Dental Caries Experience among Primary School Children in the Eastern Region of the Republic of Macedonia

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Abstract

Aim: The aim of this study was to investigate the prevalence of dental caries experience among primary school children (sixth and seventh grades) in Eastern Region of the Republic of Macedonia.

Methods: In this cross-sectional study, primary school children from sixth and seventh grades (N=396) were selected from 9 Central and 13 Regional Primary Schools. Participants dental status was evaluated using the 1997 World Health Organization caries diagnostic criteria for Decayed, Missing or Filled Teeth (DMFT) by 2 calibrated examiners.

Results: The total number of children in the sample was 396, comprising 201 (50.8%) females and 195 (49.2%) males. The mean DMFT was 3.467, with standard deviation (SD) of 2.904 and 95% confidence interval (CI) of 3.180-3.754. Significant caries (SiC) index was 6.765. The prevalence of caries-free children was 21.21%. The percentage of untreated caries or the ration of D/DMFT was 0.5324 (53.24%).

Conclusions: Dental caries experience was seen to be high among primary school children (sixth and seventh grades) in Eastern Region of the Republic of Macedonia.

Key Words: Caries, Caries prevalence, DMFT index, Macedonia

Introduction

Dental Caries is the most prevalent dental affliction of childhood. Despite credible scientific advances and the fact that caries is preventable, the disease continues to be a major public health problem. In the developing countries changing life-styles and dietary patterns are markedly increasing the caries incidence. Growing children need proper guidance for healthy growth, upkeep and hygiene of their teeth. Millions of people throughout the world have lost their teeth due to caries [1,2].

Republic of Macedonia with its 25.441 square kilometers takes the central part of the Balkan Peninsula. The whole territory of the Republic of Macedonia consists of 8 non-administrative units-statistical regions, 84 municipalities as administrative units and of 1 776 settlements. The Republic of Macedonia is a developing country undergoing many political and economic changes in an effort to become a member of the European Union. In Macedonia, there is a National Caries Preventive Program which starts to be implemented in 2007 by 142 calibrated paedodontists according to the standards of the WHO, who, after the privatization of the dental sector, continued to work in the frame of public health. Except sealing, they have obligation to make other primary preventive measures according to the National Strategy of Prevention of Oral Diseases in children at age 0-14 in the Republic of Macedonia [3].

The East Region (*Figure 1*) is mainly a mountainous region and comprises the extreme east of the Republic of Macedonia. It spreads along the Bregalnica River, over the basins of Shtip, Maleshevo and Pijanec and the field of Kochani. The region comprises 14.2% of the total area of the Republic of

Figure 1: *Eastern Region of the Republic of Macedonia.*

Macedonia, with 8.7% of the total population in 2011, and it is one of the least densely populated regions with 50.7 citizens per km². The natural, geographical, climate and hydrological characteristics give the potential for production of rice, especially in the Kochani Field, which is well renowned for its rice. The basins of Pijanec and Maleshevo are favorable for growing fruits and vegetables. Due to the specific geological characteristics of mountain ranges, the region has a developed lead and zinc mining industry. Another important industry is the textile industry and a large number of textile manufacturing plants are located in this region. The mountainous terrains in the region have great potential for development of winter and alternative tourism even though they are still in the early stages of development [4].

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The current population of the Eastern Statistical Region is 181,858 citizens or 9.0% of the total population of the Republic of Macedonia, according to the last population census in 2002. The largest ethnic group in the region are the Macedonians 92.4%, Roms 3.8%, Turks 1.5%, Vlachs 1.1% and others 1.1% (*Figure 2*).

The Scientific project designed upon the World Health Organization Criteria and directed by Nečeva was conducted in four districts (Skopje, Veles, Štip and Ohrid) in the Republic of Macedonia. A total of 1034 subjects from urban and rural population groups aged 6, 12, 15, 18, 35-44 and over 65 from the whole Republic were examined. High values of DMF index were registered in all the age groups, with prevalence in the children groups, among permanent teeth. The DMF scores were as follow: 6 years 0.69, 12 years 5.22, 15 years 8.13, 18 years 9.34, 35-44 years 11.80 and over 69 years 23.84 [5,6]. Also, Bajraktarova et al. in 1999 conducted investigation of dental health of 12 years old children living in the surrounding of Skopje and found out DMF score of 3.03 [5].

The Health Strategy determines the status of the preventive dental healthcare in the Republic of Macedonia, which incorporates the following:

"Preventive dental protection of children from 0-14 years of age shall continue to be provided by the Public Health Institutions, by establishment of a network of institutions for oral health prevention, which shall be funded by public funds. Therefore, a Plan shall be elaborated for the issue of providing premises, equipment, personnel and the package of offered services, furthermore, geographical distribution of the current specialists of preventive and Paediatric dentistry shall be conducted, having in consideration that at the moment they are present only in the bigger cities of the country. Dentists shall operate within a team together with a dental nurse, and they shall perform additional trainings of nurses in preventive dental protection" [3].

In the Republic of Macedonia, a system for monitoring and registration of dental caries exists, but the statistics is not coordinated with that of the European Union and the WHO and the existing legal obligations are not respected. For that reason, database with relevant statistical indicators (DMFT) do not exist [7].

According to the opinion of the most of the experts in

Figure 2: *The percentage of Macedonians in each municipality of eastern region of the country.*

preventive dentistry, the control of dental caries can be successfully conducted by application of the following primary preventive measures: Mechanical and chemical control of dental plaque; Application of fluoride (systemic and topical); Discipline of sugar intake regime; Sealing of fissures and pits; Education and motivation for keeping oral health [8-10].

Aim

The aim of this study was to assess the dental caries experience of primary school children from sixth and seventh grades in Eastern Region of the Republic of Macedonia. Also, the necessity of this study impose for the monitoring of the outcomes from the implementation of the National Strategy for Prevention of Oral Diseases in children from 0 to 14 years of age, which started to be implemented in 2007.

Methods

The sample for the present cross-sectional study was 396 school children from sixth and seventh grades, attending 9 central and 13 regional schools in the cities and villages from this region. Based on the information from the Macedonian Institute of Statistics [11] there are approximately 3844 children attending sixth grade and 1945 attending seventh grade of the primary school in this region. Permission for the study was obtained from the school authorities, who sought and obtained consent from the parents of the children concerned.

It was decided to use cluster sampling because it was more economical and achievable within the constraints of resources and finance. All classes (sixth and seventh grades) children in these schools were included in the study. Ethical approval was obtained from the Ministry of Health. Children from sixth and seventh grades are around 12 years old, and at this age all permanent teeth, except third molars have erupted. For these reasons, 12 years has been chosen as the global monitoring age for caries for international comparisons and monitoring of disease trends.

Data were collected by means of clinical examinations in daylight using plain dental mirrors and probe, which took place in a separate room with the subject seated on the chair. Two calibrated dental examiners conducted the dental examination and the clinical part of the form was filled in by two other trained dentists (kappa values for inter-examiner reliability was 0.85). World Health Organization 1997 [11] caries diagnostic criteria were followed. The DMFT, Decayed, Missed, or Filled Surfaces (DMFS) and SiC indices were used to evaluate children dental caries experience. A new index called the 'Significant Caries Index' (SiC) was recently proposed by the World Health Organization (WHO) to draw attention to those individuals with the highest caries scores in each population [12]. The SiC Index leads to significant gains for society and for the persons concerned as more specific targeted preventive actions can be implemented. The SiC is the mean DMFT of one third of the study group with the highest caries score.

Statistical analysis

Simple descriptive statistical tests were used in the form of percentage and frequency distribution. For statistical analysis of DMFT scores to access the oral health among primary school children, the R software environment for statistical computing was used (http://www.r-project.org/).

Results

Statistical data that was collected were from primary school children in the Eastern part of the Republic of Macedonia. For each child following data was recorded: age, sex (male or female), ethnic group, area (urban or rural), city/village, number of Decayed Teeth (DT), number of Missing Teeth (MT) and number of Filled Teeth (FT). Then, the DMFT score, the sum of DT, MT and FT, was calculated and recorded for each child. The size of the statistical sample was 396. In *Tables 1* and *2*, the distribution of individuals in studied sample is given. Tables with more detailed distributions of individuals can be found in the Appendix A.

The mean value of the DMFT index for the whole sample is 3.467, with Standard Deviation (SD) of 2.904, and 95% Confidence Interval (CI) of 3.180-3.754. In the whole sample, 21.21% of the individuals were caries free (DMFT=0). As a complement of the mean DMFT value, for the whole sample, the SiC index of 6.765 was calculated.

In *Figure 3*, the distribution of DMFT score is given. The Shapiro-Wilk test for normality was performed, and the hypothesis that the data is normally distributed is rejected with p-value=1.695e-13<<0.05. In *Figure 4*, the boxplot of DMFT score in the whole sample is given, showing the range, quartiles and outliers. Additional figures with distribution of caries data for the studied sample are given in the Appendix B.

The mean DMFT index with SD and 95% CI were calculated for each group (according to sex orientation, area of living, age, nationality, city or village) and these results are reported in *Table 3*. Only two ethnic groups (Macedonians and Roms) were statistically analyzed, since these groups were the only ones that count more than 30 individuals (*Table 2*). Among the groups formed by city or village of living, only four of them count more than 30 individuals (*Tables 1a* and *1b* in the *Appendix A*), they are groups from Štip, Delčevo, Kočani and Orizari, so only for these groups the statistical analysis was performed. In *Table 3*, the percentage of caries free individuals for each group is also reported. Distributions of DMFT scores for some of the groups are illustrated by the boxplots (*Figures 5* and *6*).

One way Analysis of Variance (ANOVA) was performed to see if there are differences in mean DMFT index between the groups, and corresponding p-values are reported in *Table 3*. If there are p-values that are less than 0.05, the differences among groups are considered to be statistically significant (age groups, ethnic groups, city/village groups). Where statistically significant differences were found and there are three or more groups (age groups, city/village groups), the less conservative Holm multiple comparison test was performed to determine where these differences are. For age groups, the results are that there is statistically significant difference between I and II group (p-value=5.2e-07<<0.05) and I and III group (p-value=5.2e-07<<0.05), while there is

Table 1. Distribution of individuals in studied sample (sex, area).

Sex / Area	Male	Female	Total
Urban	122	121	**243 (61.36%)**
Rural	79	74	**153 (38.64%)**
Total	**201 (50.8%)**	**195 (49.2%)**	396

Table 2. Distribution of individuals in studied sample (age group, ethnic group).

Ethnic Group / Age Group	M	R	O	Total
I - less then 12	58	36	3	**97 (24.5%)**
II - 12 years	123	6	4	**133 (33.6%)**
III - 13 and more	138	24	4	**166 (41.9%)**
Total	**319 (80.55%)**	**66 (16.67%)**	**11 (2.8%)**	**396**

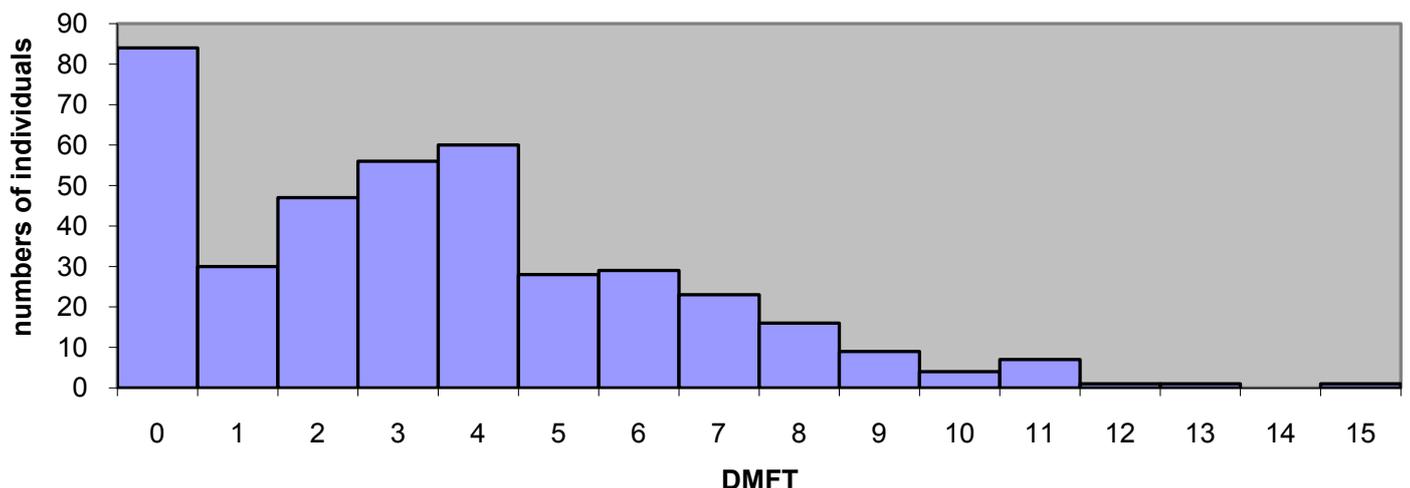M - Macedonians, R - Roms, O - Other ethnic affiliation

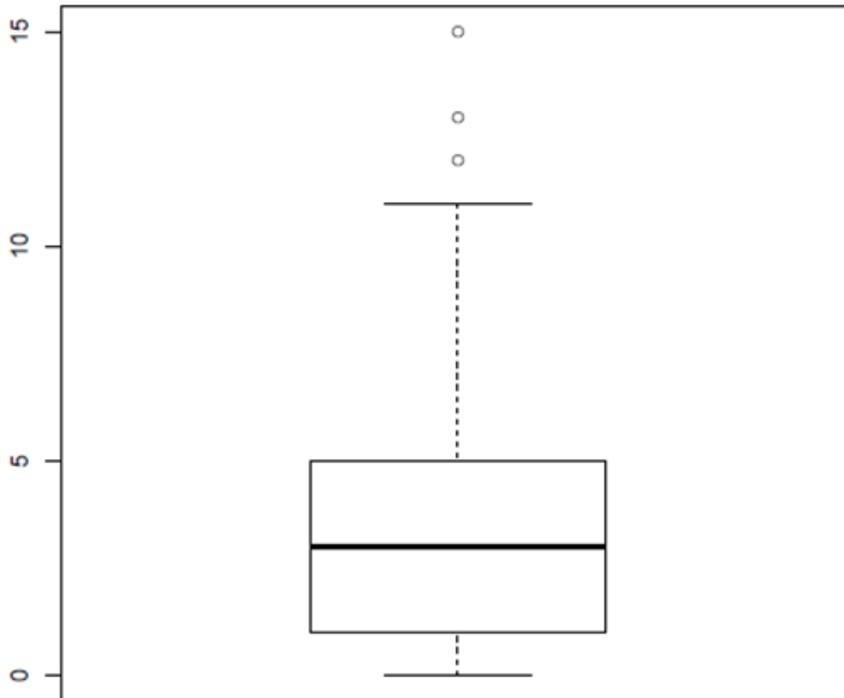*Figure 3: Distribution of DMFT score in the whole sample.*

Figure 4. Boxplot of DMFT score in the whole sample.

Table 3. Caries free individuals, DMFT scores and equality tests for mean DMFT index.

	Caries free	DMFT		p-value
		Mean (SD)	95% CI	
Whole Sample	**84 (21.21%)**	**3.467 (2.904)**	**3.180-3.754**	
Sex Groups				
Male	53 (26.37%)	3.373 (3.050)	2.949-3.797	0.513
Female	31 (15.90%)	3.564 (2.749)	3.176-3.952	
Area Groups				
Urban area	52 (21.40%)	3.321 (2.848)	2.961-3.680	0.212
Rural area	32 (20.91%)	3.699 (2.985)	3.223-4.176	
Age Groups				
less than 12 (I group)	38 (39.18%)	2.010 (2.224)	1.562-2.459	5.66E-10
12 years (II group)	22 (16.54%)	3.992 (2.968)	3.483-4.502	
13 and more (III group)	24 (14.46%)	3.898 (2.933)	3.448-4.347	
Ethnic Groups				
Macedonians	62 (19.44%)	3.680 (2.941)	3.356-4.004	7.95E-04
Roms	20 (30.30%)	2.470 (2.513)	1.852-3.087	
City/Village				
Štip	21 (32.81%)	2.406 (2.266)	1.840-2.972	2.28E-06
Delčevo	3 (5.26%)	4.614 (2.914)	3.841-5.387	
Kočani	17 (17.71%)	3.688 (2.978)	3.084-4.291	
Orizari	3 (5.00%)	4.533 (2.626)	3.855-5.212	

no statistically significant difference between II and III group (p-value=0.77>0.05). For city/village groups, the results are that there is statistically significant difference between groups from Štip and Delčevo (p-value=8.4e-05<<0.05), groups from Štip and Kočani (p-value=0.01622<0.05), and groups from Štip and Orizari (p-value=0.00011<0.05), but there is no statistically significant difference between the rest of pairs (for groups from Delčevo and Kočani, p-value=0.13221>0.05, than for groups from Delčevo and Orizari, p-value=0.87356>0.05, and for groups from Kočani and Orizari, p-value=0.13221>0.05).

The DMFT components, DT, MT and FT, were also analyzed. Their frequencies, mean values, SD's and 95% CI's are reported in *Table 4*. It is important to describe the composition of the DMFT, which allows us to evaluate the level of dental care in the country.

Discussion

Dental caries is a widespread disease. Although there is a plethora of published studies of dental caries experience among different age groups in different regions of the world, there is a lack of data on dental caries experience
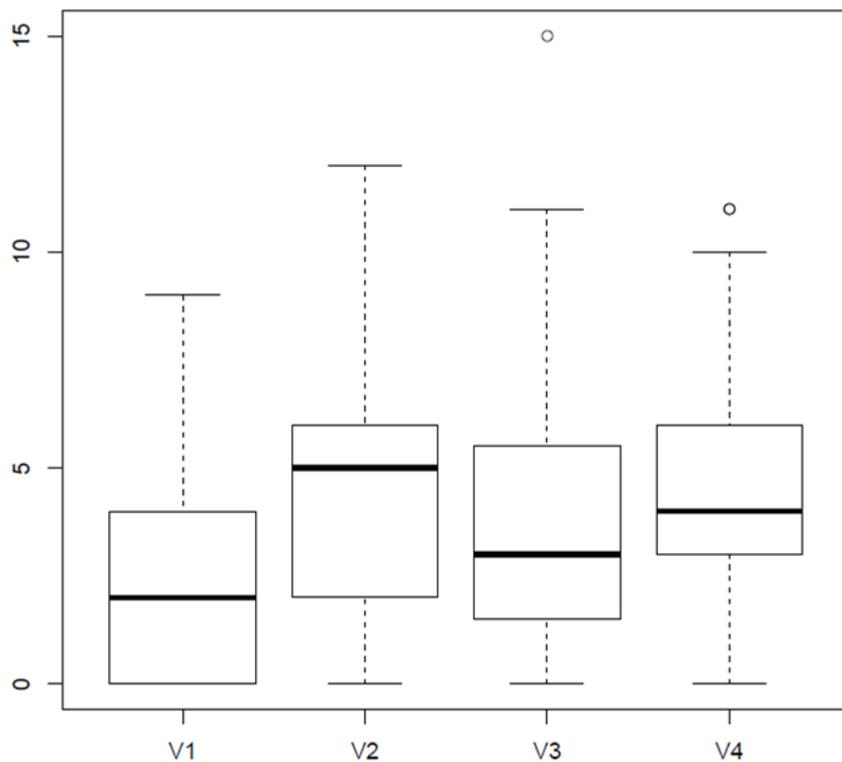
Figure 5. Boxplots of DMFT score for city/village groups (V1=Štip, V2=Delčevo, V3=Kočani, V4=Orizari).
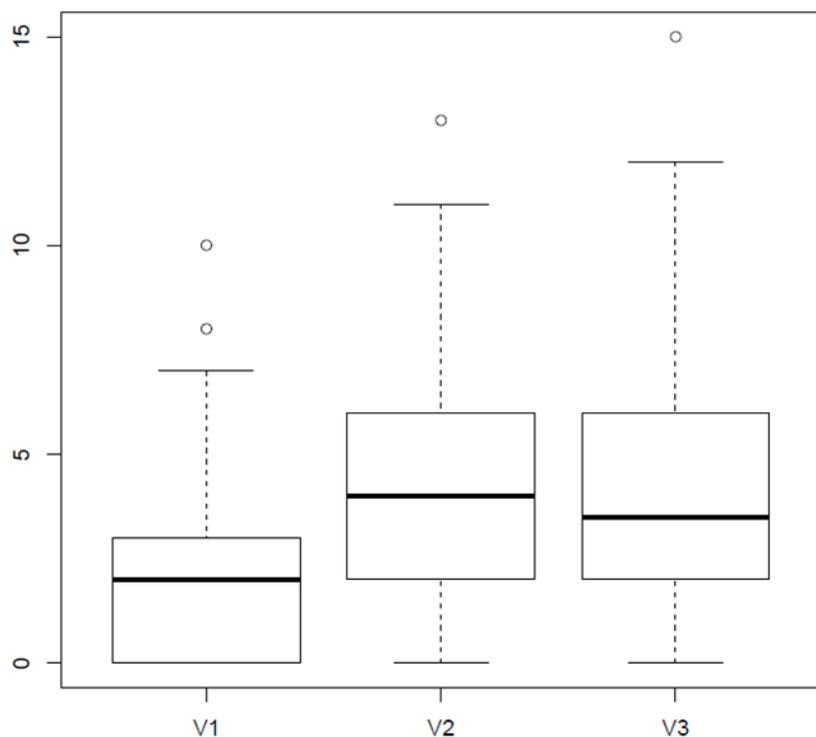

Figure 6. Boxplots of DMFT score for age groups (V1=less then 12 years, V2=12 years and less then 13, V3=13 years and more).

in the literature with regard to the Republic of Macedonia. The study aimed to assess the dental caries experience in school children from the Eastern Region of the Republic of Macedonia. The purpose of the study was to help planning preventive programmes and to serve as a baseline for future evaluation of preventive treatment for this age group.

The overall mean DMFT was 3.467 and this can be classified as high dental caries experience. This view can be strongly supported by the finding that the caries-free prevalence was 21.21% and the caries prevalence was

78.79%. Moreover, the DMFT index was 3.467 and the SiC 6.765, indicating that one-third of the sample had a caries experience twice the mean DMFT. Comparing the findings with data from other European countries appears to suggest that the mean DMFT for 12-year-olds in East region from our country may be similar to that in other Central and Eastern European countries such as Poland (3.8), Slovakia (4.3), Hungary (3.8), Latvia (3.5), Lithuania (3.6) and Albania (3.8) [13,14].

The cross-section study for 2007, realized by a team

Table 4. DT, MT, FT frequencies and scores for the whole sample

	Frequency	**Mean (SD)**	**95% CI**
DT	53.24%	1.846 (2.219)	1.627-2.065
MT	5.54%	0.192 (0.611)	0.132-0.252
FT	41.22%	1.429 (1.902)	1.241-1.617

of experts assigned by the Ministry of Health, as a really measurable indicator and standard, as determined by the WHO, estimated the DMFT-index (an average of extracted and treated carious teeth in children), showing a value of 6.88 in children at 12 years of age, which is considered a high value compared to the WHO recommendations for oral health (DMFT<3) [3].

Comparing the results from this study (DMFT=3.467) with the cross-section study from 2007 (DMFT=6.88) it is evident that the DMFT index show tendency to decrease. Our results are similar with the results of Petanovski [9] from 2009 whose findings were DMFT score of 3.56 and SiC index of 6.06 for urban 12-years old school children from the main capital city Skopje of our country. In his study determination and registration of significant Caries Index (SiC) was conducted on 360 children, at the age of twelve, coming from an urban Skopje area.

For age groups, the results are that there is statistically significant difference between the I (less than 12 year) and the II group (12years and less than 13) (p-value=5.2e-07<<0.05) and the I and the III group (13 years and more) (p-value=5.2e-07<<0.05), while there is no statistically significant difference between the II and the III group (p-value=0.77>0.05). This can be explain by the fact that the children from the first group were born in 2001 and now have less than 12 years and were exposed to fissure sealing of the first permanent molars right after their eruption, in 2007 by the calibrated paedodontists in all eight regions of our country.

According to the fact that occlusal surfaces have the highest participation in DMFT index between children, in 2007 all preventive teams started to seal occlusal fissures and pits of first permanent molars right after their eruption at all school children at first grade (born in 2001) in all regions of our country.

In accordance with the law amendments and with the Constitution of Republic of Macedonia, the compulsory primary education is prolonged for one more year, i.e. the starting limit has been lowered with the introduction of the nine-year primary education, which starts from the age of 6 and lasts till the age of 15. Previously, children started their compulsory primary education at the age of 7 and completed it eight years later.

The practical implementation of the program for nine-year education began in the school year of 2007/2008, which means that the first generation encompassed by this new program should complete the primary education in 2015. The total number of pupils who enrolled in first grade at the age between 6 and 8 years is higher in this school year 2007/2008 due to the two first grades and to the Amendments to the Primary Education Law of 2007 [15].

The caries prevalence in the Eastern region of our country is 78.79%, which is similar with caries prevalence in Poland (87%), Slovakia (88%), and Lithuania (84%) [16,17].

However, in Western European countries the situation is completely different; for example, most recent data for mean DMFT and caries prevalence in 12-year-olds was 0.8 and 32% in the Netherlands, 0.9 and 38% in the UK, and 2.1 and 64% in Italy, respectively [18].

Schools are an important source of food in children's diets. High frequency of sweet consumption is known to be related to increased risk of dental caries [18]. There is evidence that soft drinks are risk factor for tooth demineralization due to sucrose composition and low pH [14].We have to eliminate the "fast food" and soft drinks from the school stores close to schools in order to reduce the caries risk of school children in the Republic of Macedonia. The food items can be looked on as indicators of oral health-related lifestyles.

Ethnicity is associated with differences in food-related beliefs, preferences and behaviors [19]. In our study there was no statistically significant difference in the mean DMFT values for ethnic groups (Macedonians - 261 individuals and Roms - 30 individuals), with p-value=0.06452>0.05.

There was no gender difference in the mean DMFT but the prevalence of caries-free 12-year olds in Eastern Region of our country was higher in males (26.374%) than females (15.90%). The ratio of D/DMFT gives an indication of treatment need. In the current study, this ratio indicated that untreated caries was responsible for 0.532 (53.24%) of the DMFT index.It was clear that almost half of the caries experience was untreated, indicating that there was a problem with access to the dental care service by this age group.

The statistically significant difference of the caries experience between the cities and villages might be explained by the different fluoride concentration in drinking water.In the previous study we found that the concentration of fluorine in the tap water in Štip was 0.75 ppm F [20].

Conclusions

According to the findings of the present study, the conclusions are:

The prevalence of dental caries in primary school children from Sixth and Seven Grades from the Eastern Region of the Republic of Macedonia was 78.79% and varied between the cities from 67.19% in Štip, 82.29% in Kočani, 94.74% in Delčevo and 95.0% in Orizari. The mean DMFT was 3. 467 ± 2.904 and varied between cities from 2.41 ± 2.27 in Štip, 3.69 ± 2.98 in Kočani, 4.53 ±2.63 in Orizari to 4.61 ± 2.91 in Delčevo.

The present study demonstrated that dental caries experience is still high among school children (11-13 years old children) from the Eastern Region of the Republic of Macedonia. The WHO European goals for oral health by the year 2000 was that the population of 12-year olds should have a mean DMFT of no more than 2 [21]. It is apparent that these goals had not been achieved in Eastern Region of our country. Extensive privatization of the public oral health services and the slow development of insurance systems covering treatment costs had impact on these results, as well. It remains a major challenge for the Dental Public Health Service to improve access to dental care and continuing with the preventive programmes.

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Contributions of each author

• VA Data collection, interpretation, writing and study design.

• VA Data collection.

Statement of Conflict of Interest

In the opinion of the authors, there is no conflict of interests.