [2]

[1] Student of Dentistry, Faculty of Dental Medicine, Universitas Airlangga, Surabaya, INDONESIA
[2] Department of Pediatric Dentistry, Faculty of Dental Medicine, Universitas Airlangga, Surabaya, INDONESIA
*Corresponding author: soegeng-w@fkg.unair.ac.id

Abstract

Background: In Indonesia, caries is one of many dental and oral health problems which has a high incidence rate. Caries prevalence, according to Riskesdas (2013), is 1.4%. This figure is higher than the target aimed by WHO aimed, which is a caries index (DMFT-T) of 1%. Caries experience sufferers increased by 5.1% from 67.2% in 2007 to 72.3% in 2013. About 60-90% of school children have cavities which often cause pain and discomfort.
Aim: This research aims to determine the relationship of Fluoride and Calcium levels in drinking water to dental caries in children of 6-8 years in the city of Bangkalan.
Method: This study is a community-based observational analytic study. This study uses a cross-sectional design.
Results: During the test of the levels of fluoride and calcium in the urban area – precisely in SDN Demangan 01 – the result of the fluoride level was 0.058 mg/dL, and the calcium one was 103.3 mg/dL. During the test of the levels of fluoride and calcium in the coastal area – precisely at SDN Pangeranan 05 – the result of the fluoride level was 0.072 mg/dL, and the calcium one was 168.1 mg/dL.
Conclusion: People's behavior is an important factor in caries increment besides fluoride and calcium. Predisposing factors in the study led to an increase and treatment among the two research sites.

Keywords: calcium, caries, fluoride

Sminingrat A, Wahluyo S, Saskianti T (2020) The fluoride and calcium effect of drink water on dental caries prevalence in children of 6-8 years old (Observational research in Bangkalan regency). Eurasia J Biosci 14: 3683-3687.

INTRODUCTION

Caries is one of the dental and oral health problems which has a high incidence rate in Indonesia. According to Riskesdas (2013), caries prevalence in Indonesia is 1.4%, which is higher than the WHO target of caries index (DMFT-T): 1%. According to Riskesdas (2013), people who have active dental caries increased by 9.8% from 43.4% in 2007 to 53.2% in 2013. Whereas caries sufferers increased by 5.1% from 67.2% in 2007 to 72.3% in 2013 (KKR, 2013) Around 60-90% of elementary students, have cavities that often cause pain and discomfort (World Health Organization, 2013) East Java Province is one of the three provinces that have the highest increase in dental and oral health problems in Indonesia, which increased by 8.3% from 20.3% in 2007 to 28.6% in 2013 (KKR, 2013) East Java Province experienced an increase in the prevalence of active caries from 2007 to 2013 which is the increase of 3% from 47% in 2007 up to 50.8% in 2013 (Hartiningrum, & Fitriyah, 2018).

Caries is a common disease that can occur at any age, races, socio-economics, and sexes. The main factor that can cause diseases, such as dental caries, is the activity of microorganisms. These microorganisms reside in the teeth structure in the form of biofilms so that it leads to the formation of dental plaque (Srivastava, Gupta, & Rana, 2013). Caries is a disease of the hard tissue of the teeth caused by the distribution of microorganisms on carbohydrates. Caries is characterized by demineralization of enamel and dentine, followed by the damage of organic ingredients. Caries caused changes in the form of reactionary dentin and pulpitis when it approached the pulp, deliver bacterial invasion and pulp death. The infected pulp tissue will cause changes in the periapical tissue (Kidd, & Bechal, 2012).

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

Important factors that also caused caries are dental plaque, suitable carbohydrate (especially sugar), vulnerable tooth surface, and time. These factors worked together. Plaque bacteria have the ability to ferment carbohydrate substrates in suitable foods (e.g., glucose and sucrose) to form acids and cause a decrease in pH to below 5 or 4.5 in 2 to 1-3 minutes. The plaque will remain acidic for some time. This repeated pH decreases over a period of time and results in demineralization on the vulnerable surface of the tooth, and the caries process begins. Dental caries will only occur if the four factors are present. Dental caries also occur if there are some various risk factors, for example, age, sex, level of education, economic level, environment, attitudes, and behaviors related to the dental health (Mashabi, Djoharnas, & Darwita, 2008) These risk factors play an indirect role in the process of caries occurrence.

Dental health in early childhood needs more attention because this period is an important period in the development of healthy teeth (Pawar, & Garten, 2010; Zafar, Harnekar, & Siddiqi, 2009). Dental problems which are caries in children of 6-8 years have an impact on dental health, such as the relationship with caries experience in the permanent teeth (Alm, 2008). Caries is a chronic disease that involved hard tissues of teeth due to the activity of microorganisms and demineralization of hard tissues which are not matched by remineralization. Caries is one of the most common oral health problem (Wong, & Lo, 2012; Abidin, & Musadar, 2018).

The definition of Fluoride is a natural chemical that strengthens enamel (email), the hard outer layer of the teeth. Fluoride helps to prevent tooth decay and repair premature damage to the teeth. Fluoride (F) is a chemical that is presented in nature and an ingredient that influences the environment from natural and industrial sources. The main source of fluoride is water. The other sources of fluoride are found in food and dental products from industries that used salts containing fluoride and/or hydro fluoride acid (Chattopadhyay, et al. 2011).

Calcium is the most important mineral needed by humans. Calcium helps the formation of bones and teeth. It is needed for blood clotting, signal transmission in nerve cells, and muscle contraction (Hariyadi, Purwanti, & Wardani, 2016; Hariyadi, Hendradi, et al. 2016; Sabir, et al. 2016; Nasution, Noerjanto, & Triwanto, 2008). Calcium helps prevent osteoporosis. Of all the calcium contained in the human body, 99% is in the bones and teeth. Calcium also seems to play a role in lowering blood pressure, and it has been shown to reduce the risk of cardiovascular disease in post-menopausal women. Minerals of calcium and phosphate as calculus formers can be obtained from food and drink, especially in people who lived in the coastal area (Apsari, et al. 2016). People who lived in there generally consume drinking water from well water containing fluoride and besides also contained phosphate and calcium, which are quite high. Based on the facts, this research aims to determine the relationship of Fluoride and Calcium levels in drinking water to dental caries in children aged 6-8 years in the city of Bangkalan.

METHODS

This study used a community-based observational analytic and a cross-sectional design. The sample in this study was elementary students aged 6-8 years from SD Demangan 01 Bangkalan and SDN Pangeranan 05 Bangkalan using a total sampling technique (220 students)

The independent variable of this study was caries severity, and the related ones were caries severity with dental caries index DMF-T and def-t. The data collection procedure used is the questionnaire method. Questionnaires were given to grade 1 and 2 elementary students in Bangkalan City.

The technique of collecting caries severity data is by directly examining the oral condition of the object of the study to find out the index def-t and DMF-T for students in grades 1 and 2 of the elementary school in the Bangkalan city. This research involves participants in the process using a questionnaire that was accordant with the ethical research principle based on the regulation of research ethics regulation. The present study was carried out in accordance with the research principles. This study implemented the basic principle ethics of respect, beneficence, non-maleficence, and justice.

Data obtained from the results of giving questionnaires and clinical examination results in grades 1 and 2 elementary students in the Bangkalan City were processed using the T-test, Mann-Whitney test, and Spearman test of SPSS.

RESULTS

Data were obtained from several areas in the urban area of Bangkalan city precisely at SD Demangan 01; and the coastal area at Pangeranan 05 Elementary School with 70 students in each place. Hence,the total among those all is 140 students under study.

In fluoride and calcium levels test in the urban area, precisely in SDN Demangan 01, the results of fluoride levels were 0.058 mg / dL and the calcium ones were 103.3 mg / dL. Whereas fluoride and calcium levels test in the coastal area, precisely at SDN Pangeranan 05, the results of fluoride levels were 0.072 mg / dL and the calcium ones were 168.1 mg / dL.

Based on these results, a data analysis test was performed using the T-test pair statistical test to determine the existence of a comparison. This study is a community-based observational analytic study and uses a cross-sectional design.

Based on the statistical test of the relation between the def-t and DMF-T scores in Bangkalan which use the Mann-Whitney Test, the correlation coefficient value was 4.093 and the P-value was 0.000. It means that there is an influence between the regions with def-t and DMF -T scores.

Based on the statistical test of the relation between def-t and DMF-T scores and fluoride levels in Bangkalan used Spearman test, the correlation coefficient value was 0.725 (correlation coefficient> 0.2), and the P-value was 0,000 (p-value <0.05) which means there is a relationship between def-t as well as DMF-T scores and fluoride levels.

Based on the statistical test of the relation between def-t and DEF-T scores and calcium levels in Bangkalan city used spearman test, the correlation coefficient value was 4.093 and the P-value value was 0,000, which means that there is an influence between the def-t and DMF-T levels with calcium levels.

DISCUSSION

This study was conducted to determine the relation between fluoride levels and calcium in the water against dental caries in children aged 6-8 years in Bangkalan city. The study was conducted in July - October 2018 in SDN Demangan 01 and SDN Pangeranan 05 Bangkalan Regency. There were 140 respondents of parents and children aged 6-8 years as subjects of the study.

Based on the research results which have been done, the fluoride levels of SDN Demangan were 0.058 mg / L and calcium levels were 103.3 mg / L in the urban area of PDAM water. Whereas in Pangerangan 05 SDN, the fluoride levels were 0.072 mg / L and calcium levels were 168.1 mg / L in the coastal area of well water. Based on the statistical tests performed by the Mann-Whitney test, it can be seen that there are influences between regions with def-t and DMF-T scores. The average score of def-T and DMF-T in the urban area was found that caries decreased in eighth to sixteenth week, with values at the eight week = 4.0588, and at sixteenth week = 4.0294. Whereas in the coastal area, there was an increase in caries in seventh to fifteenth week, with a significant increase of the values obtained at the seventh week = 5.0429 and at the fifteenth week = 5.5000.

Based on the Minister of Health Regulation Number 429 / Menkes / Per / IV / 2010 concerning Water Quality Requirements, the maximum levels of fluoride that can be consumed is 1.5 mg / L (Wandrivel, Suharti, & Lestari, 2012). Based on Government Regulation No. 82 of 2001 concerning Management of Water Quality and First Class Water Pollution Control which water used for consumption of drinking water and for other needs, maximum fluoride content is 0.5 mg / L (Pemerintah, & OTONOM, 2001) .Based on the results of the questionnaire filled out by respondents, about 62.8% of people who lived in the coastal area consume sweet foods more than three times in a day. This result is higher than the people who lived in the city. Only 47.5% of people who live in cities consume sweets 2-3 times a day. About 75.7% of people who live in the coastal area brush their teeth twice a day. This result is higher than the people who lived in the city. As many as 84.2% of the urban population brush their teeth three times a day. This caused a difference in the average scores of def-T and DMF-T in the urban area with the coast one.

Calcium is a biological component among the most abundant elements in the human body. Calcium plays an important role in the body's physiological processes, which is the process of bone and teeth mineralization. Calcium is very important in the formation of teeth and bone maintenance. Besides of that, the phosphor can also make the bone and the teeth become strong; hence, it is not easily damaged. In childhood, it requires enough calcium for bone and teeth to develop normally (Markovic, et al. 2009; Eda Nur, et al,2016).

Phosphor is the second largest mineral in the body, which is 1% of body weight. Approximately 85% of phosphor in the body is presented as the salt of calcium phosphate in insoluble bones and teeth. The ratio of the phosphor and calcium in bones is 1:2. The rest of phosphor is presented in all body cells, half in muscle and in extracellular fluids. As phospholipids, the phosphor is a structural component of cell walls. As organic phosphate, phosphor plays an important role in reactions related to the storage or release of energy in the form of Adenine Triphosphate (ATP) (Almatsier, Gizi, 2009). Phosphor is an important nutrient for humans and animals. In addition, a phosphor is also important for growth, maintenance, repair of all body tissues. It is needed, along with calcium and magnesium for bone growth and formation in infants and children.

Nutrition is important for the development and maintenance of teeth such as vitamins A, C, and D. Minerals such as calcium, phosphor, and fluoride are also important in the development of teeth. Vitamin C is important in normal synthesis. Dental enamel requires vitamin A for formation. Vitamin D functions to help calcium and phosphor when combined into hydroxylapatite crystals, bone and teeth formation matrix (Hall, & Girkin, 2004).

This is evidenced by the research on fluoride and calcium levels in water from two sources, which are PDAM and well water. Both of these waters have calcium levels above 30 mg / L and fluoride levels below 1 mg / L. Based on the results of the questionnaire filled out by respondents, almost all respondents consumed milk both in the urban and coastal areas. In the urban area, there are 25.7% of respondents who consume milk one time a day. Whereas in the coastal area, 54.2% of respondents consume milk one time a day. So that the average scores of def-T and DMF-T in the urban area is lower than the coastal one. This difference is due to the

high consumption of fluoride and calcium by the people in the coastal area of Bangkalan in daily life.

CONCLUSION

There is a correlation between Fluoride and Calcium levels in drinking water with dental caries in children of 6-8 years in Bangkalan city. The influence of Fluoride and Calcium levels in coast area water is very important, but for an increase in caries prevalence due to several factors, one of which is the appropriate behavioral factors in this study include the frequency of brushing, eating patterns and fewer visits to the dentist compared to children living in the urban area. The results of this study concluded that predisposing factors in the study led to an increase and treatment among the two research sites.

REFERENCES

Abidin, Z., & Musadar, M. (2018). ANALISIS PERSEPSI MASYARAKAT TERHADAP PANGAN LOKAL SAGU DI KOTA KENDARI SULAWESI TENGGARA. *Berkala Ilmiah AGRIDEVINA*, *7*(1), 1-13.

Alm, A. (2008). *On dental caries and caries-related factors in children and teenagers*. Inst of Odontology. Dept of Cariology.

Almatsier, S., Gizi, P.D.I.(2009). Basic Principles of Nutritional Sciences. Jakarta PT Gramedia Main Libr.

Apsari, R., Pratomo, D. A., Hikmawati, D., & Bidin, N. (2016, March). Microstructure and mechanical changes induced by Q-Switched pulse laser on human enamel with aim of caries prevention. In *AIP Conference Proceedings* (Vol. 1718, No. 1, p. 020001). AIP Publishing LLC.

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.

Eda Nur, A. Y. A. R., Ahmet, A. Y. A. R., & Siçramaz, H. (2016). The Evaluation of Some Dietary Fiber Rich by-Products in Ice Creams Made from the Traditional Pudding-Kesme Muhallebi. Journal of Food Technology Research, 3(2), 105-109.

Hall, A., & Girkin, J. M. (2004). A review of potential new diagnostic modalities for caries lesions. *Journal of dental research*, *83*(1_suppl), 89-94.

Hariyadi, D. M., Hendradi, E., Kusumawati, I., Maindra, H. M. C., & Azzahra, F. (2016). Evaluation of the Antibody Response and Uptake of Ca-Alginate Microspheres Containing Model Antigen After Oral Immunization. *International Journal of Pharmaceutical and Clinical Research*, *8*(2), 151-157.

Hariyadi, D. M., Purwanti, T., & Wardani, D. (2016). Stability of freeze-dried ovalbumin-alginate microspheres with different lyoprotectants. *Research Journal of Pharmacy and Technology*, *9*(1), 20-26.

Hartiningrum, I., & Fitriyah, N. (2018). Bayi Berat Lahir Rendah (BBLR) di Provinsi Jawa Timur Tahun 2012-2016. *Jurnal Biometrika dan Kependudukan*, *7*(2), 97-104.

Kidd, E. A., & Bechal, S. J. (2012). Dasar-dasar Karies penyakit dan Penanggulangan. *Jakarta: Buku Kedokteran EGC*, 2.

KKR, I. (2013). Badan penelitian dan pengembangan kesehatan. *Ris Kesehat Dasar*.

Markovic, M., Takagi, S., Chow, L. C., & Frukhtbeyn, S. (2009). Calcium fluoride precipitation and deposition from 12 mmol/L fluoride solutions with different calcium addition rates. *Journal of research of the National Institute of Standards and Technology*, *114*(5), 293.

Mashabi, N. A. A., Djoharnas, H., & Darwita, R. R. (2008). Hubungan antara status gizi dengan karies gigi pada murid-murid di sekolah dasar Kecamatan Karangantu. *Journal of Dentistry Indonesia*, *12*(1), 5-9.

Nasution, A. M. T., Noerjanto, B., & Triwanto, L. (2008, October). Development of an inexpensive optical method for studies of dental erosion process in vitro. In *Ninth International Symposium on Laser Metrology* (Vol. 7155, p. 71551O). International Society for Optics and Photonics.

Pawar, D., & Garten, L. (2010). Pain management in children. *Guide to Pain Management in Low-Resource Settings*, 255.

Pemerintah, P., & OTONOM, K. P. S. D. (2001). Peraturan Pemerintah Republik Indonesia Nomor 82 Tahun 2001. *Tentang Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air*.

Sabir, A., Mooduto, L., Kaelan, C., & Horax, S. (2016). Impact of the Use of Ethanolic Extract of Propolis, Flavonoid and Non-Flavonoid Propolis for Direct Pulp Capping in Collagen Type I Density. *Brazilian Journal of Oral Sciences*, *15*(4), 264-268.

Srivastava, N., Gupta, G., & Rana, V. (2013). A comparative evaluation of efficacy of different teaching methods of tooth brushing in children contributors. *Journal of Oral Hygiene & Health*, 1-4.

Wandrivel, R., Suharti, N., & Lestari, Y. (2012). Kualitas air minum yang diproduksi depot air minum isi ulang di Kecamatan Bungus Padang berdasarkan persyaratan mikrobiologi. *Jurnal Kesehatan Andalas*, *1*(3).

Wong, M. C. M., Lu, H. X., & Lo, E. C. M. (2012). Caries increment over 2 years in preschool children: a life course approach. *International Journal of Paediatric Dentistry*, *22*(2), 77-84.

World Health Organization. (2013). *WHO report on the global tobacco epidemic, 2013: enforcing bans on tobacco advertising, promotion and sponsorship*. World Health Organization.

Zafar, S., Harnekar, S. Y., & Siddiqi, A. (2009). Early childhood caries: etiology, clinical considerations, consequences and management. *Int Dent SA*, *11*(4), 24-36.