Dental Caries Experience among Secondary School Children in the Vardar Region of the Republic of Macedonia

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Abstract

Aim: The aim of this study was to assess the dental caries in 15-year-old children attending regular public secondary schools in Veles.

Methods: The study has been carried out during 2013 on adolescents aged 15.01(±0.42).In this cross-sectional study, the secondary school children from first grades (N=127) have been selected from 2 Secondary Schools in Veles. The dental status of the participants was evaluated on the basis of the 1997 World Health Organization caries diagnostic criteria for Decayed, Missing or Filled Teeth (DMFT) by 2 calibrated examiners. *P* value ≤0.05 was considered statistically significant.

Results: The total number of children in the exercise was 127, consisting of 59 (46.46%) female and 68 (53.54.2%) male. The mean DMFT was 4.9768, with standard deviation (SD) of 3.5084 and 95% confidence interval (CI) of 4.3603-5.5925. Significant Caries (SiC) index was 8.9302. The prevalence of caries-free children was 9.45%. The percentage of untreated caries or the ration of D/DMFT was 0.5601 (56.01%).

Conclusions: The present study provides some evidence of relatively high caries prevalence and severity in comparison with the Western European countries. It is necessary to dedicate more attention to the oral health of children and adolescents in our country.

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

Introduction

The influence of socio-economic factors and living conditions on the oral health status of individuals and populations has been documented over the recent decades [1]. Despite the recent substantial decline in the prevalence of dental caries in developed countries [2], it still remains a public health problem within the under privileged sections of the population, especially among children attending secondary schools.

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 1776 settlements [3]. The Republic of Macedonia is a developing country undergoing many political and economic changes in the process of becoming a member of the European Union. In Macedonia, there is a National Caries Preventive Program which started to be implemented in 2007 by 142 calibrated paedodontics according to the standards of the WHO, who, after the privatization of the dental sector, continued to work in the frame of public health. They have an obligation to take primary preventive measures according to the National Strategy of Prevention of Oral Diseases in children at age 0-14 in the Republic of Macedonia [4].

The Vardar Statistical Region (*Figure 1*) is one of the eight statistical regions of the Republic of Macedonia, located in the central part of Macedonia. Vardar statistical region is divided into 9 municipalities: Čaška, DemirKapija, Gradsko, Kavadarci, Lozovo, Negotino, Rosoman, Sveti Nikole and Veles.The largest ethnic group in the region is consisted of Macedonians.

The Vardar Region covers the central part of the Republic of Macedonia and spreads along the Vardar River and Ovchepole Basin. This region had the smallest number of citizens, 7.5% of the total population, in 2011. It covers 16.2% of the area of the Republic of Macedonia and at the same time is the most sparsely populated region with only 38.1 citizens per km^2.

The abundance of water resources are rivers and artificial lakes, the favorable Mediterranean climate that penetrates along the Vardar River valley and the geo-morphological configuration of the terrain are the main pre-conditions for this region to be renowned for its production of fruit and geographically specific grape vines. As a result, this region has the largest number of wine-cellars and grape-processing facilities in the country. Another important industry of the region is the production and processing of ferronickel [3].

The current population of the Vardar Statistical Region

***Figure 1**. Map of the municipalities of the vardar stastical region.*

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is 154535 citizens or 7.5% 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 89.0%, Albanians 3.3%, Turks 2,0%, Bosnians 1.9%, Serbs 0.9%, Gypsies 0.8% and others 1.1% (*Figure 2*).

In 1991, the scientific project designed upon the World Health Organization Criteria and directed by Necheva has been implemented in four districts (Skopje, Veles, Štip and Ohrid) in the Republic of Macedonia. A total number of 1034 persons from urban and rural population groups aged 6, 12, 15, 18, 35-44 and over 65 from the whole country were subject to examination. The DMF scores for 15 year children were 8.13 [5].

A system for monitoring and registration of dental caries is in place in the Republic of Macedonia, 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) does not exist [6].

Adolescence is the key life-stage when oral health behaviours such as toothbrushing and diet choices should become habits. However, it is also a period during which parental influence wanes and adolescents become more independent in terms of both their general and health behaviour. Oral Health is an integral component of a population's general health and allows individuals to function in every-day life (eat, speak and socialize) without any problems caused by illness, discomfort or disability. Furthermore, oral health contributes to the overall individual's well-being [7].

Children from this age group were born in 1997/98 and were not exposed to fissure sealing of the first permanent molars right after their eruption, which was part of the National Caries Preventive Program and National Strategy and started to be implemented in 2007 [4].

Aim

The aim of this study was to assess the dental caries prevalence and experience of 15-year-old secondary school-children within the Vardar Region of the Republic of Macedonia and evaluate how their disease pattern is related to variables, such as gender, rural-urban areas of the population.

***Figure 2**. Ethenic groups in the vardar region of Macedonia.*

Methods

The sample for the present cross-sectional study was 127 school children from first grades, attending two regular upper secondary schools, based in two different areas in Veles. Based on the information from the Macedonian Institute of Statistics [8], there are approximately 6.222 children attending regular secondary schools in this region. In the municipality Veles four secondary schools exist in which 2.738 pupils attend the schools. Veles is situated in the central part of our country. Written permission has been obtained from the Regional Education Authority and parents or guardians of the pupils. Permission for the study was obtained from the school authorities, who sought and obtained consent from the parents of the children concerned.

It has been decided to use cluster sampling because it was more economical and achievable within the constraints of resources and finance. Children from all classes in these two schools: Gymnasium "KocoRacin" from chemical engineering department with Macedonian and Albanian classes and secondary municipal school "Jofce Teslickov" from economics department were included in the study. Ethical approval was obtained from the Ministry of Health.

The inclusion criteria were as follows: Students from both gender aged 15 and attending first grade of secondary school. The exclusion criteria were students who did not arrived at their oral examination appointment and those who did not sign the information content for the conducted research.

The collected statistical data were from the secondary school children in the Central part of the Republic of Macedonia. For each child, the 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 thestatistical sample was 127. In *Tables 1 and 2*, the distribution of individuals in studied sample is given.

The study was carried out within a period of one month, April 2013. Data were collected by means of clinical examinations in daylight using plain dental mirrors and probes, which took place at the Hygienic Institute Veles in separate rooms with the person seating on the dental chair.

Children from first grades of the secondary schools are around 15 years old. At this age, the permanent teeth have been exposed to the oral environment for 3-9 years. The assessment of caries prevalence is therefore often more meaningful than at 12 years of age. Two calibrated dental examiners conducted the dental examination and the clinical

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

Sex / Area	Male	Female	Total
Urban	31	44	75 (59,1%)
Rural	37	15	52 (40,9%)
Total	68 (53,5%)	59 (46,5%)	127

Table 2. *Distribution of individuals in studied sample (city/village of living ,ethnic affiliation).*

Ethnic affiliation / City/Village of living	Macedonians	Albaninas	Others	Total
Veles	64 (50.39%)	0	5 (3.94%)	69 (54.33%)
GornoJabolciste	0 (0%)	14 (11.02%)	0 (0%)	14 (11.19%)
Buzalkovo	0 (0%)	13 (10.24%)	0 (0%)	13 (10.24%)
Ivankovci	4 (3.15%)	0 (0%)	0 (0%)	4 (3.15%)
Others	11 (8.66%)	8 (6.30%)	8 (6.30%)	27 (21.26%)
Total	79 (62.20%)	35 (27.56%)	13 (10.24%)	127 (100%)

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

Caries free		DMFT				
		Mean (SD)	95%CI	DMFT median	95%CIfor DMFT median with Wilcoxon signed rank test	p-value
whole sample	12 (9.45%)	4.9768 (3.5084)	4.3603-5.5925			
Sex groups						
Male	9 (13.24%)	4.8676 (3.5865)	3.9995-5.7358			0.7085
Female	3 (5.08%)	5.1017 (3.4426)	4.2045-5.9988			
Area groups						
Urban area	8 (10.67%)	5.1333 (3.5805)	4.3095-5.9571			0.5438
Rural area	4 (7.69%)	4.75 (3.4235)	3.7969-5.7031			
Ethnic affiliation						
Macedonians	10 (12.66%)	4.9114 (3.5920)	4.1068-5.7160			0.9315
Albanians	0 (0.00%)	4.8571 (2.8506)	3.8779-5.8364			
City/village of living						
Veles	8 (11.59%)	4.8696 (3.4467)	4.0416-5.6976	4.00	4.499949-6.5000	0.4988
GornoJabolciste	0 (0.00%)	5.429 (2.2089)		5.00	4.000008 - 6.999991	
Buzalkovo	0 (0.00%)	4.385 (3.4288)		3.00	2.000033 - 6.500000	

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 [9] caries diagnostic criteria were followed. The DMFT, Decayed, Missed, or Filled Surfaces (DMFS) and SiC indices were used to evaluate children dental caries experience. Caries prevalence was classified according to a scale as an indicator of oral health, DMFT 0 to 1.1 (very low prevalence); DMFT 1.2 to 2.6 (low prevalence); DMFT 2.7 to 4.4 (moderate prevalence); DMFT 4.5 to 6.5 (high prevalence) and DMFT>6.6 (very high prevalence). A new index called the 'Significant Caries Index' (SiC)was recently proposed by the World Health Organization (WHO) to draw attention to thoseindividuals with the highest caries scores in each population [10].

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 secondary school children, the R software environment for statistical computing was used (http://www.r-project.org/).

One way Analysis of Variance (ANOVA) was used to find the difference in mean DMFT between sex groups, area groups and ethnical groups. Kruskal-Wallis rank sum test was used to identify the difference in mean DMFT of the children living in different cities and villages.

Results

The mean value of the DMFT index for the whole sample is 4.9768, with standard deviation (SD) of 3.5084, and 95% confidence interval (CI) of 4.3603-5.5925 (*Table 3*).

In the whole sample, 12 (9.45%)% of the individuals were caries free (DMFT=0). As a complement of the mean DMFT value, for the whole sample, the SiC index of 8.9302 was calculated.The SiC indices for the sex groups (male, female), ethnic groups, area groups (urban or rural) and city/village were given in *Table 4*.

In *Figure 3*, the distribution of DMFT score is given. The Shapiro-Wilk test fornormality was performed, and the hypothesis that the data is normally distributed is rejected with p-value =(p-value = 6.726e-05). In *Figure 4*, the boxplot of DMFT score in the whole sample is given, showing the range, quartiles and outliers.

The mean DMFT index with SD and 95% CI were calculated for each group (according to sex orientation, area of residence, nationality, city or village) and these results are reported in Table 2. One way Analysis of Variance (ANOVA) was performed to see if there are differences in mean DMFT index between sex orientation groups, and corresponding p-value of 0.7085 > 0.05 indicating that there are not statistically significant differences between sex groups. Distributions of DMFT scores for some of the groups are illustrated by the boxplots (*Figures 5 and 6*).

One way Analysis of Variance (ANOVA) shows that p-value of 0.5438 > 0.05, indicating that there are no statistically significant differences between area groups.

Only two ethnic groups (Macedonians and Albanians) were statistically analyzed, since these groups were the only ones that count more than 30 individuals (*Table 2*).The one way analysis of variance (ANOVA): p-value= 0.9315 > 0.05, indicate that there are no statistically significant differences between Macedonians and Albanians.

Kruskal-Wallis rank sum test is a non-parametric test, so

Table 4. *SiC indices.*

SiC index	
Whole sample	8.93
Sex groups	
Male	9
Female	8.85
Area groups	
Urban area	9.24
Rural area	8.59
Ethnic affiliation	
Macedonians	9.12
Albanians	8.25
City/village of living	
Veles	8.87
GornoJabolciste	7.8
Buzalkovo	9

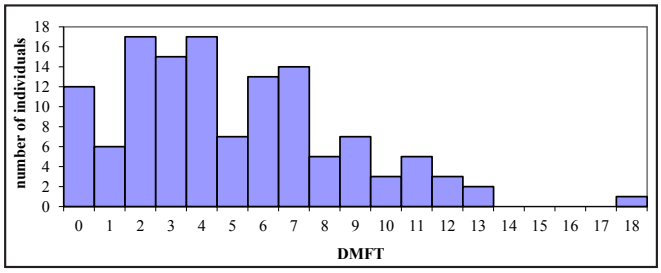

Figure 3. *Distribution of DMFT score in the whole sample.*

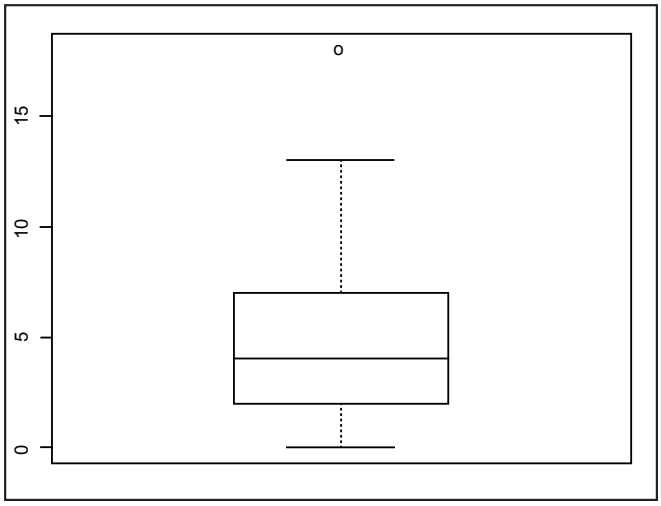

Figure 4. *Boxplot of DMFT score in the whole sample.*

the normality of data is not necessary, the equality of medians is tested, and it achieves its best performance for sample sizes 5 and larger. The p-value of 0.4988 > 0.05, indicating that there are not statistically significant differences between DMFT medians for individuals who live in Veles, G.Jabolciste and Buzalkovo.

The DMFT components, DT, MT and FT, were also analyzed. Their frequencies, mean values, SD's and 95% CI's are provided for in *Table 5*. It is important to describe the composition of the DMFT, which allows us to evaluate the level of dental care in the country.

Discussion

There has been no relevant research conducted recently in Macedonia that would have provided throughout and detailed information on the frequency of dental caries.This is the first

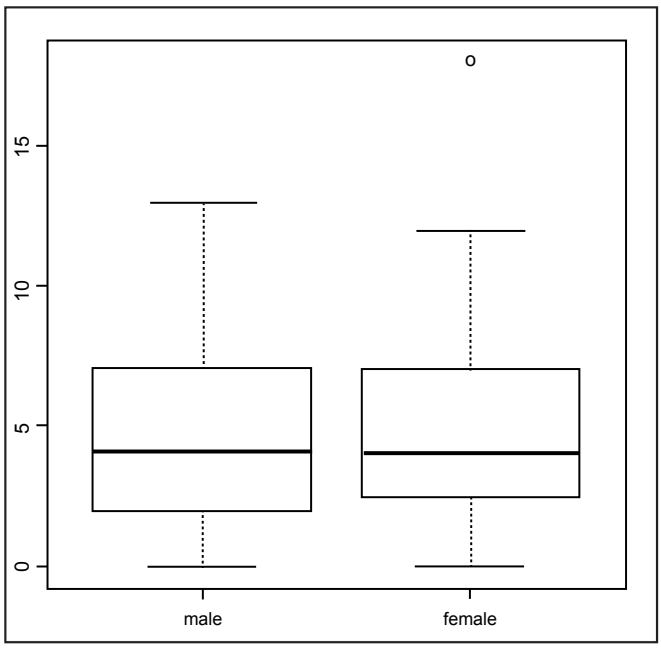

Figure 5. *Boxplots of DMFT score for sex groups.*

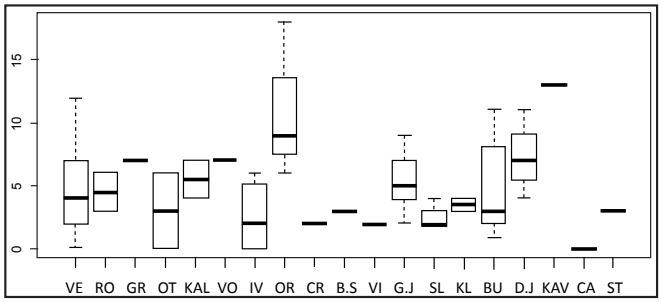

Figure 6. *Boxplots of DMFT score for city/village groups.*

Table 5. *DT, MT, FT frequencies and scores for the whole sample.*

	Frequency	Mean (SD)	95%CI
DT	56.01%	2.7874 (2.7011)	2.3131 - 3.2617
MT	9.02%	0.4488 (0.8329)	0.30255 - 0.5951
FT	34.97%	1.7402 (2.2439)	1.3461 - 2.1342

study to present SiC indices associated with caries prevalence and experience for 15-year-old children from town Veles. This study will help to evaluate the effectiveness of a preventive programs contained in the National strategy of our country.

The study aimed to assess the dental caries experience in secondary school children from the largest city in the Vardar Region of the Republic of Macedonia.

The overall mean DMFT was 4.9768 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 9.45% and the caries prevalence was 90.55.79%. Moreover, the DMFT index was 4.9768 and the SiC 8.9302, indicating that one-third of the sampled had a caries experience twice greater than the mean DMFT. Findings from Greece, suggest that the mean DMFT for 112 adolescents, aged 15-18 years old was 3,0 with 35,1% of the sample having DMFT=0, 35,8% a DMFT=1-5 and 28.8% a DMFT≥ 5 [7]. For the 15 year-olds, Oulis et al. (2010) in a national path finder survey conducted in Greece found mean DMFT of 3.19 [11].

However, according to the results given by Ambarkova et al. [12] in 2013, mean DMFT (3.467) value was acquired in

the 12-year children from East region of our country. Because we know that DMFT score increases with increasing age, we expected that the15-year group of children from Veles will have higher DMFT scores than 12-year old children.

Most western European countries (especially Denmark, Finland) and USA have reported the mean DMFT scores of approximately ranged between 2.2 and 3.1,whereas values acquired in the former eastern European countries have reported DMFT scores which were even up to three times higher [2,13,14]. Slovenian adolescents at 15 years of age have 10.2 DMFT in 1987, but only 5.6 in 1992 [13]. The notable improvement of dental health can be explained by the preventive programmes introduced in Slovenia in various periods, like supervised brushing (with concentrated fluoride gel) taking place some 16-18 times a year in primary schools attended by children aged 7-15 year and a comprehensive programme of applying fissure sealants, particularly on first molars [15].

In the study of Sanchez-Acedo et al. conducted in Valencia (Spain) in 15-year-old group the mean DMFT was 1.81 (CI-95%: 1.53-2.009) and caries prevalence 54.3% (Sanchez-Acedo) .The survey of Skinner et al. [17] conducted 2010 in New South Wales, Australia, reported a mean DMFT for 14 and 15 years olds of 1.2 and identified that 45.4% of students had an experience of dental caries [16,17].

In the present study, decay contributed the most to the DMFT for 15 year-old children, indicating that untreated caries was a problem for this age group. The decayed component (D=56%) constituted the main part of the DMFT score. Also, FT (F=34.97%), were the major part of DMFT in adolescents from this study. Permanent overall improvements are evident for the permanent teeth across the UK, D for 15-year-old children falling from 42% in 1983, via 30% in 1993 to 13% in 2003 [18,19]. In India, Nayak SS et al. find among 60 subjects in the age group of 12-15 years children of Belgaum city, mean DMFT score of 4.1.

Comparing the results from this study (DMFT=4.9768) with the results for 15 years old children from 1991(5), when the DMF scores was 8.13, it is evident that the DMFT index show tendency to decrease. In this study participated children were at the age from 14 years and 6 months to 17 years old. Groups of children with less than 15 years, with 15 years and with 16 years and more were 9, 108 and 10 respectively. The subsamples are not large enough to test differences among age groups. Mean DMFT values of 4.9768, indicated a lack of efficient disease prevention. Shearer DM and Thompson WM et al. concluded that oral health in adulthood was determined by oral health in children (20 Shearer DM et al). Among 15-year olds in Bosnia and Herzegovina, the DMFT was 7.6 (SD ± 4.1), SiC was 9.2 (SD ± 1.2), and filled teeth constituted the major part of the index [20,21].

The limitations of the dmft/DMFT index for epidemiological use have been discussed in many articles [22-25]. It is claimed that it mixes disease and treatment and makes it difficult to differentiate between previous or existing caries. The index is irreversible and cannot inform whether restorations (filled teeth F), are due to caries or other reasons, e.g. hypoplasia. The “filled teeth (F)”criterion is also inaccurate as the criteria behind the decision of a practitioner to fill a tooth, are undefined. Another problem is that the dmft/DMFT index does not indicate whether the caries lesion reported is in an active or inactive state (arrested caries). It is additionally impossible to consider the number of teeth that are at risk of caries and it cannot monitor caries progression.

The Scandinavia countries belong to the so called very low and low-caries countries [26].

The BASCD survey of 14-year-olds in the United Kingdomfound DMFT scores of 2.1 in 1990 and 1.7 in 1994 while the 2009 New Zealand Oral Health Survey found a DMFT of 1.9 amongst 12-17-year-olds [21,22]. This epidemiological study should inform oral health service planners and policy makers in our country to make informed decisions.

Conclusions

The prevalence of dental caries in secondary school children from Veles was 90.55%. The mean DMFT was 4.9768 ± 3.5084. Significant caries (SiC) index was 8.9302. The prevalence of caries free children was 9.45%.

The present study provides some evidence of relatively high caries prevalence and severity in comparison with Western European countries. It is necessary to dedicate more attention to the oral health of adolescents. This study provided data that will contribute to the national picture on adolescent oral health.

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Contributions of each author:

- VA Data collection, interpretation, writing and study design.
- AS Data collection.
- AD Literature research.
- MJ and DG were responsible for the analysis and interpretation of the data.

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