Dental Caries Experience among 15-years Old Children in the Southeast Region of the Republic of Macedonia

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Abstract

Aim: The aim of this study was to assess dental caries in 15-year-old children attending regular public secondary school in Strumica. **Methods:** The study was conducted in 15 year olds during the year 2013. In this cross-sectional study, secondary school children from first grades (N=476) were selected from two Secondary Schools in Strumica. 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. *P* value ≤ 0.05 was considered statistically significant. **Results:** The total number of children in the sample was 476, comprising 189 (39.71%) females and 287 (60.29%) males. The mean DMFT was 3.55 (standard deviation (SD) 2.99; 95% confidence interval (95% CI 3.28-3.82), the significant caries (SiC) index was 6.94. The prevalence of caries-free children was 17.25%. The percentage of untreated caries or the ration of DT/DMFT was 0.4060 (40.60%). **Conclusions:** Dental caries experience was seen to be moderate among secondary school children from Strumica city and its surrounding.

Key Words: Caries, Caries prevalence, DMFT index, Macedonia, School childrenKey Words: Bibliometrics, Citation analysis, Dental trauma research

Introduction

Over the past 20 years, a marked decline in the prevalence of oral disease has been observed in several western industrialised countries. In children, improved oral health is seen in the systematic decline in dental caries and a continually growing number of caries free individuals. This is ascribed to changing life-styles and living conditions, a more sensible approach to sugar consumption, improved oral hygiene practices, use of fluorides in toothpaste, fluoride mouth rinsing or topical application of fluorides, and systematic school.

However, the general pattern is that the prevalence rate of dental caries in children has remained high in most of Central and Eastern Europe. The mean dental caries experience (DMFT = the number of Decayed teeth, Missing teeth due to caries and Filled teeth) is relatively higher for Central and Eastern Europe but, equally important, the D-T component of the index is high in children as well. This shows that significant proportions of the children are in need of dental care.

Due to the skewed distribution, a new index called significant Caries Index (SiC) was introduced in 2000, to focus attention to those individuals with higher caries indices in the population studied [1,2].

The Southeast Region *(Figure 1)* is located in the extreme southeast part of the country and comprises the Strumica-Radovish and Gevgelija-Valandovo basins, the Strumica River valley and the lower course of the Vardar River. In 2011, 8.4% of the total population in the Republic of Macedonia lived in this region. The region covers 10.9% of the total land area of the country and has a population density of 63.2 people per km². Another specific feature of the region is that in 2011, compared to the other regions, it had the highest activity and employment rates (71.0 and 64.4, respectively) and the lowest unemployment rate (9.3) [3].

The current population of the Southeastern Statistical Region is 171.416 citizens, according to the last population census in 2002. The largest ethnic groups in the Southeast region are the Macedonians 90.4%, Turks 7.4%, Serbs 0.7% and others 1.5% *(Figure 2)*.

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 [4]. However, epidemiological data representing oral health status, particularly referring to dental caries among Macedonian school children are still insufficient and incomplete.

WHO recommends performing oral health epidemiological studies in certain key age groups: adolescents from 12 and 15 years old and in children 5 to 6 are two of these. From an epidemiological point of view, dental caries is widely
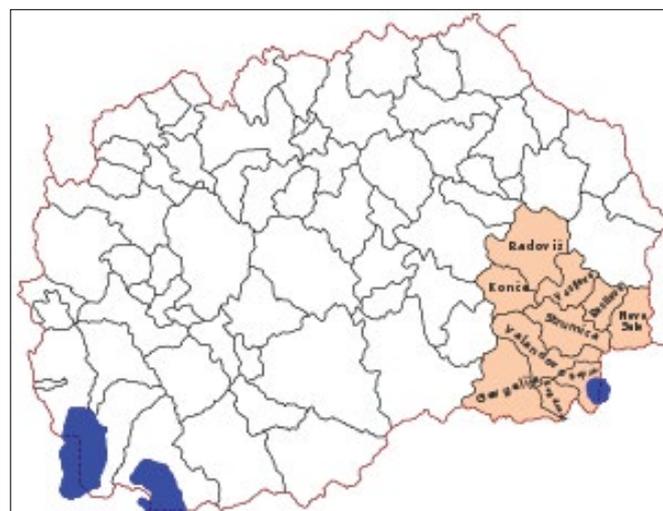
Figure 1. *The Southeast Region*

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Figure 2. The largest ethnic group in the Southeast region.

disseminated across the world and may be considered a public health problem in Macedonia. It results from differences between normal interactions of the teeth surface, microbial biofilm, oral hygiene and dietary habits, and still equally affects individuals of all ages [5]. Some reports have identified different socioeconomic and sociodemographic variables associated with caries, such as age [6-8] and being female [9,10].

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 [11].

Adolescents are more aware of the appearance of their teeth and have greater aesthetic concerns about their teeth, as compared to others [12]. Adolescent patients expect dental treatment to boost their self-esteem and confidence [13]. This maybe because they are more concerned about acceptance by peers and, thus, their oral health status can have an exaggerated effect on their self-worth and self-confidence.

Diverse strategies have been carried out to bring under control the dental caries problem, mainly by means of fluoridation in its various approaches [14,15]. 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 [15].

The objective of the present study was to expand the information with regard to adolescent oral health by evaluating experience, prevalence, and severity of dental caries in adolescents (15-years old) from Southeast region of the Republic of Macedonia.

Aim

The aim of this study was to assess the dental caries prevalence and experience of 15-year-old secondary school children within the Southeast 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.

Methods

The sample for the present cross-sectional study was 476 school children from twenty classes of first grades (electrical technicians, transport and shipping technicians, electromechanical technicians and traffic technicians) attending secondary municipality school "Nikola Karev" and Gymnasium "Jane Sandanski" in Strumica. Based on the information from the Macedonian Institute of Statistics [16] there are approximately 6790 children attending regular secondary schools in this region. In the municipality Strumica live 54 676 inhabitants. In the municipality of Strumica, three secondary schools exist in which 3807 pupils attend the schools.

Written permission was 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 was decided to use cluster sampling because it was more economical and achievable within the constraints of resources and finance. Thirteen classes of children in the secondary municipality school "Nikola Karev" and seven classes from the Gymnasium "Jane Sandanski" were included in the study. Ethical approval was obtained from the Ministry of Health.

The study was conducted over a period of one month in April 2013.Data were collected by means of clinical examinations in daylight using plain dental mirrors and probe, which took place in separate room with the subject seated on the dental chair.

Inclusion criteria for dental caries were diagnosed clinically and detected as visually apparent cavitations, discolorations of the enamel and/or visually diagnosed recurrent caries lesions. No radiographs were taken at that stage. Clinically acquired data were stored for each patient separately. DMFT scores were evaluated according to the WHO criteria [5]. The following criteria also included D component for untreated caries, M for teeth which were missing due to caries, and F for fillings that were present at the time of examination. 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).

Children from first grades of 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. Oral exams were performed by two examiners, who were previously trained and standardized. WHO's criteria for detection of caries were employed (kappa interexaminer=0.93; intraexaminer=0.98). 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 0.93). World Health Organization 1997 [5] 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 [1,2]. This index is calculated as of the DMFT scores (mean decayed, missing, and filled teeth) and the third of the population with higher DMFT scores are the bases to calculate SiC [2]. SiC Index is the mean DMFT of the one-third of a population with the highest caries values. The SiC index is calculated sorting the individuals according to their DMFT, after that one third of the population with the highest caries values was selected and the Mean DMFT for this subgroup was calculated in Excel program.

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 SAS statistical program was used. T-test was used to find the difference in mean DMFT between sex groups and area groups. *P* value ≤ 0.05 was considered statistically significant.

Results

Statistical data that was collected were from secondary school children in the Southeast Region 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 476. In *Table 1*, the distribution of individuals in studied sample *(gender, area)* is given. In *Table 2*, the distribution

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

Sex / Area	Male	Female	**Total**
Urban	92(19,33%)	73 (15,34%)	**165 (34,66%)**
Rural	195(40,97%)	116 (24,37%)	**311 (65,34%)**
Total	287 (60.29%)	**189 (39,71%)**	**476 (100%)**

Table 2. Distribution of individuals in studied sample (city/village of living) and mean DMF.

City/Village of living	Macedonians	Mean DMF
Strumica	152 (31.93 %)	3.89
Kukliš	17 (3.57 %)	3.71
Vasilevo	16 (3.36 %)	2.31
Dabile	14 (2.94 %)	3.79
Novo Selo	12 (2.52 %)	4.58
Dobrejci	12 (2.52 %)	2.5
Prosenikovo	12 (2.52 %)	2.5
Murtino	11 (2.31 %)	4.54
Piperevo	11 (2.31%)	3.64
Turnovo	10 (2.1%)	4.9
Others	209(43.91 %)	3.26
Total	**476 (100 %)**	

of individuals from Strumica city and other villages, together with their mean DMF values is given.

The mean value of the DMFT index for the whole sample is 3.55 m mi, with standard deviation (SD) of 2.99 and 95% confidence interval (CI) of 3.82-3.28. In the whole sample, 82 (17.25%) % of the individuals were caries free (DMFT=0). As a complement of the mean DMFT value, for the whole sample, the SiC index of 6.94 was calculated. The mean DMFT index with SD and 95% CI were calculated for each group (according to sex orientation and area of living) and these results are reported in *Table 3*.

In *Figure 3*, the distribution of DMFT score is given. In *Figure 4*, the boxplot of DMFT score in the whole sample is given, showing the range, quartiles and outliers.

T-test was performed to see if there are differences in mean DMFT index between the groups (male and female, rural and urban area), and corresponding p-values are reported in *Table 3*. The results indicate that there is a statistically significant difference between the mean DMF for males and females (t = -4.14, p<.0001). In other words, females have a statistically significantly higher mean score of average DMF (4.2434) than males (3.101). While, T-test with p-value = > 0.05, show that there are not statistically significant differences between mean DMFT scores for individuals who live in urban and rural area *(Table 4 and Figures 5 and 6)*.

The DMFT components, DT, MT and FT, were also analyzed. The frequencies, mean values, SD's and 95% CI's are reported in *Table 4* and *Figure 7*. The SiC indices for the sex groups (male, female), area groups (urban or rural) and city/village were given in *Table 5*.

Discussion

Data about oral health in adolescents is sparse in the scientific literature in Macedonia. In this context, one contribution of the present findings is to help fill the existing information gap for this age group. First, we found that caries prevalence was close to 82 percent in this population – that is, three out of every four adolescents had at least one tooth decayed.

This prevalence (82.75 percent), the mean DMFT index (3.55 ± 2.99) and the SiC (6.94) observed in 15-year-old adolescents were lower than those reported in the other studies from Balkan countries-for example, the findings reported by Markovic et al. [17]. Among 15-year-olds from 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. In the study from Lalić M et al. [18] conducted in Belgrade,

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

| Number	Caries free	DMFT Mean (SD)	DMFT 95% CI	p-value
whole sample 476	82 (17.25%)	3.55 (2.99)	3.82-3.28	
sex groups				
Male 287	50 (17.42%)	3.10 (2.81)	2.59-3.43	p<.0001
Female 189	32 (16.93%)	4.24 (3.13)	2.85-4.69	
area groups				
urban area 165	24 (14.55%)	3.95 (3.22)	3.46-4.44	> 0.05
rural area 311	58 (18.65%)	3.34 (2.85)	3,02-3.66	
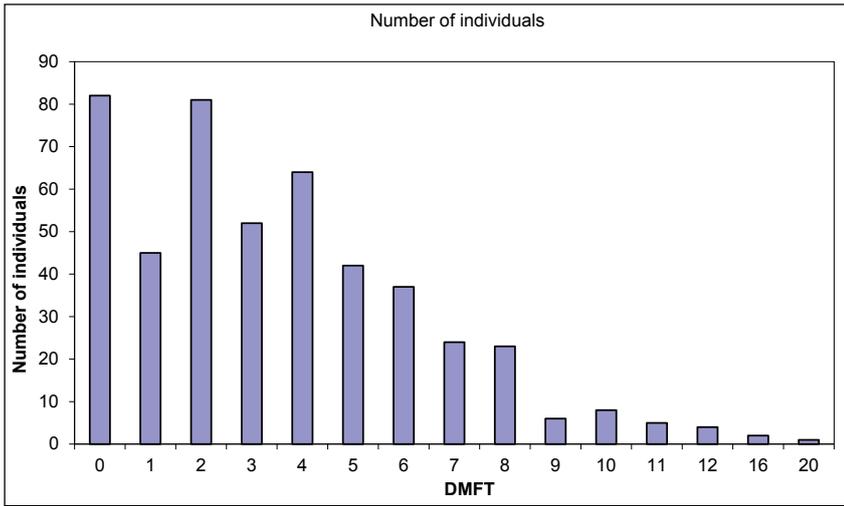
Figure 3. Distribution of DMFT score in the whole sample.
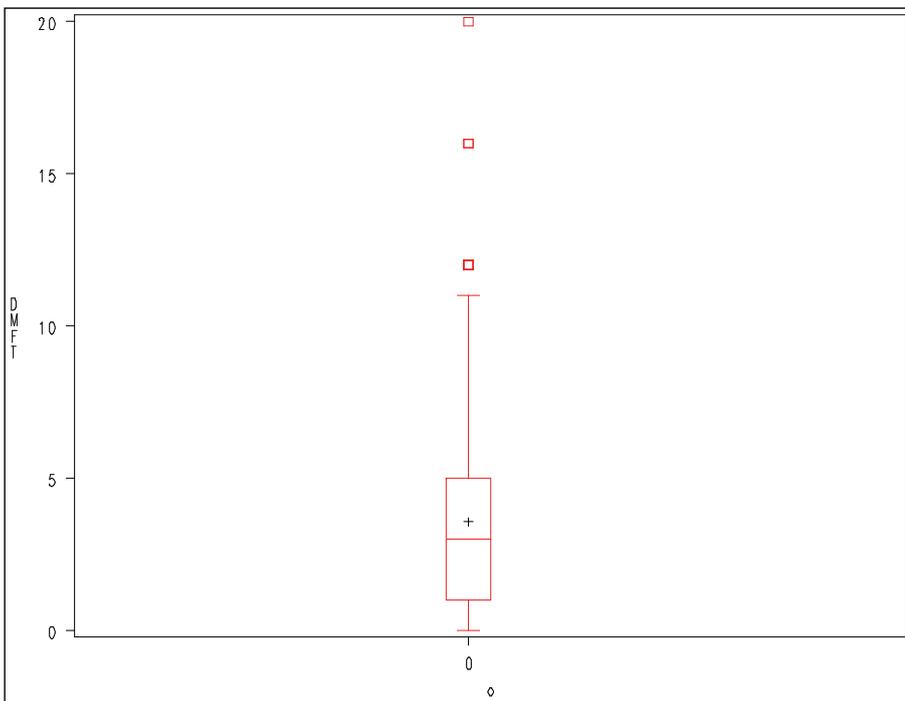
*Figure 4.* Boxplot of DMFT score in the whole sample.
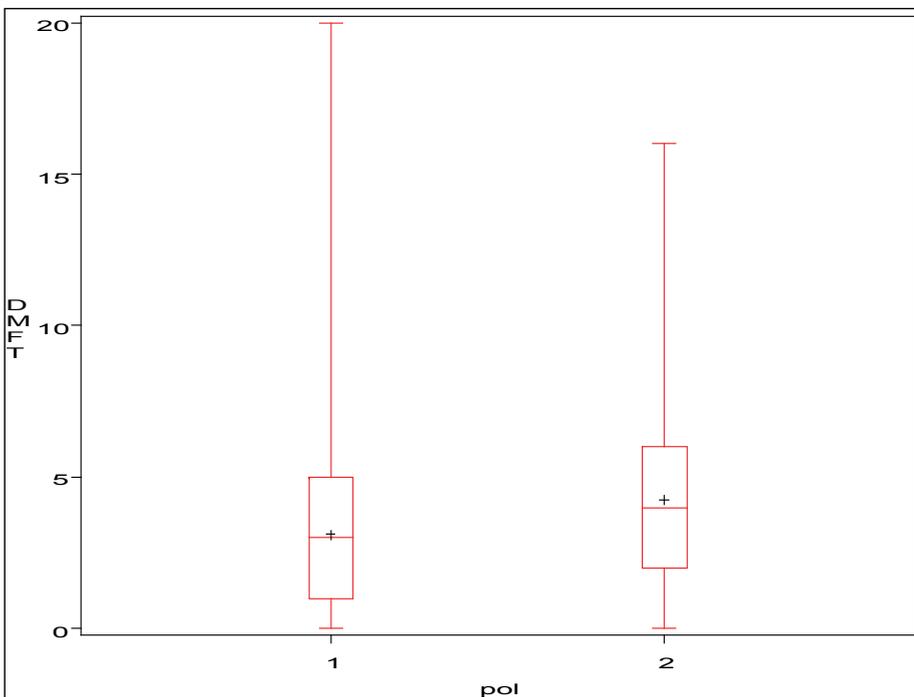
*Figure 5.* Boxplots of DMFT score for sex groups.
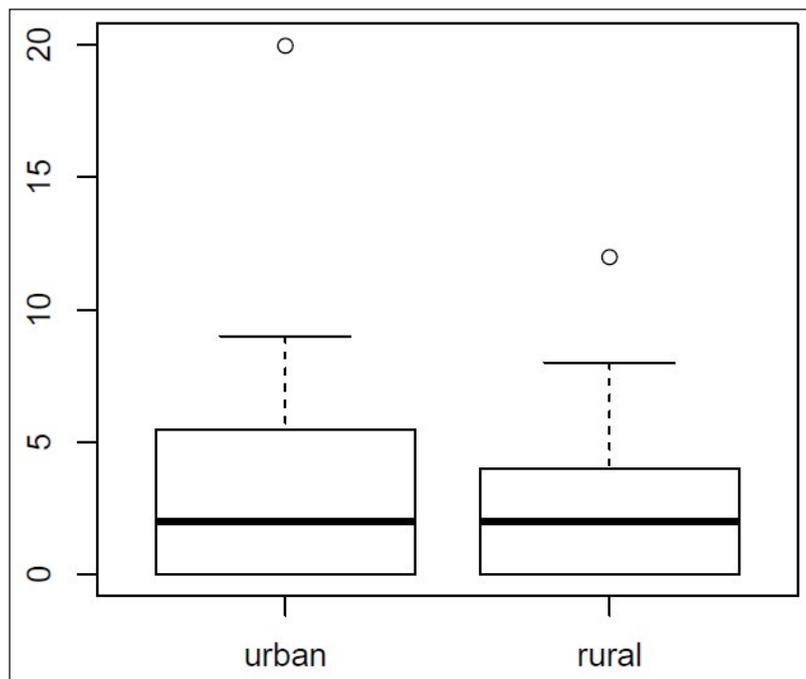
Figure 6. Boxplots of DMFT score for area groups.

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

|	Frequency	Mean (SD)	95% CI
DT	40.60%	2.88 (2.09)	2.69-3.07
MT	8.63%	0.61 (0.76)	0.68-0.54
FT	50.77%	1.80 (2.50)	1.58-2.02
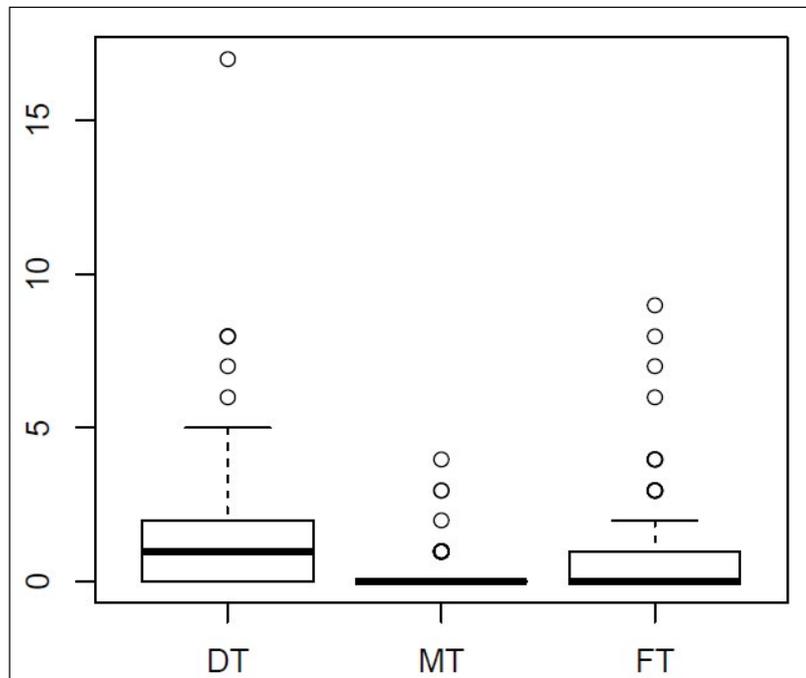
Figure 7. Boxplots of DT, MT and FT score in the whole sample.

the capital of Serbia, DMFT index of 15-year old children was 5.84.

Following WHO methodology made it possible to compare our findings with other national surveys. The first nationwide survey according to WHO standards on the prevalence of dental caries from this region (the region of former Yugoslavia) was carried out in 1986 [19]. Results showed the prevalence of dental caries in the Yugoslav child population to be very high, with a mean DMFT for 12-year-olds of 6.1 and 9.6 for 15-year-olds [19]. Slovenia was the

only former Yugoslav country where a remarkable decrease in caries prevalence was recorded [20]. In the analytical study of Nishi et al. published in 2002, all the country except three (Bolivia, Costa Rica and Honduras) has mean DMFT values less than 3. Only Jamaica, Senegal and Sweden showed SiC indices that were less than 3 DMFT [1].

The SiC is part of DMFT, calculated on one third of population with the highest caries scores and it is always higher than DMFT. In general, the greater the mean DMFT a country has, the greater the SiC index [1]. Some other studies

Table 5. *SiC indices.*

SiC	
Sex groups	
Male	5.5
Female	8.37
Area group	
Urban area	7.51
Rural area	6.47
City/village of living	
Strumica	7.06
Kukliš	6.66
Vasilevo	4.8

reported average DMFT score in the group of 15 years old subjects 1.8 in Germany [21], 3.19 in Greece [22], 4.3 in Slovenia [20], and 6.6 in Bosnia [23].

However the average DMFT score of 3.55 DMFT for15 year old children from Strumica was worse than the value of average DMFT score find by Schiffner et al in Germany [21], and by Oulis et al. in Greece [22]. The study of Đorđević S et al., reported average DMFT score in the group of 15 years old subjects to be 6.6 in Bosnia [23].

This region of our country is economically more developed compared to other regions. Strumica is the main agricultural center in the Republic of Macedonia, with good developed food industry, textile factories and a developed domestic and international trade network. This is due to its location and favorable climate. Strumica is the largest city in the eastern Republic of Macedonia, near the Novo Selo-Petrich border crossing with Bulgaria.

In the investigation conducted from May 2003 to May 2004, Ambarkova et al. [24] studied the fluoride concentration in the sources of drinking water in 92 localities from Macedonia. Optimal fluorine contents was found in the tap water from village Kolešino, and suboptimal in the villages Balinci, Marvinci, Brajkovci, Murtino and Pirava. Unfortunately, our study did not include students who were born in Balinci, Marvinci and Brajkovci villages, but included ten students from Murtino and two students from Pirava villages. The mean DMF index of the 10 students from Murtino was 4.54, which was higher than the average DMF of the whole sample. By 2009, the Kukliš, Dabile, Dobrejci, Murtino and Prosenikovo villages were included on public water supply. However, according to the results given by Ambarkova et al. [25] in 2013, mean DMFT (4.97) value was acquired in the 15-year children from Vardar region of our country. With the introduction of SIC World Health Organization makes a big step forward in the introduction of the new global order in the area of oral health, which is the value of the significant caries to be less than three index by 2015.

In the study conducted by Ambarkova V et all in East region, the total number of adolescents was 414, comprising 188 (45.4%) females and 226 (54.6%) males. The mean DMFT was 5.77 in Eastern region, with standard deviation (SD) of 4.02 and 95% confidence interval (CI) of 5.38- 6.16 [26]. According to studies by Ambarkova et al., dental caries experience was seen to be high among 15- year old secondary school adolescents in Vardar and Eastern Regions [25,26].

School health education programmes may be instrumental in development of healthy lifestyles in oral health as well as general health. Several studies conducted in Eastern Europe [27-30] have shown that in addition to involvement of parents, schoolteachers may assist in this process of oral health promotion.

Since health promotion activities in Macedonia are not systematically and consistently implemented, and the health care system is oriented toward treatment rather than prevention of oral diseases, mean DMFT score in 15 year-old adolescents of 3.55 was moderate.

The main advantage of this study is that it, was performed using internationally accepted methodology recommended by the WHO (1997) [5] allowing comparability of the findings with European studies and with earlier studies in the region. The limitations of the DMFT index for epidemiological use have been discussed in many articles [31-35]. 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 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. Another limitation is that we did not use the ICDAS system which gives more detailed description on the severity of caries.

According to Krisdapong S et al. [34], the traditional method of measuring oral health and treatment needs, based principallyon clinical indices, is inadequate [34]. He tough that to better comprehend a population's oral health and consequently plan oral health services more appropriately, some countries have included measures of perceived oral health or OHRQoL in their national oral health surveys [34-37].

This can aid in better understanding of their oral health perspective and the impact of their condition on their quality of life. By use of such a tool, oral health providers can tailor the treatment plan based on individual perceptions and expectations.

In Central and Eastern European countries, increased prevalence of dental caries in school children and adolescents is associated with inconsistent implementation of preventive measures and lack of organized health promotion activities [38]. In the future we expect as a result of the application and implementation of the National Strategy for prevention of oral diseases in children from 0 to 14 years of age, launched in 2007, DMFT index in this group of children drastically to be reduced.

Conclusions

The prevalence of dental caries in secondary school children from Strumica was 82.75%. The mean DMFT was 3.55 ± 2.99. Significant caries (SiC) index was 6.94. The prevalence of caries free children was 17.25 %.

The present study provides some evidence of moderate caries prevalence in comparison with 15 aged adolescents from Vardar region of our country. 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 and help in promoting adequate oral health based on the community needs.

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Contributions of each author

- VA Data collection, interpretation, writing and study design.
- OP Data collection

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