Dental Caries Experience among Six Year Old Children of the Republic of Macedonia

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Abstract

Objectives: The aim of this study was to assess the dental caries among primary school children (first grades) in Eastern, Southeast and Vardar Region of the Republic of Macedonia and evaluate if the disease pattern is different between the regions.

Materials and Methods: A cross sectional study was conducted in 2013 involving 301 six year old primary school children (born in 2007), who were randomly selected from seven central and 13 regional primary schools. The ethical clearance was taken from institutional ethical committee of the Faculty of Dentistry at the University of St Cyril and St Meth and parental consent was obtained for each child. Participants’ dental status was evaluated using the 1997 World Health Organization caries diagnostic criteria for decayed, missing and filled primary teeth (DMFT) and decayed, missing or filled permanent teeth (DMFT) by two calibrated examiners. Data obtained during the survey were stored in a database (SPSS 13.00 and tested for possible statistically significant differences using the Kruskal-Wallis ANOVA test. A p ≤ 0.05 was considered statistically significant.

Results: The total number of children in the sample was 301, comprising 152 (50.50%) females and 149 (49.50%) males. The results of this survey showed that the DMFT score of the six-year-old children from all three regions was 5.59 ± 3.82, while in the Eastern region was 5.65 ± 3.68 for the primary dentition and 0.04 ± 0.26 for the permanent dentition. Average DMFT score of the six-year-old children from the southeast region was 5.29 ± 4.30 for the primary dentition and 0.07 ± 0.3 for the permanent dentition, while for six-year-old children group from the Vardar region it was 5.81 ± 3.5 for primary dentition and 0.17 ± 0.5 for the permanent dentition. Kruskal-Wallis ANOVA test by ranks gave a p-value of 0.4 > 0.05, indicating that there was no statistically significant difference between DMFT scores of six-year-old children from different regions for primary teeth. Kruskal-Wallis ANOVA test by ranks gave a p-value of 0.03 < 0.05, indicating that there were statistically significant differences between DMFT scores of six-year-old children from different regions for permanent teeth. Significant caries (SIC) index was 9.93 ± 2.0. The prevalence of caries-free children was 15.82%. The percentage of untreated caries or the ratio of DMFT/DMFT was 85.08% (85.51%).

Conclusions: Dental caries experience was seen to be high among six year old children of the Republic of Macedonia.

Keywords: Dental Caries; DMFT Index; Macedonia

Background

Republic of Macedonia with its 25.44 square kilometers takes the central part of the Balkan Peninsula. The whole territory of the Republic of Macedonia consists of eight non-administrative units-statistical regions (Figure 1), 84 municipalities as administrative units and of 1776 settlements. The eight non-administrative units are: Southeast, Vardar, Eastern, Southwest, Pelagonia, Polog, Northeast and Skopje region. Dental caries is a public oral health problem and one of the major unmet needs in oral health amongst the six year old children of the Republic of Macedonia.

Children at the age of five years represent a key group recommended by the WHO for assessing caries of the primary teeth [1]. Although the global prevalence of caries among six-year-old children is decreasing, it remains a major public health problem with a considerable variation among countries [2]. While the prevalence of caries among six-year-olds was 32% in Spain [3], 46% in Portugal [4] and 49% in Austria [5], corresponding proportions for Turkey [6], China [7,8], India [9] and Ecuador [10] were 77%, 78%, 81% and 87% respectively. In European countries caries experience expressed as a sum of decayed, missing, filled teeth (DMFT index) for the six-year-olds varied from less than two affected teeth per child in Sweden [11], Norway [12], Finland [13] and Switzerland [14] to 4.7 in Belarus [15], while in China [16], the DMFT level of 4.5 was observed in the same age group.

The latest nationally representative Macedonian oral health survey made under the common Yugoslav study “Assessment of oral health and necessary treatment in populations of Yugoslavia, applying the basic criteria initiative of the WHO”, was performed in period 1987-1991 and showed that the DMFT index in permanent dentition among six-year-old children was 0.54 [17]. The oral health survey performed in 2013 by Ambarkova in the two municipalities (Berovo and Pechchevo) from the Eastern Region of the Republic of Macedonia showed that the prevalence of caries in primary dentition among five-year-old children was 90.91% and the mean DMFT index was 6.01 with decayed teeth (dt) being...
a predominant component (dt = 4.76, mt = 0.42, ft = 0.96) [18]. No adequate information about caries prevalence and experience among children is currently available from the region, particularly its rural areas which suffer poor availability of and accessibility to dental health services.

**Materials and Methods**

**Design and Population Studied**

In this cross-sectional study, which was conducted in September 2012 and from March to May 2013, DMFT (permanent teeth) and DMFT (primary teeth) indices among primary school children from three regions were investigated.

**Study Area**

In our study only children from three (Southeast, Vardar and East) regions are included. According to the last census in 2002 the Southeast, Vardar and East regions have a population of 171,416, 154,535, 181,858 citizens respectively. The Southeast Region is located in the extreme southeast part of the country and comprises the Strumica-Radovish and Gvegevlia-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). The East Region 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 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 Vardar Region comprises the central part of the Republic of Macedonia and spreads along the Vardar River and Ovchepole Basin. This region had the smallest number of children, 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 citizen per km² [19].

**Sample**

Children from first grades (N= 301) were randomly selected from 7 central and 13 regional primary schools. At least 50 children from each location were recruited according to WHO recommendations [1], comprising approximately 3% of all six-year-old children in the region. All study participants underwent a clinical dental examination in the selected primary schools. The children were anaesthetized, if necessary, and canines with intact crowns were removed from the study sample. In the three regions examined, no significant differences were found in the prevalence of caries experience, therefore only primary teeth were taken into consideration. Caries prevalence was calculated as a number of children with at least one affected tooth (decayed or missing or filled) divided by all examined children in the sample and multiplied by 100%. Caries experience was expressed as a sum of decayed, missing, filled teeth (DMFT index). Teeth which were absent because of natural tooth exfoliation were not taken into consideration in assessing the missing component.

**Statistical analysis**

Data obtained during the survey were stored in a database (SPSS 13.00) and tested for possible statistically significant differences using the Kruskal-Wallis ANOVA test. A p < 0.05 was considered statistically significant.

Two examiners were trained and standardized using a Kappa test (> 0.90) before starting the study. All data were expressed as mean ± standard deviation for continuous variables; frequencies and percentages were calculated for categorical data. Statistical analysis was accomplished by using non-parametric Mann-Whitney U Test. Kruskal-Wallis Test was performed to see if there are differences in mean DMFT/DMFT scores between the regions. Descriptive statistic was performed by calculating median and inter-quartile range.

**Results**

The total number of children in the sample was 301, comprising 152 (50.50%) females and 149 (49.50%) males (Table 1). The mean DMFT was 5.59 ± 3.82. Significant caries (SiC) index in the group of children was 9.93 ± 2.0. The prevalence of caries-free children was 15.82%. The percentage of untreated caries or the ratio of dt/DMFT was 0.8581 (85.81%).

The average value of a DMFT index of primary teeth is 5.29 ± 4.3 in the group of 6 years old children of the Southeast region, 5.1 ± 3.5 in the group of children from the Vardar region, while the average DMFT index of primary teeth in the group of children from the Eastern region was 5.65 ± 3.68 (Table 2, Figure 2). Statistically insignificant are the differences between the DMFT indices of primary teeth among six years old children from the three analyzed regions (p = 0.4).

In Table 2, (Kruskal-Wallis ANOVA test by ranks) p-value was > 0.05, indicating that there was no statistically significant difference between DMFT scores of six year-old children from different regions for primary teeth.

The research results shown in Table 3 showed that dental caries of primary teeth was about 80% of six years old children from all three regions analyzed, with statistical confirms that differences in the prevalence of caries in primary teeth between the three regions are insignificant (p = 0.66).

<table>
<thead>
<tr>
<th>Area</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>88</td>
<td>95</td>
<td>183</td>
</tr>
<tr>
<td>Rural</td>
<td>61</td>
<td>57</td>
<td>118</td>
</tr>
<tr>
<td>Total</td>
<td>149</td>
<td>152</td>
<td>301</td>
</tr>
</tbody>
</table>

**Table 1:** Distribution of individuals in studied sample (gender, area).
Missing teeth was found to be 8.4% of six years old children from the Southeast region, 18.2% of children from the East, and even 33.6% of children from the Vardar region (Table 3). These described differences in the distribution of the missing primary teeth among the six-year-old children from Southeast, Vardar and East region are highly statistically significant ($p = 0.000043$).

Highly significant differences in the terms of frequency of primary teeth restorations are detected between the six year old children from the three analyzed regions ($p = 0.002$). Restored primary teeth have only 5.3% of children from the Southeast region, 17.8% of children from the Vardar region, and 23.2% of the children who live in the East region (Table 3).

The group of six years old children from the Vardar region shown in table 4, significant ($p = 0.03$), significantly more often than children from Southeast and East regions had carious permanent teeth, while the difference in the prevalence of restored permanent teeth are insufficient to be confirm as statistically significant ($p = 0.56$) (Table 4).

The six year old children from the Southeast, Vardar and Eastern regions had significantly different values for DMFT index of permanent teeth ($p = 0.03$). The average value of this DMFT index in the Southeast region is $0.07 \pm 0.30$, in the Vardar region $0.16 \pm 0.54$, in the East region $0.04 \pm 0.28$ (Table 5).

### Table 2: Descriptive statistics / DMFT score of deciduous teeth / regions / within six year children of the Southeast, Vardar and Eastern region (Kruskal-Wallis ANOVA by Ranks $H (2, N= 301) = 1.842206$ $p = 0.4$).

<table>
<thead>
<tr>
<th>Region</th>
<th>N</th>
<th>Mean ± SD</th>
<th>95% Confidence interval of means</th>
<th>Min-Max</th>
<th>Median</th>
<th>Lower–upper quartiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southeast</td>
<td>95</td>
<td>5.29 ± 4.3</td>
<td>4.42 – 6.17</td>
<td>0 – 18</td>
<td>5.0</td>
<td>2.0 – 8.0</td>
</tr>
<tr>
<td>Vardar</td>
<td>107</td>
<td>5.81 ± 3.52</td>
<td>5.14 – 6.49</td>
<td>0 – 12</td>
<td>6.0</td>
<td>3.0 – 8.0</td>
</tr>
<tr>
<td>Eastern</td>
<td>99</td>
<td>5.65 ± 3.68</td>
<td>4.91 – 6.38</td>
<td>0 – 16</td>
<td>5.0</td>
<td>3.0 – 8.0</td>
</tr>
</tbody>
</table>

### Table 3: Distribution of decayed, missing and filled primary teeth in terms of regions/six year old children.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regions</th>
<th>Southeast</th>
<th>Vardar</th>
<th>Eastern</th>
</tr>
</thead>
<tbody>
<tr>
<td>d - decayed primary teeth</td>
<td>not exist</td>
<td>18 (18.95%)</td>
<td>17 (15.89%)</td>
<td>14 (14.14%)</td>
</tr>
<tr>
<td></td>
<td>exist</td>
<td>77 (81.05%)</td>
<td>90 (84.11%)</td>
<td>85 (85.86%)</td>
</tr>
<tr>
<td>Pearson Chi-square:</td>
<td>0.84 df=2</td>
<td>$p=0.66$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>m - missing primary teeth</td>
<td>not exist</td>
<td>87 (91.58%)</td>
<td>71 (66.36%)</td>
<td>81 (81.82%)</td>
</tr>
<tr>
<td></td>
<td>exist</td>
<td>8 (8.42%)</td>
<td>36 (33.64%)</td>
<td>18 (18.18%)</td>
</tr>
<tr>
<td>Pearson Chi-square:</td>
<td>20.1 df=2</td>
<td>$p=0.000043**$</td>
<td>$p=0.01$</td>
<td></td>
</tr>
<tr>
<td>f - filled primary teeth</td>
<td>not exist</td>
<td>90 (94.74%)</td>
<td>88 (82.24%)</td>
<td>76 (76.77%)</td>
</tr>
<tr>
<td></td>
<td>exist</td>
<td>5 (5.26%)</td>
<td>19 (17.76%)</td>
<td>23 (23.23%)</td>
</tr>
<tr>
<td>Pearson Chi-square:</td>
<td>12.46 df=2</td>
<td>$p=0.002**$</td>
<td>$p&lt;0.01$</td>
<td></td>
</tr>
</tbody>
</table>

### Table 4: Distribution of decayed, missing and filled permanent teeth in terms of regions/six year old children.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regions</th>
<th>Southeast</th>
<th>Vardar</th>
<th>Eastern</th>
</tr>
</thead>
<tbody>
<tr>
<td>d - decayed permanent teeth</td>
<td>not exist</td>
<td>92 (96.84%)</td>
<td>97 (90.65%)</td>
<td>97 (97.98%)</td>
</tr>
<tr>
<td></td>
<td>exist</td>
<td>3 (3.16%)</td>
<td>10 (9.35%)</td>
<td>2 (2.02%)</td>
</tr>
<tr>
<td>Pearson Chi-square:</td>
<td>6.805 df=2</td>
<td>$p=0.03$</td>
<td>$p&lt;0.05$</td>
<td></td>
</tr>
<tr>
<td>f - filled permanent teeth</td>
<td>not exist</td>
<td>92 (96.84%)</td>
<td>105 (98.13%)</td>
<td>98 (98.99%)</td>
</tr>
<tr>
<td></td>
<td>exist</td>
<td>3 (3.16%)</td>
<td>2 (1.87%)</td>
<td>1 (1.01%)</td>
</tr>
<tr>
<td>Pearson Chi-square:</td>
<td>1.16 df=2</td>
<td>$p=0.56$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2: Mean value of DMFT score of permanent teeth/regions for six year old children.
Kruskal-Wallis ANOVA test by ranks gave a p-value of 0.003* < 0.05, indicating that there were statistically significant differences between DMFT scores of six-year-old children from different regions for permanent teeth.

### Discussion

The study revealed an extremely high prevalence of caries among children at the age of six years (93.4%), which is two to three times higher than in Western Europe, but similar to the findings from developing setting [3,5,7,10]. The previous study directed by Necheva and conducted in the cities of Skopje, Veles, Stip, and Ohrid, covered 1,034 subjects from rural and urban population groups aged 6, 12, 15, 18, 35-44 and over 65 from the whole Republic were examined [17]. The observed caries experience among six-year-old children in our country expressed as DMFT index was lowest in Ohrid region (0.09) and the highest in the Skopje region (0.98) in the study conducted by Neceva LJ in 1991 [17].

One may speculate that the observed high levels of the DMFT (5.59) and its components among six-year-old children may be explained by traditionally poor oral hygiene in this age group, particularly in rural areas with a low level of parental supervision, teeth brushing, and the absence of any special prevention program in the region during the last 20 years for this particular group. Our conclusion is consistent with Pastbin MU [20].

While the overall prevalence of caries remained essentially unchanged over the 20 year period [17], and exceeds the corresponding levels in most European countries and China [8].

In the study conducted in 1994 in Zagreb kindergartens, 9.4% of six-year-old children without caries was recorded [21]. In the examination conducted in 1997 by Jankovik et al. [22], in the town of Zabok in Croatia, to assess the impact of war life circumstances on oral hygiene, the DMFT index of 6-year-old children was 6, similar as the average DMFT index in our study. In the period from 2008 to 2009, the data collected by Ivanic Jokic N et al. [23], among six-year-old school children in the Primorsko Goranska Country (Croatia) showed the DMFT index of 4.68 and a significant proportion of children with caries (74.5%), which is less than the prevalence of 84.18 found in our survey. Clinical examinations of 6-year-old children in the city of Rijeka, carried out from September 2012 to May 2013 by Mirceta D et al. [24], showed DMFT of 3.67 and 22% of caries free children, while our results are 5.59 ± 3.82 and 15.82% caries free children [25].

The results of our previous studies [18], indicate poor oral health of six-year-olds from the Eastern region, according to our interpretation, due to inadequate organized dental service which existed in the past, inadequate dental personnel deployed, unplanned work and, as most important the absence of a planned and organized prevention activities. It can be concluded from the fact that in the Vardar region there are only nine, in the Eastern seven, while in the Southern region eight Specialists Dentist for Pediatric and Preventive Dentistry, while in the Skopje (Capital) region there are 35 Specialists Dentist for Pediatric and Preventive Dentistry. Other contributing factors include the generally lower health status, socioeconomic disadvantage, poor oral health literacy and poorer access to services of Macedonian children compared with their European counterparts. Interesting finding among the parents is the lack of awareness of the first permanent molar. The lack of educational measures leads to a high morbidity of this important tooth. Often, parents believe that the first permanent molar belongs to the primary dentition and will subsequently be replaced.

The most common reason that children visit the dentist was a toothache. There were only a small number of children who visited to a dentist prior to pain. Usually, children were accompanied by their parents. There first comments regarding their dental visit were “my child has a terrible toothache all night and we couldn’t sleep at all”. The children with toothaches had bad experiences at the dentist and have refused future visits.

In the study conducted by Khan NB et al. in Saudi Arabia among six-year-old children, caries prevalence was 82.9% with a mean DMFT of 4.45 [26]. The current study results are only comparable to the rates in Sarajevo, Bosnia (DMFT 7.53) (ages 5-7), Kosovo (DMFT 5.9), Albania (DMFT 8.5) and Russian north (DMFT 6.71) [27-29].

The main advantage of the study is the use of the internationally accepted sampling and dental investigation methods recommended by WHO, ensuring internationally comparability of the results [1]. The study was performed by a two trained specialists which are calibrated and standardized using a Kappa test (> 0.90) before starting the study, using the WHO methodology [1].

The limitations of the DMFT and DMFT indices for epidemiological use have been discussed in many articles [30-33]. 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 (International Caries Detection and Assessment System) which gives more detailed description on the severity of caries.

### Conclusion

Dental caries experience was seen to be high among six-year-old school children (first grades) in Eastern, Southeast and Vardar Region of the Republic of Macedonia. The DMFT score of the six-year-old children from all three regions was 5.59 ± 3.82 for the primary teeth and 0.096 for the permanent teeth.

Along these lines, Republic of Macedonia needs to continue and intensify efforts towards further development of the system of oral-health monitoring and protection, in compliance with appropriate quality standards, through cooperation of numerous participants such as the Ministry of Health, the Macedonian Institute of Public Health, the Macedonian Health Insurance Fund, the schools of
dental medicine and providers of dental health care, all with the aim to achieve better oral health.

Government should set strategies to implement the recommendations of the report of the joint WHO/FAO (Food and Agriculture Organization) expert consultation on Diet and the prevention of chronic diseases and should support food-based dietary guidelines. Also Government should ensure that teachers, pupils and health professionals receive adequate education on diet, nutrition and dental health issues.

References