Mouth and Teeth

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The correlation between the DMFT of the 12-year-old children and the concentration of fluorine in drinking water from the Southeast region of the Republic of Macedonia

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Abstract

The aim of this study is to determine the correlation between the DMFT index of 12-year-old children from the Southeast region and the concentration of fluorine in drinking water from the populated areas where children live.

Material and method: In the examination, 129 children were enrolled, out of 2 central and 2 regional primary schools, at which the DMFT index was determined. The children live in 2 different cities and 2 different villages. Four water samples were taken from the examined area to determine the fluorine concentration by using the electrochemical method using the pH / ISE meter-Thermo-Orion with a special F-electrode (Thermo Orion Ion Plus Fluoride Electrode) at the Institute for public health. Spearman's method was used to determine the correlation between the specified variables.

Results: The total number of children in the examined sample was 129, out of which 70 (54,3%) were male and 59(45,7%) were female. The average DMFT index in this group of children was 1,94 with a standard deviation of ± 2.5. Maximum concentration of fluorine in drinking water of 1.36 ppmF was determined in the village Bansko, and 0.36 ppmF in the village Murtino, while the minimum (0.08 ppmF) in the city Strumica. Correlation of the DMFT index in 12-year old children from the Southeast region and the concentration of fluorine in the drinking water has a negative, indirect correlation, with the value of the coefficient r = - 0,1655.

Conclusion: The correlation between the DMFT index and the concentration of drinking water is a negative, indirect correlation, and statistically, this correlation is highly significant (p<0,05).

Introduction

The Southeast region is one of the eight statistical and planning regions of Macedonia. This region borders with the Vardar and Eastern regions. The region covers the Strumica-Radovish and Gevgelija-Valandovo valleys, ie the drainage area of the Strumica river and the lower catchment area of the river Vardar. Its surface is 2,739 square kilometers or 11 percent of the territory of the Republic of Macedonia. There are ten municipalities in this region. In 2011, 8.4% of the population of the Republic of Macedonia lives in this region. The density of the population is 63.2 people per km2, and it is valid for a well-developed region in our country where the unemployment rate is only 9.3. (1 Regions) [1].

In the Southeast region, according to the 2002 census, there are 171,416 citizens or 8.47% of the total population of the Republic of Macedonia. In this region, the water supply is performed by the public enterprises: Utility Utilities - Bogdanci, Public Utility Service "Communal Services" - Valandovo, JKP "Komunalec" - Gevgelija, JKP "Komunalec" - Polin-Star Dojran, PE "Progres" -Radovis, JKP " Komunalec "- Strumica.

In the area of the municipality of Strumica there are 25 villages. The villages Bannica and Gabrovo are connected to the water supply system in 2011, the villages of Gorni Baldovci from March 2010, while the villages Bansko, Dabile, Dobreci, Kuklis, Murtino and Sachevo from 2009. In 2008, the villages Svidovica, Prosenikovo, and the village of Vodoca were connected to the water supply network. The villages of Veljusa and Kosturino are not yet connected to the water supply network [2].

There are insufficient data on the state of dental caries in the Republic of Macedonia. They are published sporadically and non-continuously. Necheva L and all through the project "Assessment of oral health and necessary treatment in the population of SFRY, applying the basic criteria and initiative of the WHO" conducted in 1991, determined the DMFT index of 12-year-old children from 3.48 in Veles and 6.55 in Skopje [3].

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There is insufficient data on the state of dental caries in the Republic of Macedonia. They are published sporadically and non-continuously. Ambarkova found in her research an average DMFT index of 3.47 for 12-year-old children from the Eastern regions of permanent teeth [4]. In 2013, Ambarkova et all conducted an epidemiological study among 15 secondary school students from two high schools from the Strumica city and received an average DMFT index of 3.55 among these respondents [5]. This has prompted us to take this study in order to determine the prevalence of dental caries in 12-year-olds in the Southeast region, as well as determine the correlation between the DMFT index and the concentration of fluorine in the drinking water from this region.

Material and method

The clinical trial consisted of defining the DMFT of the 12-year old children in accordance with the basic criteria for assessment of oral and dental health and the need for rehabilitation, which is recommended by the World Health Organization (WHO, 2013). We estimate the intensity of dental caries according to the generally accepted Klein-Palmer index "DMF", which is a set of decayed, missing and filled teeth. The examinations were carried out by two dentists in accordance with the recommendations stemming from the basic criteria for assessment of oral and dental health recommended by the WHO [6].

The 12-year-old children who were included in the examination were from the following elementary schools in the southeast region: one central (Murtino) and two regional primary schools Marsal Tito from Bansko and Sacevo, and central primary school Sando Masev from Strumica city. For all 12-year old children, standard dental systematic examinations were made with probe and mirror.

For the determination of the fluorine concentrations by laboratory examination, we used samples of water from all urban and rural settlements, where the children from the Southeast region of the Republic of Macedonia live.

In our study, an electrochemical procedure was used to determine the concentration of fluoride with an ion-selective electrode. A major part of the ion-selective electrode is the lanthanum membrane fluoride. When the membrane is in contact with the solution containing fluoride (in this case water), the difference in potential is measured. This potential depends on the amount of free fluoride ions and is described by the Nernst formula

E=Eo-ClogA

E-measured potential of the electrode; E-reference potential (constant); A-quantity of fluoride in the solution; C-slope of the electrode

The samples were collected in 100 ml polyethylene containers with a cap that had threads. The measurement was carried out as soon as the water samples arrived in the laboratory. After shaking the water bottle, 1 ml of each sample is taken and mixed with 0.1 ml Total Strength Adjusting Buffer. The fluorine concentration of all samples was determined using the ionic-selective electrode (Thermo Orion Ion Plus Fluoride Electrode) and the ionometer (pH / ISE meter-Thermo-Orion) at the Public Health Institute. For chemical analysis 10% of TISAB Aluminon was used. Fluoride standards with a concentration of 0.01 to 1.00 mg / l were used to calibrate the measurements. Before the starting of the fluorine measurement, some preparations must be made to check the correctness of the measuring instrument and the slope of the electrode. This is done according to the manufacturer's instructions. When the instrument is ready, the measurement can begin.

Results

In this cross-sectional study 129, 12-year old children from the Southeast region are included presented in the investigation, of which 70 (54.3%) of men and 59 (45.7%) of females (Table 1). Regarding their nationality, 112 (86.8%) are Macedonians, while the remaining 17 (13.2%) are children with Roma nacionality. There is no big difference in the place of residence, ie 48.8% of the children are from the Strumica city, 51.2% of the children from this group live in the rural area, 21.7% are from the village Murtino, 27.1% are from the Bansko village and 2.3% children live in the village Sachevo (Table 1).

Figures 1 and 2 show the distribution of the decayed, extracted and filled permanent teeth in the 12-year-old group of children from the South-East region. Seventy-eight children are without dental caries 78 (60.5%), while from the group of 51 (39.5%) children with caries on permanent teeth, the largest number of children are with dental caries on one tooth 21 (16.3%). In 3 (2,3%) children from this group,

Table 1. Distribution of the children in relation to thegender, nacionality and place of living

	N	%
Gender of the children		
Male	70	54,26%
Female	59	45,74%
Nacionality		
Macedonians	112	86,82%
Roma	17	13,18%
Place of living		
Town	63	48,84%
Village	66	51,16%
Name of town/village		
Strumica	63	48,84%
Murtino	28	21,71%
Bansko	35	27,13%
Sacevo	3	2,32%

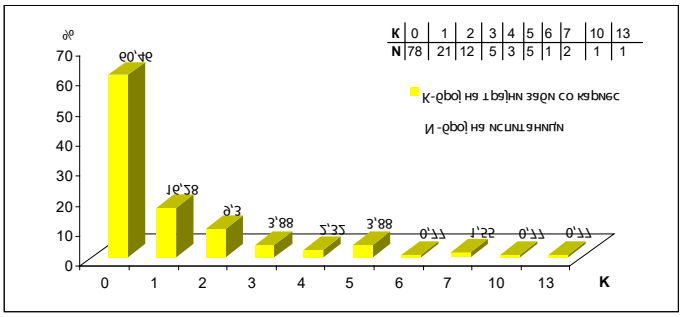

Figure 1. Distribution of the children in relation to the number of decayed permanent teeth

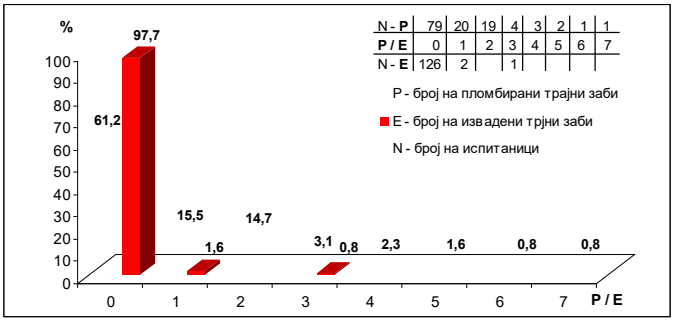

Figure 2. Distribution of the children in relation to the number of filled and extracted permanent teeth

teeth extraction was carried out, as follow: only one child has a 3 teeth extraction. Seventy-nine79 (61.2%) children are without filled teeth, while in the group with restored teeth, 20 (15.5%) examinees have one restored tooth and 19 (14.7%) children are with 2 restored teeth.

The minimum number of decayed, extracted and filled permanent teeth in the group of 12-year-old children from the Southeast region is 1, while the maximum number of decayed teeth is 13, the maximum number of missing teeth 3, the maximum number of filled teeth is 7. The calculated mean or median indicates that half of the respondents in this sample have dental caries of more than 2 teeth, have extraction of more than one tooth, and have more than 2 filled teeth (Table 2).

The value of the DMFT index of permanent teeth in the group of 12-year-old children from the Southeast region ranges from 0 to 13, and on average DMFT is 1,94 ± 2,5 (Table 3).

The distribution of decayed, extracted and filled teeth within the respondents at the age of 12 years from the Southeast region, depending on the sex, is presented in Table 4. Decayed teeth are more commonly among male children (40% vs 38.98%), extracted teeth are more frequently registered in female respondents (3.39% vs 1.43%), they also more often than male children have filled teeth (49.15% vs 30%). The tested differences in the number of carious, extracted and filled teeth, depending on the sex of the subjects in this group, show statistical significance only in the distribution of the restored teeth (p = 0.03). In the Southeast region, female children at the age of 12 year, considerably more often than male children, have a dental intervention for the fillings of their teeth.

The sex of respondents at the age of 12 in the Southeast region has no significant impact on the value of the DMFT index (p = 0.35) (Table 5).

The average value of the DMFT index in the group of male examinees is 1.66 ± 2.14, while in the group of female children, the DMFT index has an average value of 2.27 ± 2.85 (Table 5).

Table 6 shows the distribution of carious, extracted and filled teeth depending on the place of residence (town or village) of the respondents aged 12 years from the South-East region. The results show that within the children from the rural areas of this region dental caries is significantly more frequently (p = 0.03) registered (48.48% vs 30.16%). Tooth extractions are registered only in the group of children living in the village - 4,55%, while filled teeth more often have children from the city (39,68% vs 37,88%), but this difference is not statistically significant (p = 0, 83).

Table 7 shows the distribution of decayed, extraction and filled teeth among the 12-year old children from the Strumica city and the rural municipalities - Murtino, Bansko and Sachevo.

Table 2. Descriptive statistic / number of the permanent teeth

Descriptive Statistics - (number of permanent teeth N=250)				
variable	**N (%)**	**median**	**min-max**	**lower –upper quartiles**
D –decayed teeth	140(56%)	2,0	1,0 – 13,0	1,0 – 4,0
M –missing teeth	5(2%)	1,0	1,0 – 3,0	1,0 – 3,0
F –filled teeth	105(42%)	2,0	1,0 – 7,0	1,0 – 2,0

Table 3. Descriptive statistic /DMFT index of the permanent teeth

Descriptive Statistics - DMFT (index of the permanent teeth)						
variable	**N**	**mean±SD**	**95% confidence interval of means**	**min-max**	**median**	**lower –upper quartiles**
DMFT	129	1,94 ± 2,5	1,5 – 2,37	0 – 13,0	1,0	0,0 – 3,0

Table 4. Distribution of the decayed, missing and filled permanent teeth in relation to gender

variable	**gender**	
	male(n %)	**female (n %)**
D – decayed permanent teeth		
No exist	42 (60%)	36 (61,02%)
exist	28 (40%)	23 (38,98%)
Pearson Chi-square: 0,014 df=1 p=0,91		
M –missing permanent teeth		
No exist	69 (98,57%)	57 (96,61%)
exist	1 (1,43%)	2 (3,39%)
Pearson Chi-square: 0,54 df=1 p=0,46		
F – filled permanent teeth		
No exist	49 (70%)	30 (50,85%)
exist	21 (30%)	29 (49,15%)
Pearson Chi-square: 4,95 df=1 p=0,03* p<0,05		

Table 5. Descriptive statistic of the DMFT index of the permanent teeth / gender differences

Descriptive Statistics - DMFT (index of permanent teeth)						
variable gender	**N**	**mean±SD**	**95%confidence interval of means**	**min-max**	**median**	**lower –upper quartiles**
Male	70	1,66 ± 2,14	1,15 – 2,17	0 – 12	1,0	0,0 – 2,0
Female	59	2,27 ± 2,85	1,53 – 3,01	0 - 13	1,0	0,0 – 4,0

Table 6. Distribution of the decayed, missing and filled permanent teeth in relation to the place of living

variable city/village	**city/village**	
	city	**village**
D – decayed permanent teeth		
Not exist	44 (69,84%)	34 (51,52%)
exist	19 (30,16%)	32 (48,48%)
Pearson Chi-square: 4,53 df=1 p=0,03* p<0,05		
M – missing permanent teeth		
Not exist	63 (100%)	63 (95,45%)
exist	0	3 (4,55%)
Pearson Chi-square: 2,93 df=1 p=0,087		
F –filled permanent teeth		
Not exist	38 (60,32%)	41 (62,12%)
exist	25 (39,68%)	25 (37,88%)
Pearson Chi-square: 0,04 df=1 p=0,83		

Table 7. Distribution of the decayed, missing and filled permanent teeth from Strumica, Murtino, Bansko and Sacevo

Variable city/village	**Name of the city/village**			
	Strumica	**Murtino**	**Bansko**	**Sacevo**
D –Decayed permanent teeth				
Not exist	44 (69,84%)	11 (39,29%)	22 (62,86%)	1 (33,33%)
exist	19 (30,16%)	17 (60,71%)	13 (37,14%)	2 (66,67%)
M—missing permanent teeth				
Not exist	63 (100%)	26 (92,86%)	34 (97,14%)	3 (100%)
exist	0	2 (7,14%)	1 (2,86%)	0
F –filled permanent teeth				
Not exist	38 (60,32%)	14 (50%)	25 (71,43%)	2 (66,67%)
exist	25 (39,68%)	14 (50%)	10 (28,57%)	1 (33,33%)

The value of the DMFT index does not depend significantly on the place of residence of the 12-year-old children from the Southeast region (p = 0.08). In the group of children from the urban area the average value of the DMFT index is 1.44 ± 2.08, while in the group of children from the rural area, the DMFT index has an average value of 2.41 ± 2.77 (Table 8).

Table 9 shows the descriptive statistics on the value of the DMFT index in the analyzed municipalities in the South-East region, Strumica, Murtino, Bansko and Sachevo.

Table 10 shows the average values of the fluoride concentration in drinking water relation to the sampling point of the water.

The analyzed correlation between the value of the DMFT index as a dependent variable and the concentration of fluorine in drinking water is shown in Figure 3. The value of the coefficient R = - 0.167 shows that there is a negative, ie indirect correlation between these two variables. This means that by increasing the concentration of fluorine in water, the value of the DMFT index decreases, and vice versa, smaller values of the DMFT index are obtained if the concentration of fluoride in the drinking water is higher. For p <0.05 and statistically this correlation is significant, ie significant.

Table 8. Descriptive statistic of the DMFT index of the permanent teeth /place of living

Descriptive Statistics - DMFT (index of permanent teeth)						
variable city/village	N	mean±SD	95%confidence interval of means	min-max	median	lower –upper quartiles
city	63	1,44 ± 2,08	0,92 – 1,97	0 – 13,0	1,0	0,0 – 2,0
village	66	2,41 ± 2,77	1,73 – 3,09	0 – 12,0	1,5	0,0 – 4,0

Mann-Whitney U Test Z=1,72 p=0,08

Table 9. Descriptive statistic of the DMFTof the permanent teeth / Strumica, Murtino, Bansko and Sacevo

Descriptive Statistics - DMFT(index of permanent teeth)						
variable city/village	N	mean±SD	95%confidence interval of means	min-max	median	lower –upper quartiles
Strumica	63	1,44 ± 2,08	0,92 – 1,97	0 – 13,0	1,0	0,0 – 2,0
Murtino	28	3,64 ± 3,23	2,39 – 4,89	0 – 12,0	2,5	1,0 – 5,5
Bansko	35	1,37 ± 1,88	0,73 – 2,02	0 – 7,0	0,0	0,0 – 3,0
Sacevo	3	3,0 ± 2,64	-3,57 – 9,57	0 – 5,0	4,0	0,0 – 5,0

Table 10. Distribution of the concentrations of Fluorine in drinking water in relation to the place of living

Places of living	Concentration of F in water
Strumica	0,0810
Murtino	0,3820
Bansko	1,3600

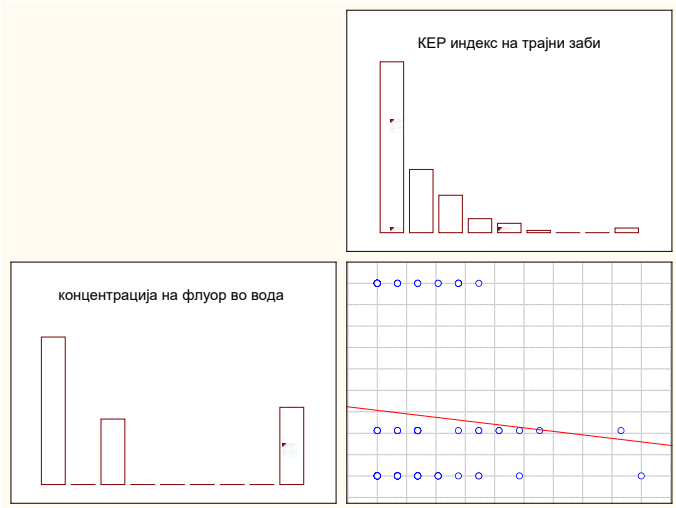

Figure 3. Correlation – DMFT index of the permanent teeth / concentration of the fluorine in drinking water

The analyzed correlation between the value of the DMFT index in 12-year-olds in the Southeast region and the concentration of fluorine in drinking water shows that between these two variables there is a negative or indirect correlation with the value of the coefficient R = -0.16 for p <0 , 05 and statistically this correlation is significant, ie significant.

Discussion

The results of the oral health situation and the required needs of the population for oral rehabilitation from our country, obtained from the Epidemiological Study in 1991, worked in the framework of the joint Yugoslav study "Assessment of oral health and necessary treatment in the population of the SFRY(Socialistic Federal Republic of Yugoslavia), applying the basic criteria and initiative of the WHO ", indicate a very serious condition. The DMFT index ranged from 0.54 in six-year-old children to 23.84 in the population of 65. In this study managed by Necheva, investigation was conducted in the cities of Skopje, Veles, Stip and Ohrid, and 1.034 examinees from the rural and urban environment at the age of 6, 12, 15, 18, 35-44 and over 65 years from the whole country have been enrolled. The average DMFT index for the permanent dentition of 12-year-old children in 1991 was 3.48 in Veles and 6.55 in Skopje (3).

In their study, Davidovic B et al examined the condition of oral health in 599 students from the age of 6 and 12 from the eastern towns of the Republic of Srpska and found the value of the average DMFT index of 2.6 in 6-year-olds and 5.5 in 12-year-olds children [7].

Gjorgjev D et al performed systematic reviews of the basic parameters of nutritional status and dental status (dental caries and dental fluorosis) in 76 school children. In the part of the children included in the study (test group) which from their birth drink water from the village where they live with a mean fluorine content of 2.71 mg / L (village.Tromeger), the average DMFT index of permanent teeth was very low 0.56, but most had dental fluorosis between first and second degree ("mild" and "very mild"). In the other children (control group) who drink water containing fluoride less than 0.5 mg / L (from the village Staro Nagoricane) from the birth, the average DMFT index was 3.09, while the occurrence of tooth fluorosis was absent. A difference in nutritional status between the two groups has not been established [8]. Today, in the village of Tromedje, optimization of the fluoride content of about 1 mg / L has been achieved thanks to the mixing of water from the newly built village water supply with water from the city water supply Kumanovo, which contains fluoride in the concentration of about 0.1-0.2 mg / L.

In order to improve oral health in the Republic of Macedonia, the National Strategy for Prevention of Oral Diseases was adopted in children aged 0-14 years, in the period 2008-2018 [9]. The primary preventive measures include mechanical and chemical control of the dental plaque, exogenous and endogenous application of fluoride, controlled sugar intake, regular oral care of the teeth, use of the dental floss, sealing of fissures, education and motivation of the children for maintaining of the oral health. The implementation of this program was conducted by preventive teams. In the professional staff for strategy implementation all specialists for pediatric and preventive dentistry, general dentists who are employed in the state sector in preventive dentistry, kindergarten teachers and teaching staff in schools were included.

In another study conducted in Italy, the average value of the DMFT index was (1.1) [10]. Also, in South Africa as a developing country, the average value of the DMFT within 12-year-old children was 1.1 [11].

In Jordan, the average DMFT within 12 years old children was 2.51 [12], and in Kuwaiti students it was 2.6 [13], and finally in Syria, the average DMFT index was moving from 1.4 to 2.5 for the same age in 2004 [14]. In Israel, the average DMFT index was 1.66 [15].

In 1980, the World Health Organization established a global World Caries Map (oral data bank) for oral health in 12-year-old children for 107 out of 173 countries. Of these, 51% had an average DMFT index of 3.0 or less, while the remaining 49% had higher values. In 2000, the bank had data from 184 countries, of which 68% had an average DMFT index of less than 3 [16]. Regarding Nigeria as a developing country, it was found that 85% of 12-year-olds were without caries [17].

In countries with a relatively low DMFT index within 12-year-old children, 65% of children have experienced dental caries of their permanent teeth. Of the Scandinavian countries, England and the Netherlands are the only countries where about half of the 12-year-olds have no caries. Most EU countries have an average DMFT index below 3.0 in 12-year-old children. The nine countries that have the average DMFT index above 3.0 are Austria, Iceland, Germany, Greece, Israel, Spain, Yugoslavia, Hungary (4.3) and Poland (5.1). The Baltic countries, like Latvia (7.7), have a high level of average DMFT index. Indicator of the inability of the current dental services to cope with the problem of dental caries is the relatively high percentage of untreated caries lesions. The percentage of untreated carious lesions in 12-year-olds is 29% in France, 45% in the UK, 46% in Hungary, and 53% in Poland [18-20]. The pilot study, conducted in the Republic of Macedonia in1994, determined the frequency of unsanitary caries among children (from first, third, fifth, seventh grade from primary school and first and fourth grade of secondary school) of 38.8%. While dental caries prevalence ranged from 90.9% in fifth grade (primary school) up to 100% in the first class(secondary school). Students at the age of 12 years in the same study have a moderately high average DMFT index of 4.2 [21].

In the Republic of Macedonia there is an inadequate system for monitoring and registration of dental caries, our statistics are not in line with that of the European Union and WHO, the existing legal obligations are not respected and therefore there are no relevant statistical indicators (DMFT) [22,23].

The epidemiological study conducted in 1991 by Neceva, determined the average DMFT index of the 12-year-old children from minimum value of 3.48 from city Veles and maximum value of 6.55 in Skopje, the capital of our country [24].

According to the results we received from this study, 12-year-old children from the Southeast region have low prevalence of tooth cavities cause by dental caries. We hope that the state of oral health in all children from the Republic of Macedonia in the future will be improved even more.

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