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Prevalence and severity of dental caries among 18-year-old Lithuanian adolescents

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ABSTRACT

Objective: The aim of the study was to evaluate the prevalence and severity of dental caries among 18-year-old Lithuanian adolescents and to disclose possible differences in the prevalence and severity of dental caries related to gender, urbanization, and different county.

Material and methods: A total of 1063 18-year-old adolescents attending school, 427 boys and 636 girls from 10 Lithuanian counties including urban and rural areas, were included in the cross-sectional study on dental caries. The method of multistage cluster sampling was used. The dental examination was performed according to the methodology of oral status evaluation recommendations by the World Health Organization (WHO). The prevalence of dental caries, DMFT score, Significant Caries Index, and dental care index were determined.

Results: The overall prevalence of dental caries among 18-year-old Lithuanian adolescents was 78.3%. The study population had a mean DMFT score of 2.93 [SD, 2.81]. Considering the gender, a higher DMFT score was observed among girls than boys (3.03 [SD, 2.88] versus 2.73 [SD, 2.71]) and in rural than urban areas (3.02 [SD, 2.98] versus 2.89 [SD, 2.73]). The Significant Caries Index and the dental care index among 18-year-old adolescents were 6.14 and 62.3%, respectively.

Conclusion: This study showed a relatively high prevalence of dental caries. The existing differences of caries experience between the urban and the rural areas as well as between the counties could be influenced by the socioeconomic differences in the country.

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1. Introduction

Dental caries is one of the most prevalent oral diseases of public health concern affecting adolescents [1]. Dental caries forms through a complex interaction over time between acid-producing bacteria and fermentable carbohydrate, and many host factors including teeth and saliva [2]. Adolescence is the period in the human life when the relationships between biological, behavioral, socioeconomic, and psychological conditions have a very strong effect on caries etiology [3]. According to the World Health Organization (WHO), adolescents are individuals aged from 10 to 19 years [4]. The American Academy of Pediatrics divides adolescence into three stages: early adolescence (11- to 14-year-old), middle adolescence (15- to 17-year-old), and late adolescence (18- to 21-year-old) [5]. Late adolescence is very important for oral health because individual's personality, diet-related choices, oral hygiene behavior, and motivations formed during this period [6]. Behaviors and attitudes formed during adolescence usually last into adulthood [7].

Dental caries among adolescents is mainly explored in age groups younger than 15 years. Epidemiological information about caries experience in older adolescent groups is scarce because these adolescents are frequently omitted from oral health survey reports. To our knowledge, no studies on caries experience among 18-year-old have been conducted in Lithuania. This age group is important because after studying the prevalence and severity of dental caries, it will be possible to improve dental screening, treatment, and prevention strategies. In Lithuania, 87% of 18-year-old adolescents attend schools, and according to the Eurostat data this percentage is one of the highest among all the member states of the European Union [8]. Therefore, it is easy to implement the preventive program and involve adolescents in it, and it is the last chance before graduation from school and fall into the adult world where dental treatment will not be free of charge anymore.

The aim of the study was to evaluate the prevalence and severity of dental caries among 18-year-old Lithuanian adolescents and to disclose possible differences in the prevalence and severity of dental caries, related to gender, urbanization, and different Lithuanian administrative units – counties.

2. Materials and methods

2.1. Study design, population, and sample

This cross-sectional dental caries study was carried out among 18-year-old Lithuanian adolescents in 2014. The method of multistage cluster sampling was used. Lithuania is divided into 10 counties. In the first stage, each county was divided into smaller urban and rural administrative units (clusters). During the second stage, in each cluster, schools (sub-clusters) from the alphabetic list of all the schools based on the data from the education management information system of the Centre of Information Technologies in Education were selected (the first and the last school from the list were chosen). In the third

stage, 3rd gymnasium classes (a block) were selected. One hundred adolescents from each selected block were asked to complete the questionnaire about their birth date, gender, and oral hygiene skills. Totally, 2000 adolescents from all over the country were approached. The study was voluntary; the inclusion criteria were age of 17.5–18.5 years and agreement to be enrolled into the study by signing written informed consent. A total of 1063 adolescents met the inclusion criteria. Adolescents were informed about the fact that they could withdraw from the study at any time.

The sample size was calculated using the Paniott's formula with the error of 0.05% based on the 18-year-old population in 2012 which was 37,036 according to the Statistics Lithuania. By using this formula, it was determined that not less than 39,618-year-old adolescents had to be included in the study.

The permission for the examination of schoolchildren was given by the Kaunas Regional Biomedical Research Ethics Committee on November 27, 2012 (No. BE-2-47).

2.2. Clinical examination

The dental examination was performed according to the methodology of oral status evaluation recommended by the WHO [9], under standardized conditions using dental chairs available in the school dental offices and portable dental units equipped with a halogen light source, compressed air, and suction device.

In oral health reports, the prevalence of dental caries usually is defined as the percentage of population affected by dental caries, and caries severity or experience is calculated based on D (decayed) M (missing) and F (filled) T (teeth) index following the WHO criteria (1997). Two pediatric dentists trained and calibrated for recording the parameters of oral health performed examinations. Training and calibration was performed on 35 18-year-old subjects who were not included in the final sample. Kappa statistics was used to test inter-investigator reliability. A kappa value for the inter-investigator reliability was 0.92.

2.3. Statistical analysis

Statistical data analysis was performed by using the SPSS 22.0 (Statistical Package for the Social Sciences for Windows) program. The interdependence of qualitative characteristics was evaluated with the help of chi-square (χ^2) criterion. Quantitative variables were expressed as mean with standard deviation or mean with 95% CI. One-way analysis of variance (ANOVA) was used to compare quantitative data of more than two independent groups. The Bonferroni post hoc test was used for multiple paired comparisons. The threshold for statistical significance was set at $P < 0.05$.

The Significant Caries (SIC) Index was calculated by adding the highest one-third of DMFT scores and dividing it by one-third of the total sample size [10]. The care index was also calculated; this is the proportion of teeth with caries experience, which have been filled, derived by taking the number of filled teeth and dividing by the total number of decayed, missing, and filled teeth and converting to a percentage (FT/DMFT) [11].

Table – The prevalence of dental caries and the DMFT score by gender, place of residence, and counties among 18-year-old adolescents.

County	Prevalence of caries, %	DMFT score, mean (SD)				
		Gender		Place of residence		Total
		Boys	Girls	Urban	Rural	
Vilnius	74.8 ^{ab}	2.58 (2.76)	2.25 (2.21) ^{fi}	2.26 (2.37) ^{fil}	3.10 (3.02) ^a	2.43 (2.53) ^{gi}
Kaunas	86.6 ^{acde}	2.96 (2.24)	3.28 (2.88)	3.26 (2.58) ^a	3.09 (2.60) ^b	3.19 (2.58) ^a
Klaipėda	72.0 ^{cf}	1.72 (1.76) ^a	2.65 (2.53) ^g	2.29 (2.29) ^{gim}	2.45 (2.52) ^c	2.32 (2.33) ^j
Šiauliai	78.8	2.61 (2.46)	2.41 (2.31) ^{hj}	2.31 (2.22) ^{hkn}	2.86 (2.60) ^d	2.48 (2.35) ^{hk}
Panevėžys	82.7 ^{fg}	2.22 (2.36)	3.52 (2.56) ^a	3.16 (2.43) ^b	2.52 (2.93) ^e	3.01 (2.56) ^b
Telšiai	73.0 ^{dh}	3.39 (3.28)	3.33 (3.03) ^b	3.84 (3.04) ^{cijk}	2.51 (3.08) ^f	3.35 (3.11) ^c
Tauragė	77.3	3.33 (3.44)	3.63 (3.06) ^c	4.17 (3.32) ^{dfgh}	2.56 (2.80) ^g	3.51 (3.20) ^d
Marijampolė	68.1 ^{egki}	1.69 (1.54)	1.58 (1.63) ^{abcde}	1.37 (1.31) ^{abcde}	2.09 (2.02) ^h	1.61 (1.60) ^{abcdef}
Alytus	84.3 ^k	3.37 (3.62)	4.43 (3.61) ^{dfgh}	2.85 (2.70)	5.55 (4.20) ^{abcdefgh}	3.97 (3.63) ^{egh}
Utena	85.9 ^{bbh}	3.79 (2.37) ^a	4.08 (3.90) ^{ej}	4.22 (3.64) ^{elmn}	3.41 (2.78)	3.98 (3.42) ^{fjk}
Total	78.3	2.73 (2.71)	3.03 (2.88)	2.89 (2.73)	3.02 (2.98)	2.93 (2.81)
	$\chi^2 = 21.58,$ $df = 9,$ $P = 0.01$	$F = 2.59,$ $df = 9,$ $P = 0.006$	$F = 5.40,$ $df = 9,$ $P < 0.001$	$F = 8.04,$ $df = 9,$ $P < 0.001$	$F = 3.25,$ $df = 9,$ $P = 0.001$	$F = 6.95,$ $df = 9,$ $P < 0.001$

The same superscript letters indicate a statistically significant difference in caries prevalence between the counties.

3. Results

A total of 1063 18-year-old adolescents (427 boys and 636 girls) were enrolled in the study. The overall prevalence of dental caries in this population was found to be 78.3%. Table shows the prevalence of dental caries among adolescents by counties and presents the mean DMFT values by gender, living place (urban/rural), and county. The mean DMFT score of all study participants was 2.93 [SD, 2.81]. Higher mean DMFT values were recorded for girls than boys (3.03 [SD, 2.88] and 2.73 [SD, 2.71], respectively). The differences with respect to the living

place were found as well: the mean DMFT score in the rural areas was 3.02 [SD, 2.98] and in the urban areas it was lower, i.e., 2.89 [SD, 2.73] (Table).

Fig. 1 depicts the prevalence of dental caries in the permanent dentition of 18-year-old adolescents by tooth type. The prevalence of dental caries was the highest in the maxillary and mandibular first molars (26%–28%). The maxillary and mandibular first molars were followed by the second molars (15%–19%).

The 18-year-old adolescents in all counties had more filled teeth (FT score 1.99 [SD, 2.26]) than teeth with the untreated caries lesions (DT score 0.79 [SD, 1.45], $P < 0.001$) (Fig. 2).

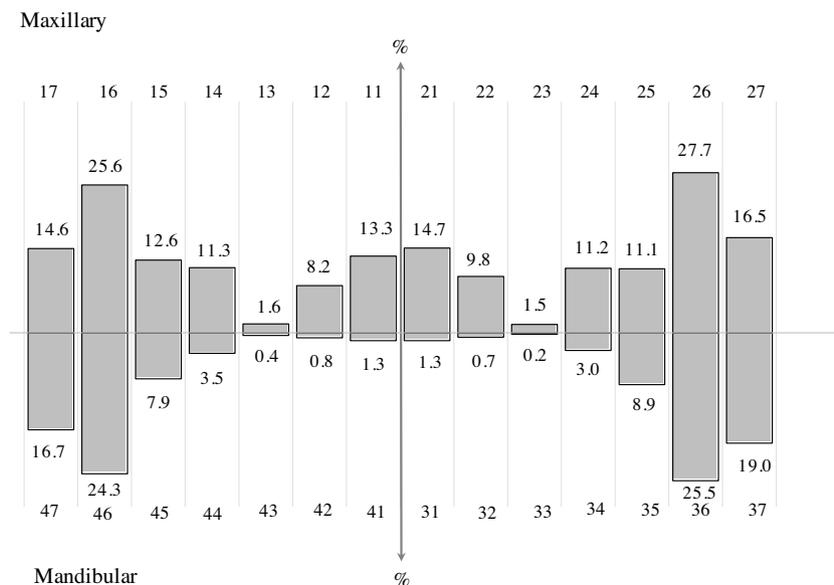


Fig. 1 – Prevalence of dental caries in the permanent dentition by individual teeth among 18-year-old adolescents.

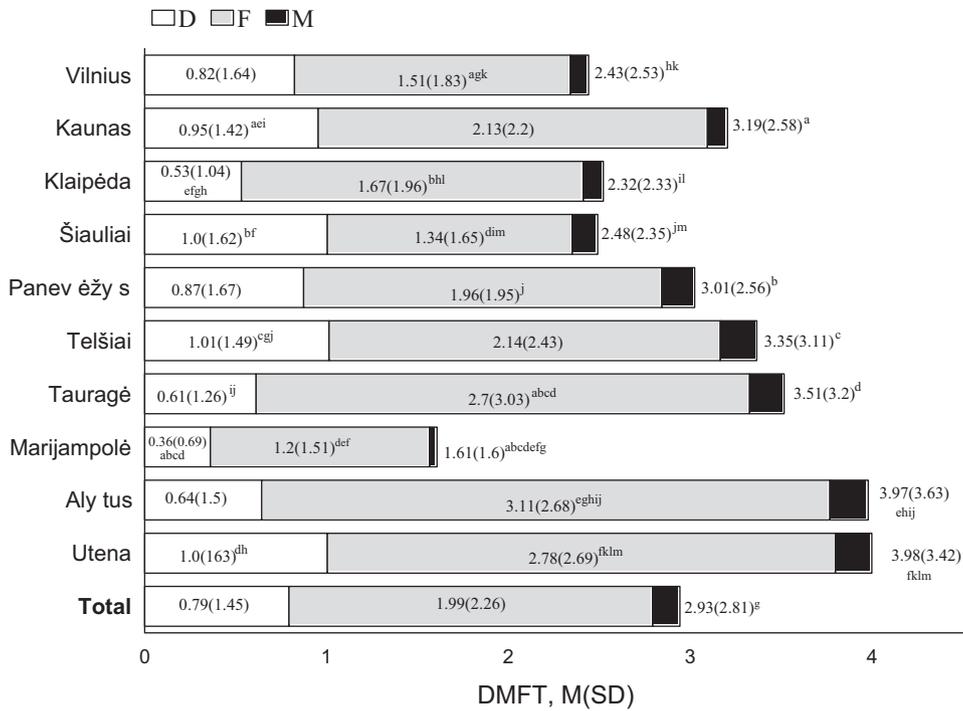


Fig. 2 – The DMFT score and its components indicating the severity of dental caries by different counties among 18-year-old adolescents. The same superscript letters indicate a statistically significant difference in caries prevalence between the counties. $F = 2.398$, $df = 9$, $P = 0.01$ (D); $F = 7.708$, $df = 9$, $P < 0.001$ (F); $F = 1.138$, $df = 9$, $P = 0.3$ (M); $F = 6.95$, $df = 9$, $P < 0.001$ (DMFT).

The overall SiC Index among 18-year-old adolescents was 6.14 (Fig. 3). The highest SiC Index was documented among adolescents in Alytus County (6.97), and the lowest SiC Index, in Marijampolė County (4.67).

Fig. 4 shows the care index by counties. The overall care index among 18-year-old Lithuanian adolescents was 62.3% with more than one-third of all decayed teeth being untreated. The highest and lowest care indices were documented in Alytus (75.7%) and Telšiai (54.5%) Counties, respectively.

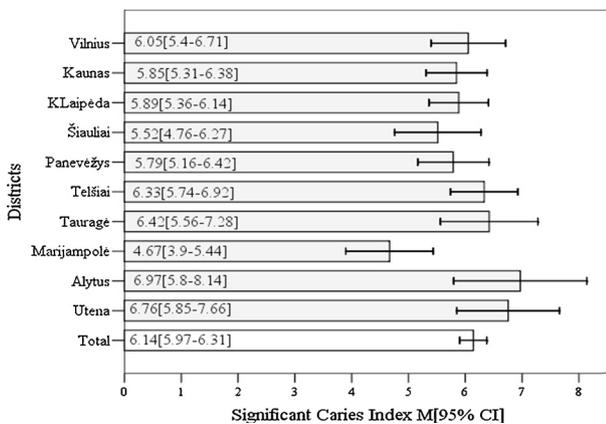


Fig. 3 – The Significant Caries Index among 18-year-old adolescents by different counties. $F = 1.87$, $df = 9$, $P = 0.056$.

4. Discussion

In 2007, the WHO reported that 60%–90% of the schoolchildren worldwide had dental caries [12]. Dental caries is widely spread among children in different age groups in Lithuania as well. The study carried out in Lithuania in 1993 showed that the mean DMFT score for the 15-year-old group was 7.00 (with

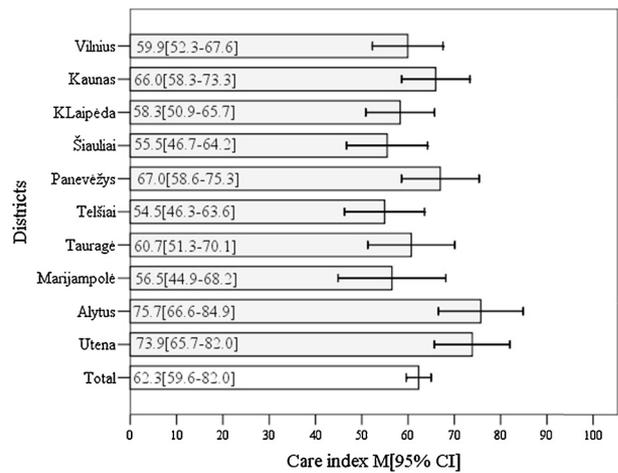


Fig. 4 – The care index among 18-year-old adolescents by different counties. $F = 2.57$, $df = 9$, $P = 0.006$.

a DMFT score of 8.00 for the low-fluoride area and 4.40 for the high-fluoride area) [13]. Another study by Milčiuvienė et al. reported a decline in the DMFT score from 6.41 to 5.48 among 15-year-old Lithuanian schoolchildren during the 22-year period from 1983 to 2005 and a decreased prevalence of dental caries (from 96% to 93%) [14]. However, this improvement in Lithuania is so marginal when compared with other countries. For example, in Denmark the mean DMFS score was 6.70 among 15-year-old children in 1988 and it declined to 3.00 in 2003 [15]. A considerable decline in the DMFT value in the developed countries has been observed among older adolescents as well. For example, in Norway the percentage of caries-free 18-year-olds increased from 2% to 15% between 1985 and 2000, while the DMFT score declined from 10.20 ± 0.75 to 5.20 ± 0.78 , i.e., by 49% [16]. The Oral B's Nordic Report on Oral Health reported that in Finland 16% of 18-year-olds were caries free in 2000. A similar situation was observed in Norway in 2006 where 16% of 18-year-olds were caries free; in Sweden, 25% of 19-year-olds were caries free in 2005 [17]. The Nordic European countries are well known for their oral health care provision model, which is based on significant level of public funding, a large number of dentists working in the public health service, free dental care for everybody under 18-year-old and national programs focused on the preventive field [18].

Lithuania regained the political and economic independence 25 years ago. Since then, many changes have occurred in all administrative and governmental sectors including the health care system. Moreover, a large variety of oral hygiene products became available on the market, and the mass media made an impact on the public by promoting the usage of toothpastes with fluoride. The well-known fact is that the regular use of fluoride toothpaste is associated with a clear reduction in caries increment [19]. Despite these changes, the prevalence of dental caries among 18-year-old Lithuanian adolescents is 78.3% and is comparable with the reported caries prevalence in the Nordic countries 8–10 years ago. There may be many reasons for slow caries decline among the Lithuanian adolescents that are beyond the analysis of this study. We could make a hypothetical assumption that socio-demographic factors such as high emigration rate could not be excluded as one of the reasons for the observed differences in the DMFT scores, with respect to the living place. According to the emigration rate, Lithuania is one of the leading countries in the European Union [20]. There is such a social phenomenon when emigrated parents leave the custody of their children to grandparents, and possibly, oral health of those children is not enough taken care of. This could explain the higher DMFT score distribution in rural areas. The proportion of people at risk of poverty or social exclusion is higher in rural than urban areas. The employment rate in Lithuania is higher among those living in cities than among the inhabitants of rural areas [21].

Comparison of the changes in the caries prevalence among 18-year-old Lithuanian adolescents over time is very difficult because no epidemiological studies have been carried out in Lithuania in this age group. In 2005, the study conducted among 15-year-old schoolchildren showed a DMFT score of 5.58 [14]. In the present study that was carried out in 2014 the corresponding score among 18-year-olds was found to be 2.93. These two studies cannot be compared due to different

participants' age, sample sizes, and study design. However, a tendency for a caries decline among the Lithuanian adolescents can be anticipated.

The observed differences in caries experience between the counties may be influenced by a number of factors such as varying fluoride levels in drinking water, dental care services promoting preventive oral measures, socioeconomic and sociodemographic factors, etc. The northwestern region of Lithuania has water supply that contains high fluoride, with a concentration of 1.7–2.2 ppm in drinking water, whereas the rest of the country is a low fluoride area (0.16–0.18 ppm) [22]. Higher mean DMFT scores among the girls could be explained by the fact that teeth erupt earlier in girls than boys; therefore, they are for a longer time exposed to the environment [23]. Furthermore, hormonal fluctuations during puberty may influence oral health [23]. Dietary habits between girls and boys are different; biochemical composition of saliva and saliva flow rate may differ as well [23,24]. As reported previously, the social role of a girl in a family also could contribute to possible differences in oral health between boys and girls [23]. All these inconsistencies could make the oral environment more cariogenic for girls than for boys.

Comparison of the findings of our study with worldwide data is difficult because information on oral health among 18-year-old adolescents is limited [25]. Moreover, most of the studies do not meet the national survey criteria. In Italy, the DMFT score was 3.60 among 17- to 19-year-old adolescents [26]; in the United States, 3.25 among 16- to 19-year-old adolescents [27]; in Sweden, 3.10 among 19-year-old adolescents [17]. In the countries such as Turkey [28] and Azerbaijan [29], the DMFT scores among 15–19-year-old adolescents were 4.12 and 3.61, respectively. In Belarus, the DMFT score among 18-year-olds was reported to be 6.80 [30]; in Uzbekistan, 3.30 [30]; and in Albania, 5.20 [31]. However, comparison of all these data with the findings of our study is difficult because the study design, population, and sample size are different as well as all studies were conducted in the different year. These worldwide differences are based on economic and political situation, government influence on health-related programs, and eating and oral hygiene habits in each country.

Assessment of the distribution of DMFT components showed that the filling (F) component accounted for the greatest proportion of the entire caries profile in all the counties. This implies that dental services are available for adolescents; moreover, they are free of charge but this also means that there is the lack of the primary focus on dental caries prevention. This statement also is supported by the care index, which was 62.3% among 18-year-old Lithuanian adolescents. Almost in all Lithuanian counties, the care index was more than 58%, and we can suggest that oral health services provide an adequate traditional dental care level (drill and fill). This parameter is also influenced by the law that obligates parents to take their children to medical examination including dental check-up each year before school, and if it is necessary to treat teeth that are decayed.

Evaluation of the prevalence of dental caries in the permanent dentition showed that the first molars, as expected, were decayed most frequently (around 25%), followed by the second molars (from 14% to 19%) and the

maxillary central incisors (13% and 15%). Since 2004, the preventive dental sealant program in Lithuania has been running. The adolescents of this study were not involved in the first stage of sealant application in the first molars, but had a chance to participate in the second stage of the program when the second molars were sealed. This might be one of the reasons why the first molars are decayed more often than the second molars.

The SiC index has been proposed to bring attention to the individuals who have the highest caries scores in every population [10]. It is an indicator that reflects the situation among the most caries-exposed individuals and could be included in future population-based oral health surveys together with the mean DMFT [32]. The SiC index measured in the population of the present study varied by different counties (from 4.67 in Marijampolė County to 6.97 in Alytus County), possibly reflecting different socioeconomic conditions that play a role [33]. However, evaluation of the SiC index as well as comparison of this index between different countries is complicated, when there is lack of basic epidemiological information about dental caries among 18-year-old adolescents. Bratthall et al. suggested that the SiC index should be less than 3 in 12-year olds and less than 5 in 15-year olds [10] thus indicating the acceptable limits of dental caries polarization in populations. If we follow this algorithm, we could make a hypothetical statement that for 18-year-old adolescents, it should be less than 7.

The data presented in this study can serve as a baseline for planning oral health promotion programs. The relatively high burden of dental decay in the population of 18-year olds indicates the need for more preventive actions to be taken at earlier stages of life. The implementation of community-based health promotion could aid the control of dental caries increments among Lithuanian children. Particularly, it is recommended to pay attention at high caries risk groups, aiming to reach those individuals with the most urgent need for dental care.

Finally, to our knowledge, it was the first study on dental caries enrolling 18-year-old Lithuanian adolescents, carried out in Lithuania. Limitations of this study include a cross-sectional study design that does not allow observing trends in the prevalence and severity of dental caries in this age group over time.

5. Conclusions

This study showed a relatively high prevalence of dental caries. The existing differences of caries experience between the urban and the rural areas as well as among the counties could be influenced by socioeconomic differences in the country. The highest proportion of F component in the DMFT index indicates that dental caries in this population is mainly controlled by traditional curative strategies, with little focus on preventive care measures.

Conflict of interest

The authors state no conflict of interest.

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