

მაც გაიარეს კომპლექსური პაროდონტოლოგიური მკურნალობა და სტომატოლოგიური იმპლანტაცია. პაციენტები დაყოფილი იყო 3 ჯგუფად პაროდონტიტის სიმძიმის ხარისხის (I, II, III) და მკურნალობის მეთოდის გათვალისწინებით. განვითარების I სტადიის გენერალიზებული პაროდონტიტით ავადმყოფების, რომელთაც ჩაუტარდათ კბილების ერთეობიანი და მრავალეობიანი იმპლანტაცია და მიზნობრივი ოსტეოტროფული თარეპია, შემოთავაზებული ქირურგიული მეთოდით მკურნალობის შედეგების შეფასებამ 12 თვის შემდეგ გამოვლინდა ყველა იმპლანტის 100%-იანი შენარჩუნება. პაციენტებში II ხარისხის გენერალიზებული პაროდონტიტით, რომლებსაც ჩაუ-

ტარდა მკურნალობა და სტომატოლოგიური იმპლანტაცია ეტაპობრივად, იმპლანტების უსაფრთხოებამ შეადგინა 92.1%, პაციენტებში, რომლებმაც გაიარეს ერთსაფეხურიანი სტომატოლოგიური იმპლანტაცია, პაროდონტის ქირურგიული მკურნალობით, იმპლანტების უსაფრთხოებამ შეადგინა 89.4%. პაციენტებში გენერალიზებული პაროდონტიტის III ხარისხით, რომლებსაც ჩაუტარდა პაროდონტოლოგიური მკურნალობა და სტომატოლოგიური იმპლანტაცია, იმპლანტების უსაფრთხოებამ შეადგინა 80.2%, ხოლო პაციენტებში, რომლებსაც ჩაუტარდა პაროდონტის მკურნალობა და ერთსაფეხურიანი სტომატოლოგიური იმპლანტაცია - 51.7%.

ELEMENTAL CONTENT – GENERAL AND ORAL HEALTH OF CHILDREN

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In the last decade, there has been a significant increase in the interest in an in-depth study of macro and microelemental metabolism in the human body in normal as well as pathological conditions. A new area of biomedical research – microelementology is actively developing due to the fact that most macro and microelements are parts of biologically active substances and have an influence on them; since they are involved in most metabolic and immune processes, they determine the functionality of various organs and systems [1].

The widespread use of research and analysis of chemical elements in medical science and practice has received a great response, and a new direction has been created in the form of medical elementology, which is currently being intensively developed. The chemical and analytical basis of the latter is the determination (from macro to ultra-micro) of the content of chemical elements in the body in a wide range [12].

Over the past 50 years, a variety of data on the elemental composition of various biological tissues and fluids have been collected on the basis of international scientific studies which has made it possible to use various biological substrates as an indicator of assessing the state of health and functionality of an organism. These substrates are: blood, hair, nail, dental hard tissues, etc. [7]. The high priority among these biological materials is given to hair and dental hard tissues, since the hair is easy to assemble. The method is non-invasive, represents solid material and provides information about both the current and past status [9]. The high priority of dental hard tissues is due to the ability to fully determine the composition of chemical elements that remain throughout their existence.

It is noteworthy that children and adolescents are most sensitive to diseases caused by an imbalance in mineral metabolism. The high sensitivity of a growing organism is caused by the features of anatomical and physiological development, critical periods of the development of organs and systems, peculiarities of metabolic processes, the presence of a labile immune system, etc.

Above mentioned, it is very important to determine the composition of essential macro and microelements in the body, due to their imbalance, especially in childhood, causes various disorders and changes in both somatic and dental conditions.

The aim of the research was to determine the content of the essential macro and microelements in hair and dental hard tissues

and to study the possible effect of their imbalance both on the general and dental health of the child.

Material and methods. In order to evaluate the condition of dental hard tissues, we randomly examined 375 children from Batumi (Georgia) pre and public schools aged 3 to 12 years. They were split into three age groups: 108 preschoolers aged 3-6, 153 students aged 7-9 and 114 children aged 10-12. Besides, they were divided into a gender - 189 females and 186 males.

Monitoring of the examined children was conducted using standard indices provided by the World Health Organization. We defined the prevalence of caries (%) and its experience (dmft/DMFT). According to the dmft/DMFT score we pointed out three categories of the status of caries: mild caries (dmft/DMFT<6), moderate caries (dmft/DMFT: 6-9) and severe caries (dmft/DMFT >9). The children were examined with a disposable mouth mirrors and dental explorer probe. All dental examinations were conducted by one pediatric dentist and one assistant by the natural light in the medical room of the preschools, as well as public schools. The results of the survey were recorded in our survey cards. The Approval to conduct the study was received from the appropriate pre and public school authorities.

To determine the effect of the imbalance of macro and micro elements on somatic and dental diseases according to the caries status (mild and severe) 48 children aged 3-12 were chosen from the examined 375 children. For the purpose of the study children were divided into two groups - control group (15 children) with mild caries only with dmft/DMFT <2, and case group (33 children) with severe caries with dmft/DMFT >9. Hair samples and extracted teeth were used to evaluate elemental composition. The examination was conducted after the written forms of consent of all the participants' parents. The study was carried out in the period from June 2018 – June 2019. Ethical approval was obtained from the Bioethics Committee at the National Centre for Disease Control and Public Health, Tbilisi, Georgia (approval number #2018-032).

To assess the state of macro and microelement composition in the body, hair samples from the occipital area were used, and it amounted to 0.1-0.3 grams. We used X-ray fluorescent spectroscopy - MBW 081 / 12-4502-00 to study the qualitative and quantitative composition of chemical elements in the hair in accordance with the methodology of the International Atomic

Agency (hair washing method proposed by the international Atomic Energy Agency – IAEA 1978) [2]. The analysis was carried out using a new generation analyzer Elvax, energy dispersive x-ray fluorescent spectroscopy. Having prepared the hair under study, we evaluated instantaneous composition of essential macro- (Ca, K, S, Cl) and microelements (Zn, Fe, Cu, Se, Mn, Cr, Br, Co, Ag, V, Ni, Rb, Mo, Sr, Ti).

Ascertainment of essential macro(Ca) and microelements (Fe, Cu, Rb, Zn, Ni, Mn, Sr) in dental enamel and dentin was conducted using the same method - x-ray fluorescent spectroscopy.

General health status was assessed on the basis of the examined children's medical cards which were provided by the pediatrician.

The obtained data were statistically processed and analyzed using the Statistical Package for Social Sciences (SPSS), version 21 (IBM SPSS statistics for Windows, version 21.0/99 Armonk, NY :IBM Corp.

Results and discussion. Our research into dental caries among the examined 375 children revealed that the prevalence and experience of dental caries in all age groups and gender was high. Assessment of caries experience (dmft/DMFT) among the caries indices (decayed, missing and filled teeth) showed the number of caries decayed teeth had the highest component with

girls as well as boys. The average value of carious teeth was 5.29 ± 4.3 and of filled teeth was 0.56 ± 1.64 . The median index of caries experience was 5 (Interquartile Range [IQR] 3; 8; minimum 0, maximum 23). Caries experience was of no significant difference according to sex. The average age for the female participants was 8.3, for the males was 7.5 - the difference was statistically significant. The prevalence of caries among the examined children according to gender was not statistically significant, but the prevalence of caries in age groups was statistically significant (Pearson Chi-Square 14.2; df -2; $p=0.001$). The following figures were recorded: a mild caries among the examined 375 children - 34.9% (131), a moderate caries - 21.6% (81) and a severe caries - 43.5% (163). These results indicate a low level of dental awareness, neglect of prevention programs and timely treatment in Batumi, Georgia.

As already mentioned, the determination of essential chemical macro and microelements in dental hard tissues and hair plays an important role in monitoring human health and assessing the risks of developing dental diseases; The composition of the essential macro and microelements in these substrates gives us a complete picture of the metabolic processes and the quality of the mineral composition in the human body [12].

Table 1. Macro and microelements composition in hair according to the caries status ($p < 0.05$)

Caries status	Microelements	Mean	Std.Deviation
Mild caries	Ca	374.0325	121.02241
	Zn	135.8673	29.22045
	K	105.7973	54.55677
	Fe	20.3238	7.71902
	Cu	10.2538	2.58727
	Se	.3744	.18518
	Mn	.8706	.41023
	Cr	2.8594	1.45265
	S	26631.6556	8436.52958
	Br	3.7206	2.86052
	Cl	393.3237	282.54857
	Co	.4163	.43613
	Ag	.1081	.14419
	V	.1094	.12369
	Ni	.5744	.46302
	Rb	.8619	.72026
	Mo	.1119	.12227
Sr	1.1331	.76738	
Ti	.7444	.93381	
Severe caries	Ca	315.3223	83.18693
	Zn	122.2142	44.61694
	K	121.8252	229.82116
	Fe	18.1444	5.16935
	Cu	11.3313	5.33033
	Se	.3197	.19400
	Mn	.7069	.39261
	Cr	2.5616	2.18547
	S	22423.8450	8820.54410
	Br	3.9578	3.68068
	Cl	360.9722	330.94807
	Co	.4178	.31746
	Ag	.2231	.32320
	V	.1009	.15932
	Ni	.7813	.64435
	Rb	.9141	.81006
	Mo	.1441	.11717
Sr	1.3053	95393	
Ti	.9222	1.32894	

For the purpose of the study, was carried out spectral analysis of hair and dental hard tissues in 48 children aged 3-12 to determine general and dental health. 4 macro (Ca, K, S, Cl) and 15 microelements (Zn, Fe, Cu, Se, Mn, Cr, Br, Co, Ag, V, Rb, Mo, Sr, Ti) were investigated in hair (Table 1).

As it can be seen from table 2, among the examined children the average composition of Ca, Zn and Fe in the hair was the lower limit of the norm according to spectral analy-

sis but the content of these elements was even lower among those children who suffered from a severe caries. Therefore, we think that this has resulted in the demineralization of the dental hard tissues (Fig.).

The comparative analysis of the quality of dental experience and composition of chemical elements in dental hard tissues showed a statistically significant difference depending on the caries status (Table 2).

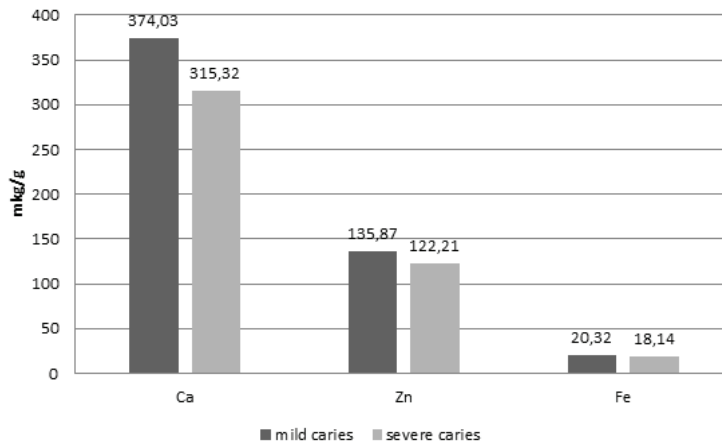


Fig. Composition of Ca, Zn and Fe in hair according to the status of caries

Table 2. The composition of macro and microelements in dental hard tissues according to the caries status ($p < 0.05$)

Caries status	Microelements	Mean	Std.Deviation
Mild caries	Rb	0.5150	0.33847
	Ca	278901.2800	54351.25500
	Zn	131.0887	21.75224
	Ni	1.0887	1.28259
	Mn	8.8412	4.97925
	Fe	60.7088	39.58241
	Sr	81.9750	26.02221
Severe caries	Rb	0.5040	0.25277
	Ca	243737.9094	28075.56138
	Zn	105.22	100.12950
	Ni	0.8387	0.53436
	Mn	7.9937	4.54674
	Fe	53.4182	43.35722
	Sr	86.0791	27.91277

Currently, the insufficient amount of essential macro and microelements and their imbalanced use is a constant negative factor influencing the health, development, organs and systemogenesis of all age groups in many countries of the world [14]. First and foremost, it affects health, physical and mental development of the growing generation [16,18]. The mentioned factor has also been identified in our studies and certain health problems were found in children with important macro and microelement deficiency, namely, calcium, since calcium is the main component of the bones and dental hard tissues [19]. Although calcium is presented in other tissues and cells in small quantities, unlike calcified tissues, it plays an important role in vital processes - it is involved in blood coagulation, transmission of nerve impulses, muscle functioning, and also stimulates the production of hormones in the body.

According to our data, it was found out that in children with calcium deficiency (in hair and dental hard tissues), bone mineralization disorder (52%) and weakening of the immunity (72%) which led to frequent morbidity.

It should be emphasized that iron is an important element in the human body. It plays a major role in many metabolic processes, especially, in redox reactions, immune processes and DNA synthesis. Iron also participates in the development of the central neurological system, autoimmune system, endocrine system and cardiovascular system [6]. It is a main component of hemoglobin and myoglobin. Accordingly, iron deficiency is the most widespread nutritional and health problem all over the world and infants and young children are in the highest risk group, because of their rapid growth. Iron deficiency negatively affects the physical and mental development of the child and the immune system, increases the risk of behavioral disturbances, leads to dysfunction of the salivary glands and reduces buffering activity and causes anemia [10].

Our studies found that in the case of iron deficiency, 35% of children had anemia, 16% iron deficiency anemia, 29% had dizziness, poor physical growth, weak immune system and in fewer cases in young children there was psychomotor developmental delay, stubbornness, and nail brittleness.

It should be pointed out that Iron has a cariostatic effect [5]. This can be proved by several studies, among them a survey done by Koppal et al suggest that iron deficiency and ECC are definitely interconnected [11]. The study conducted by Abdallah et al., showed that children with lower hemoglobin levels had significantly high dmft index [3]. Our study also supported these findings. In our survey, there was a negative correlation between dmft/DMFT index and iron concentration in dental hard tissues (Spearman's rho -0.623; $p < 0.001$), which denotes that children with iron deficiency had significantly high dmft/DMFT index.

Zinc is an essential trace element for the functioning of the human body [17]. It plays an important role in the development of the immune system, formation of mineral tissues [15] (bone, dental hard tissue), participating in RNA, DNA and proteins synthesis, and it is also involved in the activation of the enzyme system and metabolic processes.

Our study revealed that the examined children, who had a minimal or deficient composition of zinc in the studied substrates, were characterized by frequent catarrh of the upper respiratory tract, some with viral diseases, growth retardation or lack of appetite and the rest of them had brittle nails. This was caused by the weak immune system.

It is known that zinc is an important in the maintenance of oral health [8]. There are several studies on the benefits of zinc. A study of Mohammed NR et al., proved that zinc reduces enamel demineralization [13]. In the study conducted by Atasoy revealed the relationship between Zinc deficiency and children's oral health [4]. Whereas the of results our study showed a negative correlation between caries experience and zinc concentration in dental hard tissue (Spearman's rho -0.407; $p = 0.031$), which means that in cases of minimal or deficiency of zinc, children had high dmft/DMFT index.

Conclusion. The research of the essential macro and microelements in the hair and dental hard tissues showed a high coefficient of correlation between the mineralization of dental hard tissues as well as the general health of the growing body.

REFERENCES

1. Aliasgharpour Mehri. Trace Elements in Human Nutrition (II) – An Update. *Int J Prev Med.* 2020; 11: 2.
2. Anatoly V Skalny, Natalia V Simashkova, Tatiana P Klyushnik, Andrei R Grabeklis Geir Bjørklund, Margarita G Skalnaya, Alexandr A Nikonov, Alexey A Tinkov. Hair toxic and essential trace elements in children with autism spectrum disorder. *Metab Brain Dis.* 2017 Feb;32(1):195-202. doi: 10.1007/s11011-016-9899-6. Epub 2016 Aug 31.
3. Abdallah MA, Abed HH, Hamza G, Alsahafi EN. The association between dmft index and haemoglobin levels in 3-6 year-old Saudi children with anaemia: A cross sectional study. *J Taibah Univ Med Sci.* 2016; 11(1): 72-6.
4. Atasoy HB, Ulusoy ZIA. The relationship between Zinc deficiency and children's oral health. *Pediatric Dentistry.* 2012; 34(5): 383-386.
5. Babu NSV, Bhanushali PV. Evaluation and association of serum iron and ferritin levels in children with dental caries. *Journal of Indian Society of Pedodontics and Preventive Dentistry.* 2017; 35(2): 106-109
6. Clara Camaschella. Iron deficiency. *Blood.* 2019 Jan 3; 133(1):30-39. doi: 10.1182/blood-2018-05-815944. Epub 2018 Nov 6.
7. Ewelina P. Dutkiewicz, Pawel L. Urban. Quantitative mass

spectrometry of unconventional human biological matrices. *Philos Trans a Math Phys Eng Sci.* 2016 Oct 28; 374(2079): 20150380.

8. Fatima T, Rahim ZBHA, Lin CW, Qamar Z. Zinc: A precious trace element for oral health care? *J PMA.* 2016; 66(8):1019-1023.
9. Joanna Fiłon, Jolanta Ustymowicz-Farbiszewska, Elżbieta Krajewska-Kułak. Analysis of lead, arsenic and calcium content in the hair of children with autism spectrum disorder. *BMC Public Health.* 2020 Mar 23; 20(1):383. doi: 10.1186/s12889-020-08496-w.
10. Jenalee R. Doom, Blair Richards, Gabriela Caballero, Jorge Delva, Sheila Gahagan, Betsy Lozoff. Infant Iron Deficiency and Iron Supplementation Predict Adolescent Internalizing, Externalizing, and Social Problems. *The Journal of Pediatrics.* April 2018; Volume 195, Pages 199-205.e2.
11. Koppal PI, Sakri MR, Akkareddy B, Hinduja DM et al. Iron deficiency in young children: A Risk Marker for Early Childhood Caries. *Int J Clin Pediatr Den,* 2013; 6(1):1-6.
12. Lingamaneni Prashanth, Kiran Kumar Kattapagari, Ravi Teja Chitturi, Venkat Ramana Reddy Baddam, Lingamaneni Krishna Prasad. A review on role of essential trace elements in health and disease. *Journal of Dr. NTR University of Health Sciences* 2015; 75-85
13. Mohammed NR, Mneimne M, Hill RG, Al-Jawad M, Lynch RJM. Physical chemical effects of zinc on vitro enamel demineralization. *Journal of dentistry.* 2014; 42(9): 1096-1104.
14. Regal L, Bailey et al. The epidemiology of global micronutrient deficiencies. *Ann Nutr Metab,* 2015; 66(suppl 2):22-23.
15. Scott A Read, Stephanie Obeid, Chantelle Ahlenstiel, Golo Ahlenstiel. The Role of Zinc in Antiviral Immunity. *Adv Nutr.* 2019 Jul 1; 10(4):696-710. doi: 10.1093/advances/nmz013.
16. Shane Michael Heffernan, Katy Horner, Giuseppe De Vito, Gillian Eileen Conway. The Role of Mineral and Trace Element Supplementation in Exercise and Athletic Performance: A Systematic Review. *Nutrients.* 2019 Mar 24; 11(3):696.
17. Youichi Ogawa, Tatsuyoshi Kawamura, Shinji Shimada. Zinc and skin biology. *Archives of Biochemistry and Biophysics.* December 2016; Volume 611, Pages 113-119.
18. Zhai R, Zhang M, Liu J et al. Reference intervals of and relationships among essential trace elements in whole blood of children aged 0-14 years. *Journal of Clinical Laboratory Analysis.* 2017; 31(2).
19. Zeeshan Qamar 1, Zubaidah Binti Haji Abdul Rahim 2, Hooi Pin Chew 3, Tayyaba Fatima. Influence of trace elements on dental enamel properties: A review. *J Pak Med Assoc.* 2017 Jan; 67(1):116-120.

SUMMARY

ELEMENTAL CONTENT – GENERAL AND ORAL HEALTH OF CHILDREN

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Aim of study - to determine the composition of the essential macro and microelements in the hair and dental hard tissues and to study the influence of their imbalance on the general and dental health of the child.

To assess the state of dental hard tissues, 375 children aged 3 to 12 years were randomly examined in Batumi. Monitoring of the examined children was carried out using standard indices provided by the World Health Organization. To determine the composition of the chemical elements in hair and dental hard tissues, according to the caries status 48 children were chosen from the examined 375 children. We used X-ray fluorescent spectroscopy method to study the qualitative and quantitative content of the chemical elements in the hair and dental hard tissues. The comparative analysis of the dental experience (dmft/DMFT) and the composition of chemical elements in dental hard tissues showed a statistically significant difference depending on caries status. The effect of some essential elements on the general health of the child has also been identified.

The study into the composition of the essential macro and microelements in the hair and dental hard tissues revealed a high coefficient of correlation both with the mineralization of dental hard tissues and with the general health of the growing body.

Keywords: essential microelements, dental hard tissue, hair, children, caries.

РЕЗЮМЕ

ЭЛЕМЕНТНЫЙ СОСТАВ – ОБЩЕЕ И СТОМАТОЛОГИЧЕСКОЕ ЗДОРОВЬЕ ДЕТЕЙ

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Целью исследования явилось определение содержания эссенциальных макро- и микроэлементов в стержне волос и твердых тканях зубов и возможное влияние их дисбаланса на общее и стоматологическое здоровье детей.

На первом этапе с целью оценки состояния твердых тканей зуба исследованы 375 детей и подростков в возрасте от 3 до 12 лет, проживающих в г. Батуми. Исследование проводилось с использованием стандартных показателей, предоставленных ВОЗ (распространенность и интенсивность кариеса). На втором этапе для определения содержания химических элементов в стержне волос и твердых тканях зубов обследовано 47 детей. Использована рентгенофлуоресцентная спектроскопия для качественного и количественного исследования содержания химических элементов.

Сравнительный анализ степени выраженности кариеса и состава химических элементов в твердых тканях зубов показал статистически значимую разницу в компенсации кариеса. Выявлено влияние некоторых эссенциальных эле-

ментов на общее состояние здоровья детей. Исследование содержания эссенциальных макро- и микроэлементов в стержнях волос и твердых тканях зубов показало высокий коэффициент корреляции как с минерализацией твердых тканей зуба, так и с общим состоянием здоровья растущего организма.

რეზიუმე

ელემენტური შემადგენლობა – ბავშვთა ზოგადი და პირის ღრუს ჯანმრთელობა

მ.ბერიძე, თ.შიშნიაშვილი, ს.ფუტურიძე, მ.კალანდაძე, ვ.მარგველაშვილი

თბილისის სახელმწიფო სამედიცინო უნივერსიტეტი; ივ. ჯავახიშვილის სახ. თბილისის სახელმწიფო უნივერსიტეტი, საქართველო

კვლევის მიზანს წარმოადგენდა ესენციურ მაკრო- და მიკროელემენტთა შემცველობის განსაზღვრა თმის ღერსა და კბილის მაგარ ქსოვილებში და მათი დისბალანსის შესაძლო გავლენის შესწავლა ბავშვების ზოგად და სტომატოლოგიურ ჯანმრთელობაზე.

პირველ ეტაპზე კბილის მაგარ ქსოვილთა მდგომარეობის შესაფასებლად გამოკვლეული იყო ქ. ბათუმში მცხოვრები 375 ბავშვი და მოზარდი 3-დან 12 წლის ასაკში. გამოკვლეულთა დათვალიერება ჩატარდა მსოფლიო ჯანდაცვის ორგანიზაციის მიერ მოწოდებული სტანდარტული ინდექსების გამოყენებით (კბილის კარიესის გავრცელება და ინტენსივობა). მეორე ეტაპზე თმისა და კბილის მაგარ ქსოვილებში ქიმიურ ელემენტთა შემცველობის დასადგენად გამოკვლეულია 47 ბავშვი, რომელიც შერჩეული იყო გამოკვლეული 375 ბავშვიდან. ქიმიურ ელემენტთა შემცველობის თვისობრივი და რაოდენობრივი კვლევისთვის გამოყენებული იყო რენტგენოფლუორესცენტული სპექტროსკოპია.

კბილის კარიესის ინტენსივობის ხარისხსა და კბილის მაგარ ქსოვილებში ქიმიურ ელემენტთა შემადგენლობის შედარებითმა ანალიზმა გამოავლინა სტატისტიკურად სარწმუნო განსხვავება კარიესის კომპენსაციის მიხედვით. ასევე დადგენილია გარკვეულ ესენციურ ელემენტთა გავლენა ბავშვის ზოგად ჯანმრთელობაზე.

თმის ღერსა და კბილის მაგარ ქსოვილებში ესენციურ მაკრო- და მიკროელემენტთა შემცველობის შესწავლამ გამოავლინა მაღალი კორელაციის კოეფიციენტი კბილის მაგარ ქსოვილთა მინერალიზაციასთან და მოზარდი ორგანიზმის ზოგად ჯანმრთელობასთან.