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Dental caries experience among 12-year-old children in Northwest Russia

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Objective: To estimate the prevalence and experience of dental caries among 12-year-olds in Northwest Russia. ***Methods:*** Altogether 355 schoolchildren at the age of 12 were selected at random from 3 urban and 4 rural areas in the Arkhangelsk region. Girls comprised 53.7% of the sample. Caries experience was assessed at D3 level by a single calibrated examiner. The prevalence of caries was estimated with 95% confidence intervals (CI) using Wilson's method. Caries experience was estimated using DMFT index and presented as means and 95% CIs. Dichotomous and numerical data were analysed by chi-squared tests and Mann-Whitney tests, respectively. ***Results:*** The prevalence of caries was 83.4% (95%CI 79.2-86.9) with the mean DMFT of 2.95 (95%CI 2.70-3.20). On average, there were 1.56 (95%CI 1.37-1.76) decayed, 0.03 (95%CI 0.01-0.06) missing and 1.34 (95%CI 1.16-1.52) filled teeth. No gender differences in the prevalence of caries in any of the settings or in the full sample were observed. The overall caries experience was higher in urban than in rural areas (3.38 vs. 2.64, p=0.001). The mean number of decayed teeth in urban areas was lower (1.29 vs. 1.77, p=0.009), but the number of filled teeth was greater (2.02 vs. 0.85, p=0.001) than in rural areas. ***Conclusions:*** The prevalence and experience of caries among 12-year-olds in the Arkhangelsk region is greater than in most European countries. Urgent public health measures at both population and individual levels are needed to improve the situation.

Key words: *caries experience, 12-year-old children, Russia*

Introduction

Despite dental caries experience among 12-year-old children decreasing during the last decade, it remains one of the major public health problems worldwide (World Health Organization (WHO), 2004). The prevalence and severity of dental caries among 12-year-olds varies considerably between and within countries. While the prevalence of caries was 37% in the UK, 41% in Southern China and 44% in Germany (Pieper and Schulte, 2004; Pitts *et al.*, 2002; Wong *et al.*, 2001), the corresponding proportions for Puerto Rico, Hungary, Ecuador and Poland were 81%, 85%, 85%, and 88%, respectively (Elias-Boneta *et al.*, 2003; Medina *et al.*, 2008; Szöke and Petersen, 2000; Wierzbicka *et al.*, 2002).

Caries experience expressed as DMFT (Decayed, Missing, and Filled Teeth) index for the 12-year-olds was 1.61 affected teeth per child in 2004 worldwide (WHO, 2004). Among countries geographically close to the Russian Federation, it varies from under 2 affected teeth per child in Norway and Finland to 4.4 in Ukraine (WHO, 2004). In other European countries DMFT scores for the 12-year-olds ranged from 0.7 in Germany and the UK to 4.4 in Bulgaria while among Russia's neighbors in the East, children of the same age from China, North Korea and Japan had DMFT levels of 1.0, 3.0, and 1.7 respectively (WHO, 2004).

The latest nationally representative Russian oral health survey was performed in 1996-1998 and showed that the prevalence of caries in permanent dentition among 12-year-olds was 78% (Kuzmina *et al.*, 1999). The mean DMFT was 2.9 with decayed teeth being the largest component (DT=1.6; MT=0.1; FT=1.2).

People of the Russian north have poorer health in general and lower life expectancy compared to the national average (Federal state statistic service, Russia, 2009; Medical informational analytical centre, 2009). According to the results of a survey performed in the Arkhangelsk region in 1996-1998, this also applies to the oral health. The overall prevalence of caries among 12-year-olds in the region was 89% with the mean DMFT value of 3.5. While the mean number of decayed teeth in the region was similar to the national figure (1.6), the mean number of filled teeth was higher (1.7). Moreover, there were on average 0.14 missing teeth per child (Ushmanova and Obraztsov, 2001).

Many health problems during the 1990s in Russia were attributed to the economic crisis and the painful economic and social transition after the break-up of the Soviet Union in 1991. The latest dental surveys were performed in 1996-1998, more than 10 years ago during the peak of the crisis. Between 1999 and 2008 the Russian economic situation improved considerably with 6-7% annual economic growth. Given that oral health status is associated with socio/economic factors (Petersen, 2008) one may hypothesise that the prevalence and experience of caries among Russian 12-year-olds has decreased. Given that the geographic area of the

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Arkhangelsk region is comparable to the size of France, there might be substantial geographical variation in dental health status within the region. No adequate information about caries prevalence and experience among children is currently available in the region and consequently there is no foundation for preventive programs.

The aim of the study is to estimate the prevalence and experience of dental caries among 12-year-olds in the Arkhangelsk region, Northwest Russia.

Methods

The study is a part of the Russian National Dental Health Survey. Arkhangelsk region is a Federal subject of Russia with a territory of 413,100 km² all without water fluoridation. Of the (2008) 1.26 million population, 74% live in urban areas. (Federal state statistic service, 2009). The number of 12-year-olds in 1998 was 11730 (5998 males) with 85.2% living in towns. (Territorial federal state statistical service in the Arkhangelsk region, 2009).

The region's areas were stratified as urban or rural places in the north, central and south of the region then 3 urban and 4 rural settings were selected at random. Study participants were recruited in 3 towns (Arkhangelsk, Novodvinsk, Velsk) and 4 rural districts (Plesetsk, Konosha, Leshukonskoe and Krasnoborsk) of the Arkhangelsk region. Arkhangelsk, Novodvinsk and Leshukonskoe are in the north, while Velsk, Konosha and Krasnoborsk are in the south of the region. In addition, a rural district (Plesetsk) was randomly selected from centre of the region (Figure 1). In urban areas, the schools were randomly selected from different areas of each city to ensure a representative sample.

The study was approved by the ethical committee of the Northern State Medical University. School directors were informed study's aims in advance and an agreement between the school and the investigators was obtained based on the Edict № 394 of The Ministry of Health and Social Development of the Russian Federation (Ministry of Health and Social Development, Russian Federation, 2007). Written informed consent was obtained from all participants with children who refused to participate being replaced by others from the same school. There were no more than 2 refusals in any setting.

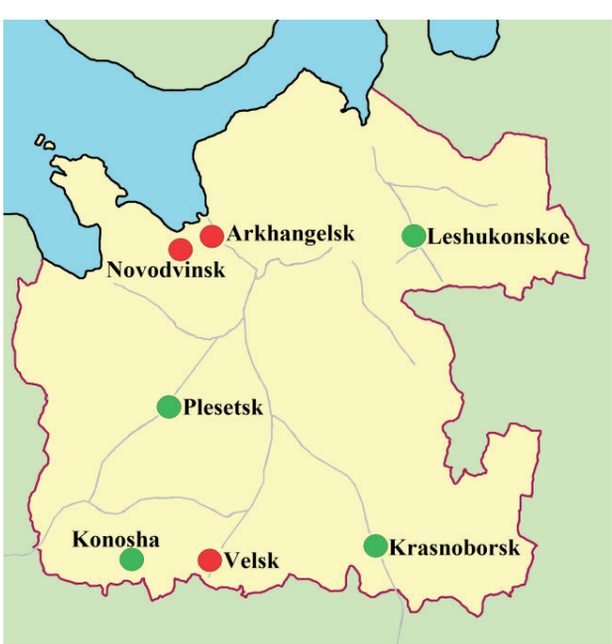

Figure 1. *Location of the selected urban (red) and rural (green) areas in the Arkhangelsk region*

At least 50 children (both genders) from each location were recruited according to the WHO (1997) recommendations comprising about 3% of all 12-year-olds in the region.

All study participants underwent a clinical dental examination in their school between November 2007 and December 2008. Clinical criteria for dental caries as defined by the WHO were applied (WHO, 1997). The examination was carried out by a single trained and calibrated dentist (MAG). Special calibration of practical skills was performed at the Moscow State Medical University of Dentistry in 2007 and a written permit to conduct this type of examination for research purposes in accordance with the WHO recommendations was obtained to ensure comparability of the results with similar studies and reduce measurement bias.

During the examination the child sat on a chair and the examiner stood or sat in front of the child. The examiner was assisted by a trained assistant who filled out registration cards. The mean duration of dental examinations was about 10 minutes. After each hour of the examination session, a 15-20 minutes break was scheduled to avoid the effects of visual fatigue. The examination was carried out with a WHO-type periodontal probe and plain mouth mirror. No radiographs were taken. Children aged 12 are the WHO index age group for assessing dental caries because almost all children have all their permanent teeth already erupted. Based on that, only permanent teeth were taken into consideration in describing dental caries experience. Dental caries in permanent dentition was detected visually at the cavitation level (D3-level). Initial caries lesions were not recorded.

DMFT index scores for each child were calculated for permanent teeth. For the DMFT index, teeth that had been extracted for orthodontic purposes or due to trauma, or were absent from birth were excluded and did not contribute to the final score. The prevalence of dental caries in permanent teeth was calculated for each setting as well as for all rural and for all urban areas and for the full sample. Ninety-five percent confidence intervals (CI) were calculated using the Wilson's method (Grjibovski, 2008).

The mean DMFT index with 95% CI was calculated for each location, for rural and urban areas and for the full sample. Differences in the prevalence of caries between districts were analysed by Pearson's χ^2 tests. Differences in DMFT and each component of the index between children who lived in urban and rural areas and by gender were analysed by Mann-Whitney tests. Differences in caries experience between the 7 settings were calculated by Kruskal-Wallis tests. When significant differences by this test were found, post-hoc comparisons were performed using Mann-Whitney tests with Bonferroni correction with critical level of significance of 0.002 to compensate for Type I error inflation due to multiple comparisons. Comparisons with a previous study in the same region were performed using z-tests. All the data were analysed using SPSS version 16.0 (SPSS Inc., US).

Results

The sample consists of 355 children, 54% girls. Detailed information about the sample by location and gender is presented in Table 1. The overall prevalence of caries was 83.4%. The lowest prevalence of caries (80%) was observed in the rural Plesetsk, Konosha and Krasnoborsk districts while the highest (90%) was in Leshukonskoe (Table 2), although the differences between the settings did not reach the level of statistical significance ($\chi^2_{(6)}$=3.135, p=0.792). The prevalence of caries in urban and rural areas was similar ($\chi^2_{(1)}$=0.310 p=0.578). No gender differences in any of the settings or in the full sample ($\chi^2_{(1)}$=0.005, p=0.942) were observed.

The overall mean DMFT was 2.95 (95%CI 2.70-3.20). Comparisons between settings for DMFT showed no differences except between Plesetsk and Novodvinsk (p=0.001). Detailed information on DMFT index is presented in Table 2. The caries experience was higher in children in towns than those from rural areas (p=0.001).

Decayed, missing and filled teeth constituted 53.3%, 1.0% and 45.7% respectively of DMFT. Mean values for D-, M- and F components for all locations are presented in Table 2.

There were on average 1.56 (95%CI 1.37-1.76) decayed teeth per child. The mean number of decayed teeth in rural areas was higher than in towns (p=0.009). Children from Leshukonskoe had on average more decayed teeth than children in the towns of Arkhangelsk and Novodvinsk (p=0.002 and p=0.001 respectively) and the rural Plesetsk district (p<0.001).

On average, there were 1.34 (95%CI 1.16-1.52) filled teeth per child. The number of filled teeth ranged from 0.62 in Krasnoborsk to 2.52 in Novodvinsk. In rural areas, there were on average fewer filled teeth per child than in urban areas (p=0.001). Children in Novodvinsk had significantly more filled teeth than children in the rural areas (all p<0.001).

We observed a mean of 0.03 (95%CI 0.01-0.06) missing teeth per child. There were no differences in the number of missing teeth either between any of the settings (p=0.296) or between rural and urban areas (p=0.901).

No gender differences in any of the components in any of the areas or in the full sample were found.

Discussion

On average, the prevalence of caries among children at the age of 12 in this study was 83.4%, which is twice as high as in the UK or in Southern China (Pitts *et al.*, 2002; Wong *et al.*, 2001). The results are similar to the prevalence of caries in Puerto Rico and Hungary and lower than in Poland (Elias-Boneta *et al.*, 2003; Szöke and Petersen, 2000; Wierzbicka *et al.*, 2002). In spite of the observed prevalence of caries being lower than it was in the region 10 years ago (83.4% vs. 89.0%),

Table 1. Sample composition by setting, age and gender and the prevalence of dental caries and mean DMFT index with 95% confidence intervals (CI) by setting among 12-year-olds in the Arkhangelsk region, Northwest Russia, 2007-2008

Setting	*Male n*	*Female n*	*Total n*	*Prevalence of caries, % (95% CI)*	*Mean DMFT % (95 CI)*
All rural areas	95	110	205	82.4 (76.6-87.0)	2.64 (2.32-2.96)
Plesetsk	20	30	50	80.0 (67.0-88.8)	2.10 (1.63-2.57)
Konosha	28	27	55	80.0 (67.7-88.4)	2.38 (1.84-2.92)
Leshukonskoe	21	29	50	90.0 (78.6-95.7)	3.54 (2.67-4.41)
Krasnoborsk	26	24	50	80.0 (67.0-88.8)	2.56 (1.93-3.19)
All urban areas	75	75	150	84.7 (78.0-89.6)	3.38 (2.99-3.77)
Arkhangelsk	23	27	50	84.0 (71.5-91.6)	3.54 (2.80-4.28)
Novodvinsk	24	26	50	86.0 (73.8-93.0)	3.70 (2.97-4.43)
Velsk	28	22	50	84.0 (71.5-91.6)	2.90 (2.31-3.49)
All Arkhangelsk region	170	185	355	83.4 (79.2-86.9)	2.95 (2.70-3.20)

Table 2. Dental caries indices by component for permanent dentition 95% confidence intervals (CI) among 12-year-olds in the Arkhangelsk region, Northwest Russia, 2007-2008

District	*DT (95% CI)*	*MT (95% CI)*	*FT (95% CI)*
All rural areas	1.77 (1.49-2.04)	0.03 (0.01-0.05)	0.85 (0.68-1.02)
Plesetsk	1.04 (0.66-1.42)	0.04 (0.00-0.10)	1.02 (0.67-1.37)
Konosha	1.62 (1.12-2.12)	0	0.80 (0.51-1.09)
Leshukonskoe	2.54 (1.86-3.22)	0.02 (0.00-0.06)	0.96 (0.57-1.35)
Krasnoborsk	1.88 (1.33-2.43)	0.06 (0.00-0.13)	0.62 (0.28-0.96)
All urban areas	1.29 (1.02-1.55)	0.04 (0.00-0.08)	2.02 (1.69-2.35)
Arkhangelsk	1.40 (0.82-1.98)	0	2.14 (1.55-2.73)
Novodvinsk	1.12 (0.71-1.53)	0.02 (0.00-0.06)	2.52 (1.87-3.17)
Velsk	1.34 (0.94-1.74)	0.10 (0.00-0.22)	1.40 (0.92-1.88)
All Arkhangelsk region	1.56 (1.37-1.76)	0.03 (0.01-0.06)	1.34 (1.16-1.52)

(Ushmanova and Obraztsov, 2001), it is still higher than the Russian average of 78.0% in the late 1990s (Kuzmina *et al.*, 1999). We did not observe any differences in the prevalence of caries between rural and urban areas or between genders.

As with the prevalence of caries, the observed mean DMFT in the Arkhangelsk region is lower than it was a decade ago (2.9 vs. 3.5) (Kuzmina *et al.*, 1999; Ushmanova and Obraztsov, 2001). However, it is considerably higher than the global average or the mean DMFT index in most neighboring countries such as Norway, Finland, China and Japan where it is below 2.0 (WHO, 2004). At the same time, the observed caries experience is similar to that of the former Soviet republics of Estonia, Belarus, Georgia and Kazakhstan (WHO, 2004).

One may speculate that the decrease in the prevalence and experience of caries among 12-year-olds could be at least partly attributed to the improved Russian economic situation. According to the Federal state statistic service in Russia (2009), some main socio-economic standards of living, such as gross domestic product on a purchasing power parity basis increased from $4200 $15100 per capita over the decade to 2009. One may speculate that the quality of nutrition and access to means of oral hygiene also improved resulting in the observed reduction in caries prevalence and experience.

There were higher levels of caries experience in urban children compared to those from rural areas, which might be partly explained by lower levels of sugar consumption in rural areas. According to the Bulletin of the WHO (2005) dietary habits influence the development of dental caries, for example excessive amounts and frequent consumption of sugars are major causes of dental caries. Other studies have also shown that children in rural areas consume less sugar-containing food than those in towns. (Honkala *et al.*, 1982; Jamel *et al.*, 1996).

Altogether, we observed a mean of 1.6 decayed teeth per child. The D component constituted 53.3% in the DMFT structure. While the mean number of decayed teeth is comparable with that observed 10 years ago, their proportion of DMFT increased from 47.0% to 55.0% indicating an increased proportion of untreated teeth in the region. The observed mean number of missing teeth is a quarter of its value 10 years ago (0.03 vs. 0.12). The proportion of missing teeth in DMFT decreased from almost 6% to 1% (Ushmanova and Obraztsov, 2001). The mean number of filled teeth in the region decreased from 1.7 in 1996-98 to 1.3 (95% CI 1.16-1.52) in 2007-08 (z test $p<0.001$). Moreover, the proportion of filled teeth in the DMFT index slightly decreased from 47.2 to 45.7% during those 10-years.

Despite decreases in both the overall prevalence of caries and mean DMFT in the region, the number of decayed teeth remained unchanged, which in combination with increased proportion of decayed teeth in the DMFT structure and decreased number and proportion of filled teeth, may reflect changes from bad to worse in the organisation of dental services in the Arkhangelsk region. Children in the region's rural areas had more decayed teeth and fewer filled teeth in comparison with children in towns suggesting either reduced access to or use of dental services in the rural areas. This pattern was similar to the previous studies both in Russia in general and in the Arkhangelsk region in particular (Kuzmina *et al.*, 1999; Ushmanova and Obraztsov, 2001). Our findings of low level of access to dental treatment are supported by the lack of dentists (mainly in rural areas). The number of dentists in the region has fallen from 724 in 1996 to 616 in 2007, there are more than 40 vacancies for paediatric dentists and the number of these specialists continues to decline. Liubova and colleagues (2008) report that in Arkhangelsk, only 6 out of 33 dental offices at schools possess the required licence for work, and a very limited number of children have an opportunity to get prevention and treatment procedures there. However, considerable decrease in both the mean number and proportion of missing teeth observed in the study may be an indicator of improvements in the quality of dental services for those children, to whom this care is available and affordable.

Although the prevalence of caries and caries experience in the Arkhangelsk region decreased among 12-year-olds, they are still notably higher than in most European countries. One may speculate that limited inclusion of pediatric dentistry into national prevention projects in Russia as well as absence of the national or regional prevention programme for main dental diseases may be underlying reasons.

A strength of the study is that it followed widely accepted methods recommended by the WHO (1997) so providing internationally comparable results besides allowing comparisons with local studies spanning a decade. The study was performed by a single trained and calibrated specialist avoiding validity-threatening inter-observer variability. However, it is possible that the results of clinical examination could vary between districts because the illumination was different in each study area. Small sample size resulted in rather broad confidence intervals and low statistical power for comparisons of prevalence and experience of caries between different parts of the region. Given that the sample was taken at random and that children from northern, central and southern parts of the region took part in the study, it is possible to generalise our results to all 12-year-olds in the region. Moreover, given relative homogeneity between the regions in Northwest Russia, it might be possible to generalise the findings to other Northwestern parts of the country.

Conclusions

Although the caries prevalence and experience levels among 12–year-olds decreased during the last 10 years in the Arkhangelsk region, Northwest Russia, the levels are still higher than in most European countries. Urgent public health measures at both population and individual levels are needed to improve the situation.

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