

OPEN ACCESS MACEDONIAN
JOURNAL OF MEDICAL SCIENCES

oa
mjms eISSN 1857-9655
<https://www.id-press.eu/mjms>



Open Access Maced J Med Sci (OAMJMS) is an international peer-reviewed, Open Access journal published four times per year. **Indexed in:** Bielefeld Academic Search Engine (BASE), CAB Direct, CiteFactor, CNKI Scholar, CrossRef DOI, DeepDyve, Directory of Open Access Journals (DOAJ), Directory of Open Access scholarly Resources (ROAD), Europe PMC, Global Health database, Global Impact Factor (GIF), Google Scholar, Harvard Library [HOLLIS +], HINARI Access to Research Initiative, JournalTOCs, Mendelley, NLM Catalog, OpenAIRE, Open Academic Journals Index (OAJI), Open Access Library (OALib), pubget, PubMed, PubMed Central, PubMed Central CANADA, SciLit, SciRew, Scopus, SouthEast European Science Advanced through Evaluation (SEESAmE), The Knowledge Network, Virtual Library of Macedonia (COBISS.MK), Western Theological Seminary, WorldCat. **Publisher:** ID Design Press, Rajko Zhinzifov No. 48, 1000 Skopje, Republic of Macedonia. OAMJMS Online (eISSN 1857-9655) offers free access to all articles at <https://www.id-design.eu/mjms/>

Editorial Team

Editors-in-Chief

Prof. Dr Mirko Zhivko Spiroski, Faculty of Medicine, Ss Cyril and Methodius University of Skopje, Skopje, Republic of Macedonia, Republic of Macedonia

Prof. Dr Doncho Donev, Institute of Social Medicine, Medical Faculty, Ss Cyril and Methodius University of Skopje, Skopje, Republic of Macedonia

Prof. Dr Olivera Stojceva-Taneva, University Clinic of Nephrology, Republic of Macedonia

Deputy Editors-in-Chief

Dr Borislav D Dimitrov, Academic Unit of Primary Care and Population Sciences Faculty of Medicine University of Southampton South Academic Block (Level C) Southampton General Hospital Southampton SO166YD England, UK

MD, MSc, PhD, MRCPsych Elizabeta Mukaetova-Ladinska, Old Age Psychiatry, Newcastle University, United Kingdom

MD, PhD candidate Marko Spasov, University Clinic of Traumatology, Orthopaedics, Anesthesia, Reanimation, Intensive Care and Emergency Department; Medical Faculty, Skopje., Republic of Macedonia

MD, MSc Sasho Stoileski, Institute for Occupational Health of Republic of Macedonia - Skopje, WHO Collaborating Center, GA2LEN Collaborating Center, II Makedonska brigada 43, 1000 Skopje, Republic of Macedonia

Layout Editor and Electronic Publishing

MSc, Eng Ivo Spiroski, ID Design 2012, Skopje, Republic of Macedonia

Evidence Based Medicine

Prof. Dr. Katarina Stavric, Children Hospital Skopje, Macedonia, Vodnjanska 17, University "Ss Cyril and Methodius", Skopje, Republic of Macedonia

Editorial Board

DDS, MS, PhD, Associate Professor Nikola Angelov, Director of the Pre-Doctoral Periodontics Clinic, Loma Linda University School of Dentistry, Department of Periodontics. Loma Linda, CA, 92350, United States

Assist. Prof. Dr. Ramush Bejiqi, University Clinical Centre of Kosovo, Paediatric Clinic, Albania

Prof. Semra Čavaljuga, Department of Epidemiology and Biostatistics, Faculty of Medicine, Sarajevo, Bosnia and Herzegovina

MD Pei-Yi Chu, Diagnostic and research pathologist, Department of Surgical Pathology, Changhua Christian Hospital, Taiwan. Address: 135 Nan-Shiao Street, Changhua 500-06., Taiwan, Province of China

MD, PhD Ivo Donkov, Staff Urologist, Lincoln County Hospital, United Kingdom

Prof. Dr. Aleksandar Dimovski, Institute of Pharmaceutical Chemistry, Faculty of Pharmacy, University "Ss Kiril and Metodij", Skopje, Republic of Macedonia

MD, PhD Andrew J. Dwork, Departments of Pathology and Cell Biology and Psychiatry, College of Physicians and Surgeons of Columbia University; Division of Molecular Imaging and Neuropathology, New York State Psychiatric Institute, Unit 62, 722 West 168th Street, New York, NY 10032, United States

MD, PhD Dimitar G. Efremov, Molecular Hematology, International Centre for Genetic Engineering and Biotechnology (ICGEB), Rome, Italy

Adriana Galan, Department of Health Programmes and Health Promotion, Institute of Public Health, Bucharest, Romania

Prof. Tania Santos Giani, Estacio de Sa University, in Health Sciences, Brazil

PhD Iva Ivanovska, Harvard Medical School, Department of Genetics, 77 Avenue Louis Pasteur, NRB room 239, Boston, MA 02115, United States

MD, PhD Jerzy Jablęcki, Associate Professor, Division of General Surgery St. Jadwiga of Silesia Hospital, Trzebnica; Head, Subdepartment of Hand Surgery an Replantation St Jadwiga of Silesia Hospital, Trzebnica; Professor,

Department of Public Health, State Higher Professional Medical School, Opole, Poland. 55-100 Trzebnica, ul. Prusicka 53, Poland

MD Mehrdad Jalalian Hosseini, Khorasan-e Razavi Blood Center, Mashhad, Iran, Islamic Republic of

PhD Radka Kaneva, Department of Medical Chemistry and Biochemistry, Medical University - Sofia, Bulgaria

Prof. Dr. Kostandina Leonida Kometi-Pekavska, Ss Cyril and Methodius University of Skopje, Faculty of Medicine, Skopje, Republic of Macedonia

MD, PhD Branko Malenica, Department of Immunology, Clinical Hospital Center Zagreb, Zagreb University School of Medicine, Zagreb, Croatia

Prof. Dr. Elida Mitevska, Institute of Histology and Embriology, Faculty of Medicine, Ss Cyril and Methodius University of Skopje, Skopje, Republic of Macedonia

MD, PhD Marija Mostarica-Stojković, Institute of Microbiology and Immunology, University of Belgrade School of Medicine, Belgrade, Serbia

PhD Vesna Nikolova-Krstevski, Harvard Institutes of Medicine, HIM-201, 4 Blackfan Circle, Boston, MA, 02134, United States

Prof. Dr. Nikola Panovski, Institute of Microbiology and Parasitology, Faculty of Medicine, Skopje, Republic of Macedonia

MD, BIDMC Iva Petkovska, Beth Israel Deaconess Medical CenterRadiology W CC - 3 330 Brookline Ave. Boston, MA 02215, United States

Prof. Dr. Gordana Petrusavska, Institute of Pathology, Medical Faculty, University of "Ss. Cyril and Methodius" – Skopje, Republic of Macedonia

Prof. Enver Roshi, Dean of Faculty of Public Health, Medical University of Tirane, Chief of Epidemiological Observatory, National Institute of Public Health. Address: Rruga e Dibres, Str. 371, Tirana, Albania

MD, PhD Gorazd B. Rosoklija, Professor at Columbia University and member of the Macedonian Academy of Sciences and Arts, United States

Prof. Dr. Aleksandar Sikole, University Clinic for Nephrology, Faculty of Medicine, Ss Cyril and Methodius University of Skopje, Skopje, Republic of Macedonia

MD, FESC Gianfranco Sinagra, Department of Cardiology, "Ospedali Riuniti" and University of Trieste, Ospedale Cattinara – Strada di Fiume, 447, 34149 – Trieste, Italy

MD, PhD Rumen Stefanov, Information Centre for Rare Diseases and Orphan Drugs (ICRDOD), Bulgaria; Department of Social Medicine, Medical University of Plovdiv, Bulgaria

Prof. Dr. Vesna Velikj-Stefanovska, Department of Epidemiology and Biostatistics with Medical Informatics, Medical Faculty, UKIM, Skopje, Republic of Macedonia

MD, MBA Milenko Tanasijevic, Director, Clinical Laboratories Division and Clinical Program Development, Pathology Department, Brigham and Women's Hospital, Dana Farber Cancer Institute, Associate Professor of Pathology, Harvard Medical School, United States

PhD Mirko Trajkovski, ETH Zürich, Wolfgang-Pauli-Str. 16/HPT D57, 8093 Zürich-CH, Switzerland

MD, FRCPC Kiril Trpkov, Associate Professor, University of Calgary, Department of Pathology and Laboratory Medicine, Calgary Laboratory Services. 7007 14 st, Calgary SW, Canada

MD, PhD Igor Tulevski, Department of Cardiology, Academic Medical Center, Amsterdam, 1100 DD, T 020 707 2930; F 020 707 2931, Netherlands

PhD Zoran Zdravkovski, Institute of Chemistry, Faculty of Natural Sciences and Mathematics, Ss Cyril and Methodius University of Skopje, Skopje, Republic of Macedonia

Editorial Office

ID Design 2012/DOOEL Skopje, Rajko Zhinzifov No. 48, 1000 Skopje, Republic of Macedonia | Telephone: +389 70 255155. | e-mail: mspiroski@id-design.eu | URL: <http://www.id-design.eu/mjms/>

Publisher

ID Design Press, Rajko Zhinzifov No. 48, 1000 Skopje, Republic of Macedonia

Basic Science

Applying the Taguchi Method to the Optimization of Anticancer Activity of Bacterial Alginate-CuO Bionanocomposite

Amin Golshah, Mojtaba Taran, Mohsen Safaei, Hamid Reza Mozaffari, Mohammad Moslem Imani, Roohollah Sharifi, Hedaiat Moradpoor, Prabhat Upadhyay

1-5

Association of Her-2 Expression and Clinicopathological Parameters in Colorectal Carcinoma in Indian Population

Rameez Hasan, Deepti Bhatt, Shahbaz Khan, Vasiuddin Khan, Amit Kumar Verma, Afzal Anees, Kapil Dev

6-11

Vancomycin MIC Distribution among Methicillin-Resistant Staphylococcus Aureus. Is Reduced Vancomycin Susceptibility Related To MIC Creep?

Hala B. Othman, Rania M. Abdel Halim, Fatma Alzahraa M. Gomaa, Malaka Z. Amer

12-18

Assessment of Density of Neovascularization in Lower Lip Squamous Cell Carcinoma in Relation To Neoplasm Differentiation Grade in Patients with and without Neck Lymph Nodes Metastasis

Lena Kakasheva-Mazhenkovska, Marko Kostovski, Gjorgje Gjokik, Vesna Janevska

19-23

The Immunomodulatory Activities of Picria Fel-Terrae Lour Herbs towards RAW 264.7 Cells

Novycha AuliaFendri, - Rosidah, - Yuandani, Sri Suryani, Denny Satria

24-28

The Role of Polymorphism Gen Methylene Tetra Hydrofolate Reductase (MTHFR) C677T in Ischaemic Stroke Patients with and Without Hypertension

Cut Aria Arina, Darwin Amir, Yahwardiah Siregar, Rosita J. Sembiring

29-32

CRP Gene Polymorphism and Their Risk Association With Type 2 Diabetes Mellitus

Hakim Bahlok Jebur, Mirza Masroor, Hafiz Ahmad, Naushad Ahmad Khan, Juheb Akther, Dipu Bharali, Vijay Kumar Singh, Amit Verma, Shahbaz Khan, Vasiuddin Khan, Rameez Hasan, Deepti Bhatt, Yamini Goyal, Kapil Dev

33-37

Balinese Cultivar of Purple Sweet Potato Improved Neurological Score and BDNF and Reduced Caspase-Independent Apoptosis among Wistar Rats with Ischemic Stroke

I Made Oka Adnyana, Raka Sudewi, Purwa Samatra, Suprapta Suprapta

38-44

Clinical Science

Serum Interleukin-27 Level in Different Clinical Stages of Lung Cancer

Akbar Soleimani Babadi, Arda Kiani, Esmaeil Mortaz, Kimia Taghavi, Adnan Khosravi, Majid Marjani, Sharareh Seifi, Habib Emami, Atefeh Abedini

45-49

Vaspin in Developing Obesity (Vande-Ob); the Correlation of Waist Circumference and Visceral Fat Percentage with Vaspin Levels in Patients with Type II Diabetes Mellitus

I Made Pande Dwipayana, I Made Siswadi Semadi, Wira Gotera, Made Ratna Saraswati, Ketut Suastika

50-52

Correlation between Serum Leptin Level with Type and Number of Lesion Skin Tag

Imam Budi Putra, Remenda Siregar, Nelva K. Jusuf, Oratna Ginting, Raja Nurhayati

53-55

Surgical Treatment of Meningiomas - Outcome Associated With Type of Resection, Recurrence, Karnofsky Performance Score, Mitotic Count

Robert Sumkovski, Micun Micunovic, Ivica Kocevski, Boro Ilievski, Igor Petrov

56-64

Correlation between Serum 25-Hydroxyvitamin D Levels with Keloid Severity

Vira Indhiratamin Damanik, Imam Budi Putra, Oratna Ginting

65-67

Sonographic Diagnosis and Clinical Correlates of Gallbladder Stones in Patients with Sickle Cell Disease in Calabar, Nigeria

Grace B. Inah, Emmanuel E. Ekanem

68-72

Dexmedetomidine versus Magnesium as Adjuvants to Bupivacaine-Induced Caudal Block in Children: A Randomized, Double-Blinded, Placebo-Controlled, Trial

Hagar Hassanein Refaee, amel Amel Hanafy Abo Elela, Maha Gamil Hanna, Mai Ahmed Ali, Amira Mohamed El Khateeb

73-76

Effect of Early Breast Milk Nutrition on Serum Insulin-Like Growth Factor-1 in Preterm Infants

Fatma A. Alzaree, Mones M. AbuShady, Mohamed Abdel Atti, Gihan A. Fathy, Essam M. Galal, Alaa Ali, Tahany R. Elias

77-81

Analysis of Treatment Results of the Thoracic Part of Oesophageal Cancer

Bekzhan Alipbayevich Orazbayev, Kani Musulmanbekov, Akat Bukenov

82-87

The Connection of the Level of Estradiol in Serum and Obesity with the Endometrial Bleeding in Postmenopausal Women

Valentina Tofiloska, Maria Krstevska, Ana Daneva-Markova, Viktorija Jovanovska

88-91

Predictors of Mortality in Pulmonary Haemorrhage during SLE: A Single Centre Study Over Eleven Years

Ibrahim Masoodi, Irshad A. Sirwal, Shaikh Khurshid Anwar, Ahmed Alzaidi, Khalid A. Balbaid

92-96

Role of Soluble Transferrin Receptor and Transferrin Receptor-Ferritin Index to Detect Iron Deficiency Anemia in Regular Hemodialysis Patients

Ketut Suega, Yenny Kandarini, Jemi Tubung

97-102

The Correlation between Malondialdehyde and Nerve Growth Factor Serum Level with Diabetic Peripheral Neuropathy Score

Eva Decroli, Asman Manaf, Syafril Syahbuddin, Yuliarni Syafrita, Dwisari Dillasamola

103-106

Predictors of Renal Dysfunction in Adults with Childhood Vesicoureteral Reflux after Long-Term Follow-Up

Smiljana Bundovska-Kocev, Dafina Kuzmanovska, Gjulsen Selim, Ljubica Georgievska-Ismail

107-113

Case Report

Drug-Induced Melanoma: Irbesartan Induced Cutaneous Melanoma! First Description in the World Literature!

Georgi Tchernev, Ivanka Temelkova

114-116

Trigonocephaly: Case Report, Review of Literature and a Technical Note

Robert Sumkovski, Ivica Kocevski, Micun Micunovikj

117-120

Irbesartan Induced Cutaneous Melanoma! Second Case in the Medical Literature!

Georgi Tchernev, Ivanka Temelkova

121-123

Retrieval of Intravascular Fractured Fragment of Tunnelled Double Lumen Catheter in Hemodialysis Patient

I Nyoman Semadi, Heru Sutanto Koerniawan, Hendry Irawan

124-126

Dental Science

Three-Dimensional Prospective Evaluation of Piezocision-Assisted and Conventional Rapid Maxillary Expansion: A Controlled Clinical Trial

Ahmed I. Abdul-Aziz, Wael M. Refai

127-133

Analysis of Calcium Levels in Groundwater and Dental Caries in the Coastal Population of an Archipelago Country

Ristya Widi Endah Yani, Retno Palupi, Taufan Bramantoro, Darmawan Setijanto

134-138

Knowledge and Interest in Treating Gingival Recession among Dental Practitioners in Saudi Arabia

Mohammad Bhat, Nabeeh AlQahtani, Mohasin Khader, Mukhatar Javali, Ali AlQahtani

139-142

Study On Social Support for Exercise And Its Impact on the Level of Physical Activity of Patients with Type 2 Diabetes

Mohammad Ali Morowatisharifabad, Mahdi Abdolkarimi, Mohammad Asadpour, Mahmood Sheikh Fathollahi, Parisa Balae

143-147

The Relationship between the Duration of Playing Gadget and Mental Emotional State of Elementary School Students

Arlinda Sari Wahyuni, Ferdinan Benito Siahaan, Mudia Arfa, Ivana Alona, Nerdy Nerdy

148-151

Socio-Economic Status Inequity in Self Rated Health in Patients with Breast Cancer

Majid Taheri, Mohammad Tavakol, Mohammad Esmail Akbari, Abolfazl Mohammadbeigi, Mahmoud Abbasi

152-156

The Characteristics and Factors Associated with Medical Waste Management Behaviour in Private Dental Health Services in Pekanbaru City, Indonesia

Oktavia Dewi, Yusni Ikhwan, Elda Nazriati, Sukendi Sukendi

157-161

Review Article

The Diagnostic and Clinical Approach to Pediatric Myocarditis: A Review of the Current Literature

Ramush Bejiqi, Ragip Retkoceri, Arlinda Maluku, Aferdita Mustafa, Hana Bejiqi, Rinor Bejiqi

162-173

Evaluation of Serum Interleukin-6 Levels in the Renal Transplant Recipients: A Systematic Review and Meta-Analysis of Case-Control Studies

Hamidreza Omrani, Sayed Vahid Jasemi, Masoud Sadeghi, Sima Golmohamadi

174-178

Analysis of Calcium Levels in Groundwater and Dental Caries in the Coastal Population of an Archipelago Country

Ristya Widi Endah Yani^{1*}, Retno Palupi², Taufan Bramantoro², Darmawan Setijanto²

¹Department of Dental Public Health, Faculty of Dental Medicine, University of Jember, Jalan Borneo No. 37, Campus Tegalboto, Jember, East Java, 68121, Indonesia; ²Department of Dental Public Health, Faculty of Dental Medicine, Universitas Airlangga, Jl. Mayjend Prof Dr Moestopo 47, 60132, Surabaya, Indonesia

Abstract

Citation: Yani RWE, Palupi R, Bramantoro T, Setijanto D. Analysis of Calcium Levels in Groundwater and Dental Caries in the Coastal Population of an Archipelago Country. Open Access Maced J Med Sci. <https://doi.org/10.3889/oamjms.2019.013>

Keywords: Groundwater; Calcium; Dental caries

***Correspondence:** Ristya Widi Endah Yani, Department of Dental Public Health, Faculty of Dental Medicine, University of Jember, Jember, Indonesia, Jalan Borneo No. 37, Campus Tegalboto, Jember, East Java, 68121, Indonesia. E-mail: ristya_widi@unej.ac.id

Received: 13-Sep-2018; **Revised:** 06-Nov-2018; **Accepted:** 07-Nov-2018; **Online first:** 14-Jan-2019

Copyright: © 2019 Ristya Widi Endah Yani, Retno Palupi, Taufan Bramantoro, Darmawan Setijanto. This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0)

Funding: This research did not receive any financial support

Competing Interests: The authors have declared that no competing interests exist

BACKGROUND: The coastal region is the largest region in Indonesia as a country of the archipelago. Characteristics of groundwater content in coastal areas are very influential on dental health, especially dental caries. The main elements contained in 1-1000 mg/litre groundwater are calcium, magnesium, sodium, potassium, chlorine, bicarbonate, and sulfate groups. Calcium is an essential ingredient for living organisms that play a role in the formation of bone and tooth along with permeability of cell walls.

AIM: This study aimed to analyse the relationship between calcium in groundwater with dental caries.

METHOD: Analytical observational study with cross-sectional approach was implemented was coastal communities in Watu Ulo Jember Regency in February 2018 (3,686 inhabitants), with sample criteria of the minimum age of 12 years and consumed groundwater as drinking water at least 2 years by purposive side. The variables in this study were calcium levels as the independent variable and dental caries as the dependent variable. Calcium was measured using the spectrophotometric method. Caries measurements were performed using the DMF-T index. Data were presented descriptively in the table and analysed by Spearman Correlation test to analyze the relationship between groundwater calcium with dental caries.

RESULTS: Average groundwater calcium content was 126.75 mg/litre (high category), and average dental caries was 2.2 (low category). Spearman correlation analysis showed $p = 0.029$ ($p < 0.000$), which means there was a correlation between groundwater calcium level with dental caries.

CONCLUSION: There is a positive relationship between the calcium content of groundwater with dental caries.

Introduction

Indonesia as an archipelago country extended geographically in such a way that major part of it is coastally located. About 60% of Indonesia's population is in 50 km range from the coastline, and more than 42 cities and 181 districts are in coastal areas [1]. Watu Ulo Jember Regency, East Java can represent the condition of coastal areas in Indonesia. Coastal areas have special characteristics that occur due to the interaction between processes found on land and in the oceans. These characteristics can have an effect on dental caries in the population living in the area, one of which is the groundwater content in

coastal areas.

Data of Susenas (2017) stated that the majority of drinking water sources of Indonesian society is obtained from groundwater, bottled water and protected wells. Quantity, continuity, and affordability are the reasons for the use of groundwater as drinking water for the majority of Indonesians [2]. Groundwater is formed in the recharge area and flows into its surrounding area through the space between the constituent rocks. Groundwater quality from one place to another varies, depending on the type of rock, and where the groundwater location is pervasive, flowing, accumulating, as well as environmental conditions. Groundwater quality is determined by physical

properties, chemical content, and bacteriology [3].

The main elements that dissolved ions in water and contained in 1-1000 mg/litre groundwater are calcium, magnesium, sodium, potassium, chlorine, bicarbonate and sulfate groups. Calcium levels in freshwater are usually less than 15 mg/litre, in waters around the carbonate rocks are between 30-100 mg/litre and in ocean waters are around 400 mg/litre [4].

Calcium is an essential ingredient for living organisms that play a role in bone and teeth formation, along with permeability of cell walls [5]. Calcium is an important constituent of enamel and dentine structures in teeth bound in apatite crystals to form calcium hydroxyapatite ($\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$) [6]. Calcium hydroxyapatite is the most stable phase of calcium phosphate compounds in physiological pH, temperature, and liquid compared to other phases [7]. Ca ion in calcium hydroxyapatite can be dissolved and displaced so that the process of demineralisation leading to dental caries. Dental caries is a disease of hard tooth tissue characterised by the destruction of enamel and dentine caused by the activity of bacterial metabolism in plaque, resulting in changes in enamel and dentine. Based on the Basic Health Research in 2013, the prevalence of dental caries in Indonesia in 2013 reached 53.2% [8], according to another research conducted in 2014 in coastal population, the prevalence of dental caries is 46.11%, which lower than the nationwide score [9].

To compensate for the demineralisation process in caries, it is necessary to have a calcium ion intake freely to assist the remineralisation process [4]. Based on the description, this study aimed to analyse the relationship between groundwater calcium content with dental caries.

Method

This was an observational analytic study with the cross-sectional method. The research approach was implemented coastal communities in Watu Ulo Jember Regency in February 2018 (3,686 inhabitants), with sample criteria of the minimum age of 12 years and consumed groundwater as drinking water at least 2 years by purposive side with the assumption that calcium in water had been absorbed by the body. Sampling was done by purposive sampling [10]. The variables in this study were calcium levels as the independent variable and dental caries as the dependent variable. Method of taking calcium in this study was done by taking groundwater from the well with a bucket then inserting the empty bottle into a bucket and opening bottle cap, filling water until full then closing and labelling bottle. The bottle was covered with plastic and put in a cool box

and sent to Perum Jasa Tirta I laboratory in Malang, East Java to test the level of calcium by spectrophotometric method [11]. The caries data retrieval method was done with Decay, Missing, Filling-Teeth (DMF-T) index. The caries examination was done by drying the tooth surface, examined by the probe and dental mouth mirror. Caries cannot be filled but excavated; the tooth cavity can be filled with the restoring material. (decay), extracted teeth or indication of retraction due to caries (missing), and tooth filling because caries (filling). Then DMF-T component was summed up [12]. The results were presented in the form of frequency distribution tables and continued by Spearman correlation test to analyse the relationship of groundwater calcium content with dental caries. This research had been approved by the Health Ethics Committee of Faculty of Dentistry, Universitas Jember (No. 087/UN25.8/KEPK/DL/2018) on February 8, 2018.

Results

The results regarding the sex in this study can be seen in Table 1.

Table 1: Data of Respondents Characteristics by sex

Sex	Total	Percentage
Male	11	36.7
Female	19	63.3
Total	30	100

Table 1 63% of the respondents are female. The results regarding the age can be seen in Table 2.

Table 2: Data of Respondents Characteristics by age

Age (Depkes, 2009)	Total	Percentage
Early teenage (12-16 y.o.)	4	13.3
Late teenage (17-25 y.o.)	5	16.7
Early adulthood (26-35 y.o.)	6	20
Late adulthood (36-45 y.o.)	8	26.7
Early elderly (46-55 y.o.)	2	6.7
Late elderly (56-65 y.o.)	5	16.6
Total	30	100

Table 2 shows that most of the final adult respondents ranged from 36-45 years old (26.7%), The minority aged 46-55 years (6.7%). The results regarding the occupation can be seen in Table 3.

Table 3: Data of Respondents Characteristics by type of occupation

Occupations	Total	Percentage
Student	7	23.3
Housewife	8	26.7
Fisherman	9	30
Merchant	5	16.7
Civil servant	1	3.3
Total	30	100

Table 3 shows that most respondents work as fishermen (30%), but 3.3% works as civil servants. The results regarding the average calcium level of

groundwater and caries can be seen in Table 4.

Table 4: Mean Calcium Levels (mg/litre) and Incidence of Dental Caries

Variables	N	Mean
Calcium	30	126.75
Caries	30	2.2

Table 4 shows the average groundwater calcium content of 126.75 mg/litre (high category) and the DMF-T index average of 2.2 (low category). The results regarding the relationship of the calcium content of groundwater with dental caries can be seen in Table 5.

Table 5: Spearman correlation test results with variable levels of calcium and dental caries

Variable	Sig	Note
Calcium-Caries	0.029	There is a correlation

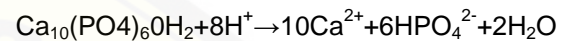
Table 5 shows a correlation of groundwater calcium content with dental caries with a significance value of 0.029 ($p < 0.05$).

Discussion

The Majority of respondents are female on the age between 36-45 years, working as a fisherman. Based on the results of a study that had been done, the average calcium water level was 126.75 mg/litre in which was categorised as high. There are four category regarding the calcium content (concentration) in water, ie low (< 60 mg/liter), medium (60 mg/liter-119 mg/liter), high (120 mg/liter-179 mg/liter), and very high (> 180 mg/liter) [13]. Several studies have shown a distinctive relationship of calcium, sodium, and fluoride content in a water source — the higher the fluorine level, the lower the calcium level. This might be caused by the exchange of Na with Ca in the underground water circulation [14]. Seawater is naturally water with a salt content of about 3.5%. Seawater contains salts, such as calcium` magnesium elements, belonging to elements of Group II A (alkaline earth), dissolved gases, organic materials and unsolved particles. The presence of salts affects the physical properties of groundwater in coastal areas [15]. Well water in the coastal area, based on geographical studies, undergoes an intrusion process from seawater so that the original freshwater soil turns into hard water. The intractable hard water of these seawater contains high calcium [16]. According to WHO standards, the average calcium content in drinking water is 75 mg/L, and the maximum allowed limit is 200 mg/L. Water with calcium levels the maximum limit can cause digestive problems, kidney problems, bladder stones, and urinary tract obstruction in humans [17]. Human activities can also affect water quality in coastal areas,

especially in tourist-dense areas that still use groundwater as the main source of water [18]. Watu Ulo is also located between the sea and rice fields that utilise groundwater for irrigation purpose so that it can affect the hardness of groundwater in the region.

The average DMF-T score of 2.2 indicates the low category. According to the DMF-T index there are five categories of, very low (0.0-1.0), low (1.2-2.6), moderate (2.7-4.4), high (4.5-6.5), and very high (> 6.6) [19], [20]. Caries occurs because of four interplaying factors: diet, time, microorganism, and host. Caries occurs when all four factors contribute to the demineralisation process [21]. Teeth demineralisation may occur if saliva has an acidic pH level where enamel dissolves by acid resulting in partial loss of ions in the enamel by the following reaction [22], [23].

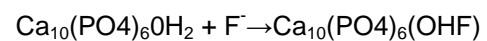


The DMF-T index of coastal communities in Watu Ulo, Sumberejo Village, Ambulu Sub-district, Jember Regency is low possibly because of the community behaviour in maintaining good oral hygiene as they consume a non-cariogenic nutritious diet.

Also, the average community in Watu Ulo, Sumberejo Village consumed groundwater with high calcium. Calcium plays a role in preventing the demineralisation process to decrease caries.

Spearman correlation results showed that there was a relationship of the calcium content of groundwater with dental caries. This occurs because calcium levels in groundwater are known to decrease dental caries which can be measured using the DMF-T index. Dental caries is inversely related to the concentration of calcium and fluoride contained in drinking water. This is supported by a study of Arvin et al., in 2018, stating that decreasing the calcium concentration from 120 mg/l to 33 mg/l can increase caries by 46% [5].

Another effect of groundwater calcium on caries suggests a positive relationship between calcium ions and fluoride levels in plaque. Calcium diffuses into the plaque and provides a bond for fluoride. The free ionic calcium ion in drinking water and fluoride causes the process of precipitation and dissolution of the fluoride ion into the biofilm fluid on the tooth surface to prevent the caries process [5]. Fluoride acts by inhibiting plaque bacterial metabolism that can ferment carbohydrates through alteration of apatite hydroxy in enamel to apatite fluorine by chemical reactions:



Apatite fluorine may cause the enamel to be more acid-resistant, thus inhibiting demineralisation and discontinuation of carious lesions [22]. WHO recommends that the ideal drinking water should contain at least 0.5-1.0 mg/L of fluoride [26]. The

lowest fluoride concentrations in drinking water of 0.5 to 1 mg/litre effectively reducing the prevalence of caries and the concentration of 100 mg/litre of calcium has the same protective effect as 0.64 mg/litre fluoride [5]. Fluoride level of < 0.5 mg/L resulted in dental caries, 0.5 to 1 mg/L was the most acceptable body-safe level, while 1-3 mg/L resulting in dental fluorosis, 3-4 mg/L causing fragile bone, and levels > 4 mg/L cause knee deformities and even paralysis [26]. The optimum F concentration for dental health is generally between 0.5 and 1.0 mg/L [27].

Saliva is a major source of minerals that rebuilds demineralised enamel. The hydroxyapatite (HA) crystals in tooth enamel, consisting of Ca, Mg, and Pi (Phosphate) are more susceptible to dissolution by acids. If the pH is more than 4.5, the lost HA is immediately replaced by fluorapatite by the F ions available in oral biofilms which is more resistant to acid dissolution. This process leads to a decrease in demineralisation and is not considered as remineralisation since it is replaced by different minerals. In addition to the reduction of enamel demineralisation, F also increases remineralisation when pH rises. Ca assist this process by providing F with a place to bind with. Minerals in drinking water are the main source of Ca and Mg which are absorbed by the body. These elements play an important role in the body's physiological functions. Fluor has anticariogenic effects. The optimum Ca and Mg level in drinking water that is beneficial for health ranges from 40-80 mg/L for Ca and 20-30 mg/L for Mg. Ca concentration in saliva to helps repair early carious lesions ideally should not exceed 90 mg/L. Ca and F together caused 45% decrease in DMF-S index, supporting the role of Ca in teeth remineralisation [27].

The average calcium content in the sample was 126.75 mg/litre equivalent to 0.81 mg/litre fluoride, which showed an effective level to decrease the prevalence of caries. Calcium obtained from the diet will be absorbed by the body and affects serum calcium levels and also in saliva secreted by the salivary gland [28]. The total concentration of calcium in drinking water is 2 mmol/litre at 25°C, whereas, the whole human saliva contains about 1 mmol/litre of calcium. Human saliva also contains high concentrations of bicarbonate as protein and phosphorus, both of which will bind to calcium saliva. This causes free calcium ions in the saliva to be reduced to half of the total saliva calcium concentration so that the process of remineralisation is less than optimal. Free calcium ions will be more effective in enhancing the remineralisation process when binding to fluoride ions to form calcium fluoride (CaF₂). From both of these things, a higher intake of free calcium is required than the calcium in saliva [4], [5]. During the demineralization process, calcium is released from the enamel, dentine, and cementum before phosphate release. Therefore the use of calcium to inhibit the demineralisation process is

considered more effective than the use of phosphate [29].

However, it is important to remember that individuals with high levels of calcium and phosphate in saliva are known to have higher resistance to caries, but are more susceptible to periodontal disease due to faster calculus buildup [30]. Therefore it is recommended to perform effective dental cleansing to prevent rapid formation of calculus as a result of high calcium intake.

Based on the research results, it can be concluded that there was a relationship of calcium levels in groundwater with dental caries. The higher Ca levels in groundwater the lower dental caries.

References

1. Asyiwati Y. Pengaruh Pemanfaatan Lahan Terhadap Ekosistem Pesisir di Kawasan Teluk Ambon. *Jurnal Perencanaan Wilayah dan Kota*. 2010; 10(2).
2. Apriyana P. Evaluasi Kinerja Pelayanan Air Bersih Komunal di Wilayah Pengembangan Ujung Berung Kota Bandung. *Jurnal Perencanaan Wilayah dan Kota*. 2010; 21(2): 3
3. Saraswati J. Hubungan Pada Kalsium Air tanah dengan Tingkat Karies Siswa SDN Kemuning Lor 04 di Kecamatan Arjasa Kabupaten Jember. *Skripsi. Universitas Jember*. 2012; 32
4. Bruvo M, et al. Optimal Drinking Water Composition for Caries Control in Population. *J Dent Press*. 2008; 87(4):340-343. <https://doi.org/10.1177/154405910808700407>
5. Arvin, E et al. Caries Affected by Calcium and Fluoride in Drinking water and Family Income. *Journal of Water and Health*. 2018; 1-8.
6. Ferracane JL et al. Can Interaction of Materials with The Dentin-Pulp Complex Contribute to Dentin Regeneration? *Journal Odontology*. 2010; 98:2-14. <https://doi.org/10.1007/s10266-009-0116-5> PMID:20155502
7. Ardhiyanto HB. Karakterisasi Scaffold Hidroksiapatit dengan Berbagai Konsentrasi Porogen. *Executive Summary Penelitian Dosen Tahap II Universitas Jember*, 2016
8. Penelitian B. Riset kesehatan dasar. Jakarta: kementerian kesehatan RI. 2013.
9. Fitriyanti A, Susilowati A, Darjono UN. Perbedaan Pola Konsumsi Ikan dan Status Kesehatan Gigi dan Mulut pada Anak Usia Sekolah Dasar (7-12 th) di daerah Pesisir dan Non Pesisir Kabupaten Jepara Tahun 2012. *ODONTO: Dental Journal*. 2014; 1(1):6-10.
10. Notoatmodjo S. *Metodologi Penelitian Kesehatan*. Jakarta : PTRineka Cipta, 2012.
11. Sumiok et al. Gambaran Kadar Fluor Air Sumur dengan Karies Gigi Anak di Desa Boyongpante Dua. *Pharmacon*. 2015; 4(4):15.
12. Radiah et al. Gambaran Status Karies dan Pola Pemeliharaan Kesehatan Gigi dan Mulut pada Mahasiswa Asal Ternate di Manado. *Jurnal E Gigi*. 2013; 1(1):9.
13. *Water Stewardship Information Series*. 2007. Hardness in Groudwater. The British Columbia Groundwater Association. Diakses dari <http://www.rnd.bc.ca/cms/wpattachment/wpID2284atID3802.pdf>
14. Uriah LA, Hyeladi D, Krzysztof S. Fluoride in groundwater in Nigeria: Origin and human health impact. *American Journal of Environmental Protection*. 2014; 3(6-2):66-9.

15. Rukminasari M, et al. Pengaruh Derajat Keasaman (pH) Air Laut Terhadap Konsentrasi Kalsium dan Laju Pertumbuhan *Halimeda* sp. *Jurnal Ilmu Kelautan dan Perikanan*. 2014; 24(1):28.
16. Lombogia IA. Hubungan konsumsi air sumur di pesisir pantai dengan hiperkalsiuria pada anak di pesisir pantai maasing. *e-CliniC*. 2014; 2(1).
17. Magesh NS, Krishnakumar S, Chandrasekar N, Soundranayagam JP. Groundwater quality assessment using WQI and GIS techniques, Dindigul district, Tamil Nadu, India. *Arabian Journal of Geosciences*. 2013; 6(11):4179-89. <https://doi.org/10.1007/s12517-012-0673-8>
18. Magesh NS, Chandrasekar N. Evaluation of spatial variations in groundwater quality by WQI and GIS technique: a case study of Virudunagar District, Tamil Nadu, India. *Arabian journal of Geosciences*. 2013; 6(6):1883-98. <https://doi.org/10.1007/s12517-011-0496-z>
19. Notohartodjo, et al. Penilaian Indeks DMF-T Anak Usia 12 tahun oleh Dokter Gigi dan Bukan Dokter Gigi di Kabupaten Ketapang Propinsi Kalimantan Barat. *Media Litbangkes*. 2013; 23(1)
20. Al-Darwish, M., El Ansari, W., & Bener, A. Prevalence of dental caries among 12–14 year old children in Qatar. *The Saudi dental journal*. 2014; 26(3):115-125. <https://doi.org/10.1016/j.sdentj.2014.03.006> PMID:25057232 PMCID:PMC4095054
21. Ramadhan, A et al. Hubungan Tingkat Pengetahuan Kesehatan Gigi dan Mulut Terhadap Angka Karies Gigi di SMPN 1 Marabahan. *Dentino Journal*. 2016;1(2):124
22. Syahril, et al. Perbedaan Kekerasan Permukaan Gigi Akibat Lama Perendaman dengan Jus Jeruk (*Citrus sinensis*, Osb) Secara In Vitro. *Dentino*. 2016; 1(1):12
23. Ramayanti, et al. Peran Makanan Terhadap Kejadian Karies Gigi. *Jurnal Kesehatan Masyarakat Andalas*. 2013; 7(2):17
24. Sudarmo AP, Baskoro MS, Wiryawan B, Wiyono ES, Monintja DR. Social Economics Characteristics of Coastal Small-scale Fisheries in Tegal City, Indonesia. *International Journal of Scientific & Technology Research (IJSTR)*. 2015; 4(1):85-8.
25. Aryati, E et al. Manfaat Ikan Teri Segar (*Stolephorus* sp) Terhadap Pertumbuhan Tulang dan Gigi. *Odontodental Journal*. 2014; 1(2):54. <https://doi.org/10.30659/odj.1.2.52-56>
26. Umarani, P. dan Ramu, A. Fluoride Contamination Status of Groundwater in East Coastal Area In Tamilnadu, India. *India: International Journal of Innovative Research in Science Engineering and Technology*. 2014; 3(3).
27. Vani NV, Idris AM, Abuhaya AH, Jafer M, Almutari DA. Assessment of calcium, magnesium, and fluoride in bottled and natural drinking water from Jazan Province of Saudi Arabia and a brief review on their role in tooth remineralization. *Journal of International Oral Health*. 2016; 8(11):1012.
28. Vasavi N, Mishra A, Reddy K. Estimation and Comparison of Serum and Salivary Calcium Levels in Periodontitis Patients and Healthy Subjects: A Clinicobiochemical Study. *Journal of Periodontal Practice*. 2016; 1(1).
29. Neel EA, Aljabo A, Strange A, Ibrahim S, Coathup M, Young AM, Bozec L, Mudera V. Demineralization–remineralization dynamics in teeth and bone. *International journal of nanomedicine*. 2016; 11:4743. <https://doi.org/10.2147/IJN.S107624> PMID:27695330 PMCID:PMC5034904
30. Prashaanthi N, Gayathri R, Vishnupriya V. A study on association of salivary calcium and phosphate in oral health. *Journal of Pharmaceutical Sciences and Research*. 2016; 8(7):623.