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Condition of mineralized tooth tissues of inhabitants of Szackie Lake District (Ukraine) regarding silver content and selected macro-elements in drinking water and soil

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Abstract

Introduction and objective. The aim of the study is to evaluate the mineralization tooth tissues in the inhabitants of Melniki village Szackie, Lake District, Ukraine, with regard to silver content and chosen macro-elements in the soil, tap water, and the water in Pisoczno Lake located in the vicinity of village.

Materials and method. The macro-elements, silver ions contained in the lake, tap water and soil were examined. 125 people aged 12–73, indigenous inhabitants of Melniki village, were qualified for dental examinations. The research took into account the distance between the place of residence and Pisoczno Lake as a source of silver ions, dividing the examined patients into 2 groups: A) living at a distance less than 2,500 m from the lake, and B) living at a distance more than 2.500 m from the lake.

Results. In area A, significantly higher contents of phosphorus and potassium were detected, while in the soil of area B there was more Ca and Mg with 3 times higher number of Mg ions. A high concentration of Ag ions was observed in both Pisoczno Lake and tap water. The severity of caries expressed by D3MFT number was 4.18 in the group aged 12–16 living in area A, and 4.24 for the inhabitants of area B. The mean value of D3MFT for the group aged 32- 45 living in area A equalled 21.58, while for area B it was 21.19. The severity of caries expressed by the mean D3MFT value in the examined group of 46–73-year-olds was 24.60 for area A, and 23.80 for area B. The observed differences were not statistically significant.

Conclusions. The high value of D3MFT recorded in the inhabitants of Melniki village indicates the poor condition of mineralized tooth tissues. The fact that the contents of macro-elements in the soil and drinking water increased, together with the distance from the Pisoczno Lake shoreline, did not affect the oral health of the indigenous inhabitants. No impact of silver ions contained in the lake and tap water on the condition of mineralized tooth tissue was detected in the examined group of inhabitants of Szackie Lake District.

Key words

D3MFT, rural inhabitants, mineralized tooth tissues, macro-elements

INTRODUCTION

Chemical elements take part in biological, geological and chemical circulation. Biological circulation describes the flow of elements in the trophic chain where water is usually its first link, followed by soil, plants, and finally humans. The transfer of elements and chemical compounds to a further link is caused by increased concentration of these elements in a given link. The role of chemical compounds in living organisms is connected with the function of enzymatic chains in the oxidation and reduction processes, protein metabolic processes and ion transportation within cells and organs. Salts of the elements accumulate in the body in 3 different places: the fast exchanging pool (blood and parenchyma); the medium-speed exchanging pool (muscles and skin), and the slowly exchanging pool (bones and teeth) [1]. These elements, which are also minerals, constitute about 4% of the body mass of an adult person. They can be divided into 2 groups with respect to their content in the body and their human daily requirements. Calcium, phosphorus, magnesium, potassium and sulphur are the macro-elements which constitute more than 0.01% with daily requirement of 100 mg/person. Microelements, also known as trace elements, constitute less than 0.01% with daily requirement below 100 mg/person. This group comprises iron, zinc, copper, manganese, fluorine, iodine, selenium and chromium. Ultra-trace elements are those which can be found in micro-gram amounts e.g. cobalt, molybdenum, nickel and vanadium. Macro-elements like calcium, magnesium, potassium and phosphorus make up the main component of mineralized tooth tissues. They take part in the synthesis of nucleic acids and proteins and help maintain acid- base balance and increase permeability of cell membranes [2, 3].

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Silver is the sole element supplied daily through breathing, drinking water and eating food. It has been concluded that 98–99% of this silver is voided from the body on the next day, while the remaining 1–2% accumulates in the human body. Heavy metals (silver is one of them) in high concentrations tend to inhibit the metabolic activity of microorganisms. Antibacterial activity of silver results from its reactions with thiol groups of the bacterium cell wall, increased permeability of the cell membrane, disturbances in ion management and the destructive action on DNA. Antibacterial activity of silver on Streptococcus, Pseudomonas and Escherichia bacteria strains has been well documented [4–8]. Minerals, which are present in drinking water and vegetables, and indirectly in the soil, ensure proper metabolism and have prophylactic activity against many diseases including masticatory system diseases. However, this only becomes possible when the content of one of the minerals in water or vegetables reaches a level beneficial for physiological and nutritive activity, although none of the minerals cross the critical line leading to disturbances in mineral management [9].

OBJECTIVE

The aim of the study is to evaluate teeth tissue mineralization of the inhabitants of Melniki village with regard to silver content and chosen macro-elements in the soil, tap water, and the water in Pisoczno Lake (Ukraine).

MATERIALS AND METHOD

The research was conducted in Melniki village, situated in the north-west part of Volyn Province in the Szackie Lake District of the Ukraine. The Lake District comprises 30 lakes, of which Pisoczno Lake is the sixth biggest with an area of 1.86 km. According to Domańska-Sienkiewicz, the water in the lake has a high concentration of silver ions [10].

The village of Melniki, is situated to the south-east of the lake with 1,192 inhabitants living on the area of 18 km.[2] The research area was divided into 2 parts. The distance from Lake Pisoczno shoreline was the criterion for the division. The areas were marked as A and B and their distance from the lake in a straight line was less than 2,500 m and more than 2,500 m, respectively.

Soil analysis. More than 16 farms (8 in each area) were tested for soil composition. Soil samples were taken for the analysis from gardens adjacent to houses, and which that had not been chemically fertilized previously, and manure fertilization scarcely applied. The samples were collected from the depth of 0–20 cm (arable layer) and each sample was composed of 5 single, randomly chosen samples. The soil, which was collected into one container with the Egner-Riehm soil sampler, was then mixed together. 0.5 kg of such material was separated into a paper bag, which constituted the representative sample for a given plot. The soil was then dried and sieved through sieve with 2 mm wide holes. The contents of $N\text{-}NH_4$, $N\text{-}NO_3$, P, K, Ca, Mg were determined in the extract of 0.03 M of acetic acid with, activated charcoal addition with soil to solution ratio 1:10; ammonium nitrogen and nitrate nitrogen were determined with Bremner's microdistillation method modified by Starck, while phosphorus colourimetrically with ammonium-vanadium-molybdate (Nicolet Evolution 300) and K, Ca, and Mg by AAS (Perkin-Elmer, AAnalyst 300)

Water analysis. Water was collected from the water-supply system into plastic containers of $1 dm^3$ cubic content, which were filled 3–4 minutes after opening the tap until they were overfilled in order to minimize the risk of creating air bubbles. Water samples from Pisoczno Lake were collected from the depth of 20–50 cm below the water surface ($1\ dm^3$) into glass bottles fitted with ground glass stoppers (PN-74C04620/00/02/03). Nitrate nitrogen was determined for both the lake and tap water with Bremner's microdistillation method, modified by Starck, while phosphorus was determined colourimetrically with ammonium vanadium molybdate and sulphur with barium chloride (Thermo, Evolution 300). K, Ca and Mg were determined by atomic absorption spectrophotometry AAS (Analyst 300 Perkin Elmer). Silver in the water was estimated with ICP-MS method in compliance with PN-EN ISO 17294–2:2006 standard.

Dental examination. Clinical tests were conducted by the light of a dentistry lamp and using diagnostic tools, and the data collected in anonymous sheets/medical files denoted by code numbers according to particular areas. Clinical evaluation of oral health of the examined people was performed in compliance with the WHO recommendations and criteria. (Oral health survey: basic methods, 5th edition, 2013). The personnel responsible for conducting dental examinations underwent the training on the calibration process and for each of its members the error value was determined. The concordance coefficient of clinical tests results- kappa according to Cohen was 0.97.The field examinations were conducted by two dentists in a team. Credibility of evaluations was verified by performing double tests on 10% of the random sample. Clinical examinations were performed in standardized conditions, using disposable dentistry sets and maintaining sterility and non-invasive methods. The venues for conducting examinations were chosen by school headmasters and prepared and secured by the research team with the use of disposable auxiliary materials (napkins, coats, gloves, masks, disinfectants). 125 people aged 12–73, indigenous inhabitants of Melniki village, were qualified for examinations. O these, 55 were aged 12–16, 40 were aged 32–45 and 30 aged 46–73. There were 56 women and 69 men. The research took into account the distance between the place of residence and Pisoczno Lake, dividing the examined patients into 2 groups: group A comprised of 52 people (23 women, 29 men) living within 100–2,500 m from the shoreline; group B comprised of 73 people (33 women, 40 men) living over 2,500 m from the shoreline (Tab. 1).

Table 1. Number and percent of Melniki inhabitants with regard to age and distance to the lake

Age in years	Group A No. and percent of the examined		Group B No. and percent of the examined		Total No. and percent of the examined	
	n	%	n	%	n	%
12–16	34	61.82	21	38.18	55	100
32–45	24	60	16	40	40	100
46–73	15	50	15	50	30	100
Total	73	58.4	52	41.6	125	100

RESULTS

The conducted research indicates a considerable differentiation between the chemical composition of the soil of the collected samples dependent on the distance from the determining plant nutrition. In both excessive and deficient amounts it not only decreases yield, but also leads to disturbances in chemical balance and lowers the quality of food plants [11]. In the tested samples, more $N\text{-}NH_4$ was found in the soil of area A than B. However, the opposite dependence was noted for $N\text{-}NO_3$. Trace amounts of ammonia ions were determined in the Pisoczno Lake water and tap water, whereas there were more nitrate ions in the samples collected from area A (differences not statistically significant). The content of mineral nitrogen in the soil below 70 $mg\cdot dm^{-3}$ is insufficient for most plants, while over 200 $mg\cdot dm^{-3}$ is excessive [12]. The quality of plant yield is influenced not only by soil and water nitrogen, but also by the content of other macro-elements. Depending on the cultivated species, the optimal phosphorus content in the soil should range from 40–80 mg $P\cdot dm^{-3}$ and 125–250 mg $K\cdot dm^{-3}$ for potassium [12]. In area A, significantly higher contents of phosphorus and potassium were detected, while in the soil of area B there was more Ca and Mg with a 3 times higher number of Mg ions. The content of potassium and phosphorus ions in both the lake and tap water was vestigial, although the contents of calcium and magnesium were twice as high in the tap water than in the lake water. Interestingly enough, a high concentration of Ag ions was observed in both Pisoczno Lake and tap water. The concentration of silver ions in the lake water was 2.19 mg $Ag\cdot dm^{-3}$, whereas in the tap water it was 1.92 mg $Ag\cdot dm^{-3}$ in the areas situated closer to the lake, and 1.93 mg $Ag\cdot dm^{-3}$ in the areas situated farther from the lake. For areas both A and B, the differences in contents of silver ions and macro-elements in tap water were not statistically significant ($p \geq 0.05$) (Tab.2, Tab. 3).

The prevalence of caries among the examined inhabitants of Melniki village in the group of 12–16-year-olds was 85.45% lower among children living in area A (82.35%), and higher among children living in area B (90.47%). In other age groups, a 100% frequency of caries was noted, regardless the place of residence. The severity of caries expressed by D3MFT number was 4.18 in the group aged 12–16 living in area A, and 4.24 for the inhabitants of area B. In the examined group, the dwellers of area A had a lower mean value of component D3T (1.94) and a higher mean value of component FT (2.21), in comparison to the dwellers of area B where the values were D3T=2.71, FT=1.52. The differences were not statistically

Table 2. Contents of N-min, phosphorus, potassium, calcium and magnesium ($mg\cdot dm^{-3}$) in the soil in Melniki

Analysed variable	Area	N	M	Me	Min	Max	Q1	Q3	SD	U	p
$N\text{-}NH_4$	A	8	39.55	33.40	22.80	71.40	26.95	50.75	16.95	22.0	0.328
	B	8	29.94	26.60	17.50	51.10	21.75	37.10	11.28		
$N\text{-}NO_3$	A	8	34.30	34.30	23.10	44.10	28.00	41.30	7.74	23.0	0.382
	B	8	41.56	40.25	17.50	64.40	26.95	58.10	18.01		
P	A	8	77.25	78.50	30.00	121.00	35.00	120.00	46.01	27.0	0.645
	B	8	75.63	76.00	30.00	121.00	31.00	120.00	47.71		
K	A	8	152.39	130.10	8.90	331.40	68.95	240.35	120.98	24.0	0.442
	B	8	151.89	181.50	28.20	237.00	95.45	198.00	78.80		
Ca	A	8	304.29	365.95	39.20	462.00	202.05	398.55	163.21	14.0	0.065
	B	8	404.86	457.50	143.70	573.30	279.20	524.25	168.63		
Mg	A	8	52.15	48.85	3.00	103.50	6.05	100.45	49.74	10.0	0.021
	B	8	151.41	150.15	73.84	228.90	89.46	214.65	66.31		

N – number of cases; M – mean; Me – median; Min – minimum value; Max – maximum value; SD – standard deviation; U – U Mann Whitney test result; p – statistical significance; A,B – examined areas.

Table 3. Contents of N-min, calcium, magnesium ($mg\cdot dm^{-3}$) and silver (µg·kg) in Pisoczno Lake and drinking water

Analysed variable	area	N	M	Me	Min	Max	Q1	Q3	SD	F	p
$N\text{-}NO_3$	lake	4	20.87	20.93	19.89	21.73	20.30	21.44	0.78	256.37	<0.001 (L-A, L-B) $p \geq 0.05$ (A-B)
	A	4	30.83	30.83	30.81	30.86	30.82	30.85	0.02		
	B	4	30.56	30.38	29.67	31.80	29.83	31.29	0.95		
Ca	lake	4	10.51	10.52	10.50	10.52	10.51	10.52	0.01	709.98	<0.001 (L-A, L-B) $p \geq 0.05$ (A-B)
	A	4	24.13	24.39	23.09	24.64	23.62	24.64	0.73		
	B	4	24.80	24.72	24.15	25.60	24.16	25.44	0.75		
Mg	lake	4	0.38	0.38	0.38	0.39	0.38	0.39	0.01	44.79	<0.001 (L-A, L-B) $p \geq 0.05$ (A-B)
	A	4	0.75	0.75	0.73	0.76	0.74	0.76	0.01		
	B	4	0.70	0.72	0.57	0.79	0.62	0.78	0.10		
Ag	lake	4	2.19	2.19	2.18	2.20	2.19	2.20	0.01	399.14	<0.001 (L-A, L-B) $p \geq 0.05$ (A-B)
	A	4	1.92	1.92	1.90	1.93	1.91	1.93	0.01		
	B	4	1.93	1.93	1.90	1.95	1.91	1.95	0.02		

N – number of cases; M – mean; Me – median; Min – minimum value; Max – maximum value; Q1 – bottom quartile; Q3 – upper quartile; SD – standard deviation; F – variance analysis ANOVA (with test NIR); p – statistical significance; L – lake; A,B – examined areas significant. Mean values of D3MFT and its components D3T, MT, FT for the group aged 12–16 are presented in Table 4.

The mean value of D3MFT for the group aged 32- 45 living in area A equalled 21.58 while for area B it was 21.19. Differences in the mean FT value between the dwellers of area A (10.04) and B area (9.13) were not statistically significant, and similar to the differences between the mean number of teeth with caries (D3T) and extracted teeth (MT). The data concerning the mean value D3MFT and its components D3T, MT, FT for the examined group aged 32–45, with regard to the distance between the place of residence and the shoreline, are presented in Table 5.

The severity of caries expressed by the mean D3MT value in the examined group of the 46–73-year-olds was 24.60 for area A and 23.80 for area B. Of note is the high value of the mean MT for the inhabitants of both area A – 15.60 and B -15.47 (difference not statistically significant). The difference between mean values of D3T (area A – 0.80, area B – 4.47) was close to statistical significance. More fillings were observed in people living closer to the lake (FT = 8.20), when compared to the average number of fillings in people living farther to the lake (FT = 4.00). The differences were close to significance (p = 0.056). Mean values of D3MFT and its components D3T, MT, FT in the group aged 46–73 are presented in Table 6.

DISCUSSION

Soil analysis for macro-element contents in Melnik in the presented study recorded levels of potassium, phosphorus,

Table 4. Mean values of D3MFT and its components D3T, MT, FT for the examined group aged 12–16 regarding distance between place of residence and shoreline

Analysed variable	Area	N	M	Me	Min	Max	Q1	Q3	SD	Z	p
D3T	A	34	1.94	1	0	14	0	3	2.78	-1.751	0.080
	B	21	2.71	2	0	9	1	5	2.31		
MT	A	34	0.03	0	0	1	0	0	0.17	0.748	0.454
	B	21	0.00	0	0	0	0	0	0.00		
FT	A	34	2.21	1.5	0	8	0	4	2.42	0.598	0.550
	B	21	1.52	1	0	4	0	3	1.47		
D3MFT	A	34	4.18	4	0	17	2	7	3.65	-0.471	0.638
	B	21	4.24	4	0	10	2	6	2.68		

N – number of cases; M – mean; Me – median; Min – minimum value; Max – maximum value;
Q1 – bottom quartile; Q3 – upper quartile; SD – standard deviation; Z – U Mann Whitney test result; p – statistical significance.

Table 5. Mean value of D3MFT and its components D3T, MT, FT for the examined group aged 32–45 regarding distance between place of residence and shoreline

Analysed variable	Area	N	M	Me	Min	Max	Q1	Q3	SD	U	p
D3T	A	24	5.50	3.5	0	16	0.5	11	5.52	182.0	0.795
	B	16	5.25	3	1	18	2.5	7.5	4.60		
MT	A	24	6.04	5.5	0	26	2.5	7	5.62	180.5	0.754
	B	16	6.81	5.5	1	23	2.5	9.5	6.06		
FT	A	24	10.04	8.5	1	23	3.5	17	7.80	186.5	0.881
	B	16	9.13	10	0	18	6	13	5.20		
D3MFT	A	24	21.58	20	12	32	17	27	6.13	187.5	0.902
	B	16	21.19	21	10	29	18.5	24	4.59		

N – number of cases; M – mean; Me – median; Min – minimum value; Max –maximum value; Q1 – bottom quartile; Q3 – upper quartile; SD – standard deviation; U – U Mann Whitney test result; p – statistical significance. 1 – bottom quartile; Q3 – upper quartile; SD – standard deviation; U -U Mann Whitney test results; p – statistical significance.

Table 6. Mean values of D3MFT and its components D3T, MT, FT in the examined group of people aged 46–73 regarding distance between place of residence and distance to shoreline

Analysed variable	Area	N	M	Me	Min	Max	Q1	Q3	SD	U	p
D3T	A	15	0.80	0	0	2	0	2	0.94	67.0	0.061
	B	15	4.47	2	0	15	0	6	5.41		
MT	A	15	15.60	11	9	30	10	29	8.72	97.0	0.539
	B	15	15.47	14	6	30	11	18	7.72		
FT	A	15	8.20	11	0	12	0	12	5.17	66.5	0.056
	B	15	4.00	0	0	13	0	11	5.28		
D3MFT	A	15	24.60	23	20	32	20	29	4.34	107.5	0.838
	B	15	23.80	23	19	32	21	26	3.53		

N – number of cases; M – mean; Me – median; Min – minimum value; Max – maximum value calcium and magnesium comparable to data obtained by other authors [13, 14]. However, magnesium content was higher in the area over 2,500 m from the lake shoreline, and the difference was statistically significant. The content of nitrogen, calcium and magnesium ions in the Pisoczno Lake water varied. The number of nitrogen and calcium ions in drinking water increased along with the increasing distance between waterworks and the shoreline. Statistically significant differences were observed in the content of nitrogen, calcium and magnesium ions between drinking water and lake water, regardless the distance to the lake. The survey from 1992–2002 carried out by Sitnik and Osadcza revealed considerable fluctuations in the concentration of calcium and magnesium ions in the water of the lake. In 1992, the calcium ions content equalled 20.4 mg/l, in October 2001 – 8.00 mg/l and in April 2002 – 20.00 mg/l. For magnesium ions in the same years, the numbers were: 1.7 mg/l; 9.14 mg/l; 2.45 mg/l, respectively [15, 16]. The study by Gogacz [17] in 2010 in the Łęczyńsko-Włodawskie Lake District of eastern Poland showed differentiated content of calcium ions, ranging from 25 mg/l – 95 mg/l; magnesium ions: 4.5 mg/l – 12 mg/l and potassium ions: 8.0 mg/l – 25 mg/l in the water of the lakes. Concentrations of these elements in tap water were as following: Mg – 9.02 mg/l; Ca – 60.33 mg/l; K -13.58 mg/l. The obtained results revealed a 100 times higher level of silver ions in comparison to other authors [18, 19].

Despite such a considerable content of silver ions in the water, high mean D3MFT values were observed. In the literature, there are no data concerning endogenous influence of silver on the masticatory system. Numerous publications prove a substantial impact of this element on both the tooth tissue mineralisation and marginal periodontium. However, the tests were performed *in vitro* or with the use of preparations containing nanoparticles of silver ions, which were applied exogenously as varnishes or gels. [19–23]. Moreover, the D3MFT value does not depend entirely on one sole factor – bacteria. To estimate properly the impact of various factors on the health of teeth it is vital to take into consideration all elements participating in the ethiopathogenesis of caries. The presented study reveals that the mean D3MFT value, together with its components, was high in the examined patients in all age groups. It equalled 4.18 for the 12–16-year-olds living in the area up to 2,500 m away from the Pisoczno shoreline, and 4.24 for those living farther than 2,500 m.

Based on the examinations of 12-year-old children conducted in Poland within the project 'Monitoring Oral Health', it was concluded that the percentage of children without caries (D3T=0) was 17.3% in 2010 for the whole country, and 12.2% for the young rural inhabitants. Monitoring research from 2014 proved that the percentage of 12-year-old children with D3T=0 increased to 24.09%, and for young rural inhabitants up to 26.92%. The mean value D3MFT equalled 3.53 in the year 2012 and 2.81 in 2014. In 2012, the numbers were higher for rural children, and in 2014, they decreased and equalled 3.84 and 2.52, respectively [24, 25]. According to the December 2014 WHO report, the lowest percentage of caries in 12-year-old children was reported in Germany, Sweden and Spain – D3MFT< 1.2, which was recognized as very low. In France and Hungary, it was low with D3MFT between 1.3–3.6. Poland and Ukraine are rated next to Lithuania and Slovakia as so- called 'medium-level' countries, with D3MFT value fluctuating between 3.7–4.4. The highest incidence of caries was observed in Croatia, Serbia and Montenegro- D3MFT > 4.4 [26,27]. A low value of mean D3MFT was also reported among indigenous inhabitants of Australia where for 12-year-old children from rural areas it was 1 [28]. For a group of Polish 15-year-old youths, mean D3MFT was 6.12 in 2011 and 5.75 in 2015. Higher values were observed for rural adolescents, constituting 6.74 and 6.15, respectively [29, 30]. The 2014 research conducted by Hilt et al. [31] showed that the incidence of caries among 15-year-old school-goers from Łódź was 93.8% and even higher – 97.8% – in rural areas, compared to urban areas (89.7%). Only 6.2% of the 15-year-old school-goers in Łódź Province were free from caries, while the mean values for severe caries were significantly higher for the rural adolescents. In the presented study, in analysing the severity of caries and its components, it was concluded that in the examined group the component D3T of active caries walower than component FT of filled teeth, with differences more clearly marked for rural areas.

For the group of patients aged 32–45, living in the area 2,500 m away from the Pisoczno Lake shoreline D3MFT value was 21.58, while for those living at the distance of over 2,500 m it was 21.19. Slightly lower D3MFT values were noted by the authors of 'A report on the condition of oral health in Poland in 2010' in which the mean D3MFTvalue for the whole examined group of patients aged 35–44 was 16.91, and for the rural population – 17.19. According to the 'International Dental Conference on Caries Control Throughout Life in Asia – 2013', the highest D3MFT values in the WHO – EURO region were observed for the inhabitants of Denmark, and the lowest for Hungarians, ranging from 15.5–16.7 [27]. Spanish authors reported that the mean D3MFTvalue in an examined group aged 35–44 equalled 7.64 [32]. Urzua et al. [33] conducting research in Chile among 35–44year-old inhabitants obtained D3MFT = 15.06. Lower values of the mean D3MFT were also obtained in Uruguay (15.20) [34].

For the examined group aged 46- 73 living in the area up to 2,500 m from the Pisoczno Lake shoreline, D3MFT value was 24.60, while for those living farther – 23.80. Lower values were reported by Eustaquio et al. [32] (16.38) in a group of people aged 65–74. For the examined group of patients aged 65–74 living in Chile, the mean D3MFT value equalled 21.57 [33]. According to Brazilian authors, for an examined group of 75-year-old patients, the severity of caries expressed by the mean value D3MFT was 30.8. The highest value was represented by the MT component which revealed 96.3% of lost teeth [35]. Alvarez et al. conducted research among 65–74-year-old citizens of Uruguay and obtained a mean value of D3MFT = 24.12 [34]. The presented study concludes that the mean values of D3MFT and its components were approximate for all the examined patients, and in all age groups, regardless the distance between households and Pisoczno Lake shoreline.

Based only on the current study, it is impossible to evaluate univocally the impact of silver and macro-elements present in the drinking water and soil on the condition of mineralized tooth tissues. The obtained results suggest that the research spectrum should be broadened to include laboratory tests to determine the content of each element in tooth tissues.

CONCLUSIONS

1. The high value of D3MFT recorded in the inhabitants of Melniki village indicate the poor condition of mineralized tooth tissues.
2. The fact that the contents of macro-elements in the soil and drinking water increased along with the distance from the Pisoczno Lake shoreline did not affect the oral health of the indigenous inhabitants.
3. No impact of silver ions contained in the lake and tap water on the condition of mineralized tooth tissues was detected in the examined group of inhabitants of the Szackie Lake District.

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