

# Epidemiological analysis of dental caries in 12-year-old children residing in urban and rural settings in the Podlaskie region of north-eastern Poland

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## Abstract

**Introduction.** Dental caries is still a social problem in many countries, including Poland. Through epidemiological studies conducted in index groups among children and adults, it is possible to monitor its progress and take appropriate action. The Podlaskie region is an area where the severity of dental caries in children has been the highest in the country for a few years, both in urban and rural settings.

**Objective.** Evaluation and comparison of indicators of the progress of caries – Decayed Missing Filled Teeth (DMFT) – in 12-year-olds from the urban and rural areas of north-eastern Poland, measured between 2003–2010.

**Materials and method.** In 2003 and 2010, respectively, 445 children were examined: in 2003 – 188: 101 boys, 87 girls; 98 from urban areas, 90 from rural areas, and in 2010 – 257 adolescents: 134 boys, 123 girls; 157 from urban areas and 70 from rural areas. The study protocol was strictly subordinated to the WHO study monitor guidelines. DMFT indices were evaluated in particular years. The distribution of their individual components was then compared and analyzed. The outcomes resulting from the place of residence and gender of the adolescents were taken into account. In the statistical analysis, Shapiro-Wilk test and Mann-Whitney U test were used.

**Results.** In 2003, the mean value of DMFT was 4.76, and in 2010 it decreased to 3.36 ( $p < 0.0001$ ). In 2003, DMFT was 4.42 in the rural areas, and after 7 years it has risen to 4.77. There was a significant decrease in the value of the index (from 5.08 to 2.82,  $p < 0.0001$ ) in the urban areas. No significant differences based on gender were observed between these years.

**Conclusions.** The values of caries intensity among 12-year-olds from the Podlaskie region, both in rural and urban areas, are still high. Among children from the rural areas, dental caries progression is more visible and has not improved during the years 2003–2010. These findings should lead to the development of programmes for the inhabitants of rural areas.

## Key words

dental caries, 12-year-old children, DMFT, epidemiologic studies

## INTRODUCTION

In 1981, the World Health Organization (WHO) set the oral health objectives for 2000 which were very detailed in relation to 12-year-olds. They recommended lowering the intensity of the caries DMFT index to 3 [1]. In Poland, this objective was not achieved. In 2000, the mean value of DMFT for Polish 12-year-old children was 3.8 [2]. Therefore, due to large differences in the frequency and intensity of dental caries in individual countries, in 2000 the WHO proposed new oral health objectives. They were more general and not based on specific numerical values and intended rather as guidelines for local authorities and health care planners to determine the local realistic objectives in given social and economic conditions [3]. For 12-year-olds it is recommended to decrease, by a fixed percentage (X%), the mean number of DMFT, first of all its component D, especially among adolescents in the high risk group. This percentage (X%) should be determined separately for each population.

By increasing a variety of health actions, the National Health Programme for 2007–2015 [4, 5] planned to reduce

to 2 the mean value of DMFT in 12-year-old children, and to decrease, in comparison to 2003, the differences in caries intensity occurring between provinces and communities of residence. Moreover, in this group a significant caries index should not exceed 4. An opportunity to assess the implementation of the above assumptions provides the regular monitoring of different age groups. The obtained results allow the epidemiological assessment of caries intensity, periodontal diseases and dental treatment needs in individual provinces, and the whole country. In the first decade of the twenty-first century, 12-year-old children residing in urban and rural areas were the target group of many studies in the years 2000, 2001, 2003, 2005, 2007 and 2010.

## OBJECTIVE

The study aimed to evaluate the intensity of dental caries, expressed by the DMFT index, in 12-year-old children, residents of the Podlaskie region of north-eastern Poland, on the basis of epidemiological studies conducted in 2003 and 2010.

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## MATERIALS AND METHOD

The study was conducted in 2003 and 2010 in the Podlaskie region of north-eastern Poland, under the National Oral Health Surveillance. The schools and places were selected according to strict rules developed by the World Health Organization (WHO) for similar epidemiological studies which took place throughout the country. Selection of the sample took place in each case on the basis of a two-tier draw. In the first stage, the Chief Professional Officer for Health Surveillance designated one district from a rural and an urban area, respectively, in the Podlaskie region. In the second stage, in these districts four schools were drawn in which the study was conducted. The number of respondents was limited by the survey assumptions, and in 2003 it was not to exceed 200 children and in 2010 – 280.

In total, 445 children were examined. The response rate was in 2003 – 94% and in 2010 – 92%. In 2003, in the Podlaskie region a total of 188 children, 101 boys and 87 girls, were examined. Ninety-eight individuals lived in urban areas, and 90 subjects came from the rural areas. In 2010, the study comprised a total of 257 12-year-olds: 134 boys and 123 girls, 157 from urban areas, and 70 from rural areas.

The examination was commenced after receipt of written consent from the children's parents. The oral examination was conducted each time in artificial light, using a dental mirror and a WHO periodontal probe to assessing the state of dentition according to the guidelines of the World Health Organization [6]. The DMFT index and its individual components: the number of teeth with active caries (D), extracted due to caries (M) and filled (F) were assessed. Obtained values were compared by analyzing both the differences between children residing in rural and urban areas, and between boys and girls. Statistical analysis was performed using the STATISTICA for Windows 10.0 package. The variables of the DMFT were checked with the tests for normality of distribution (Shapiro-Wilk). For verification of the hypotheses the Mann-Whitney U nonparametric tests were used.

## RESULTS

In 2003, the mean number of DMFT for the Podlaskie region was 4.76 for 12-year-olds, and after 7 years it decreased to 3.36 (Tab. 1). This difference is highly statistically significant. In 2003 in the rural area, the value of DMFT was 4.42 and in 2010 it had increased by 0.35 (Tab. 1). In the urban area, however, during the years 2003–2010, there was a significant decrease in the caries intensity index values ( $p < 0.0001$ ) from 5.08 to 2.82 (Tab. 1). By comparing the intensity of dental caries

**Table 1.** Comparison of DMFT values of examined children in 2003 and 2010 separately and combined, depending on place of residence.

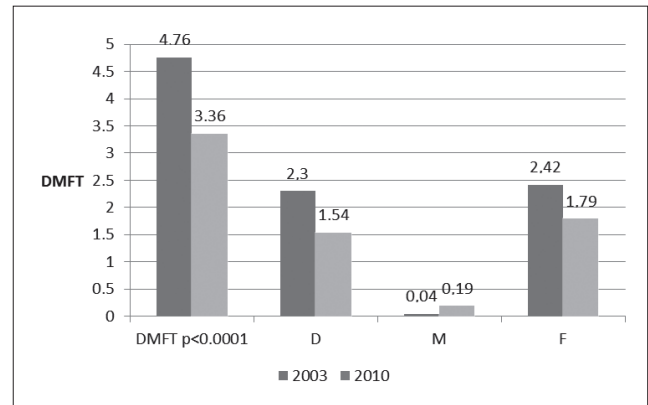
Year	DMFT			p*
	Rural (n=160)	Urban (n=285)	Total (n=445)	
2003 (n=188)	4.42±3.0	5.08±3.4	4.76±3.2	0.336
2010 (n=257)	4.77±3.4	2.82±2.4	3.36±2.9	<0.0001
p**	0.836	<0.0001	<0.0001	

n – number of examined children

\*Comparison between urban and rural (the Mann-Whitney U)

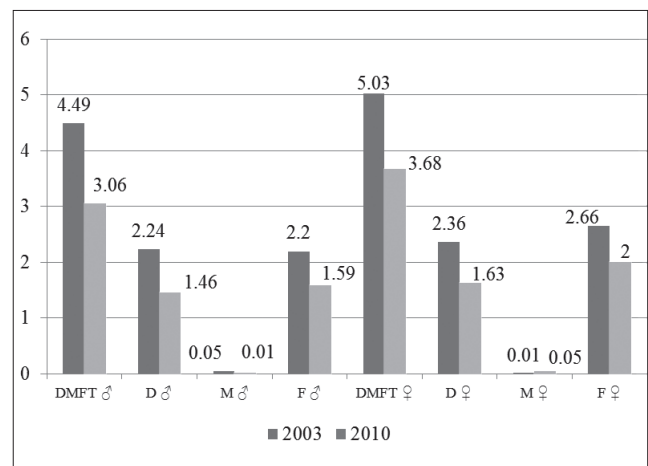
\*\*Comparison between year 2003 and 2010 (the Mann-Whitney U)

in the urban and the rural areas, no significant differences were found in 2003 (4.42 urban; rural area 5.08). In 2010, however, the difference in favour of 12-year-olds from the urban areas was significant and reached nearly two teeth: 4.77 in rural areas, 2.82 in urban areas (Tab. 1). Furthermore, analysis of the individual components of the DMFT index evaluated in 2003 and 2010 (Fig. 1) showed that in 2003



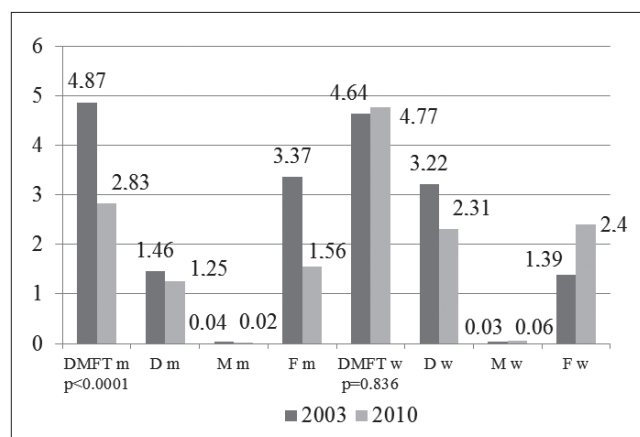
**Figure 1.** DMFT in 12-year-olds living in Podlaskie province in 2003 and 2010.

the number of teeth with active caries was higher than in 2010 (2.3 vs. 1.54), teeth extracted because of tooth decay in 2003 was 0.04, and in 2010, up to 0.19. However, the average number of filled teeth was higher in 2003 (2.42 vs. 1.79). The differences between boys and girls in each year were small, but with a clear tendency of improvement in dental health in 2010 compared to 2003 (Fig. 2). Moreover, boys represented



**Figure 2.** DMFT in 12-year-olds living in the Podlaskie province in 2003 and 2010, depending on gender (♂ – boys, ♀ – girls).

slightly better values of the DMFT compared with girls (both mean values and its individual components). In 2003, the DMFT found in boys was 4.49, which decreased in 2010 to 3.06, and in girls – 5.03 and 3.68, respectively (Fig. 2). In 2003, the number of teeth with active caries in boys was 2.24, and in girls 2.36, and both values in 2010 declined by about 0.7 (Fig. 2). The average number of teeth removed because of tooth decay among boys was higher in 2003 compared with girls (0.05 vs. 0.01), but in 2010 it dropped to 0.01, whereas after 7 years it increased to 0.05 in girls (Fig. 2). In 2003 the component F among boys was 2.2 and it dropped to 1.59, while in girls it dropped from 2.66 in 2003 to two in 2010



**Figure 3.** DMFT in 12-year-olds living in the Podlaskie province in 2003 and 2010, depending on the environment of residence (m – city, w – rural area).

(Fig. 2). When comparing individual components of the dental caries intensity index in children living in the city vs. in the country in 2003 and 2010, a significant improvement in dental health of young people from the city was found (Fig. 3). In 2003 the number of teeth with active decay in children from the rural areas was significantly higher compared with children from the urban areas – 3.22 vs. 1.46 (Fig. 3), and this situation persisted after 7 years – 2.31 vs. 1.25 (Fig. 3). Moreover, the average number of teeth removed because of tooth decay in rural area residents had doubled – 0.03 and 0.06, respectively, while the opposite situation was seen in the urban areas: in 2003, the component M was 0.04, in 2010, M = 0.02. In addition, a significant drop was noted in the number of filled teeth in children from the urban areas in 2010, compared to the situation observed 7 years ago – 1.56 vs. 3.37 (Fig. 3). There was an increase of the component F over the years in the country in 2003 and in 2010 – 1.39 and 2.4, respectively (Fig. 3).

## DISCUSSION

Children under the age of 12 are among one of the groups of great interest for WHO epidemiological measurement of caries intensity, and thus, one of the most studied age groups for the evaluation of oral health. In the literature, there are many papers presenting the results of studies on the achievements in Poland and its individual regions with respect to the second oral health objective for 2000 [2, 7, 8, 9, 10]. It should be noted that Poland is one of the few countries in Europe that failed to meet these assumptions [2, 7]. Moreover, in the Podlaskie region, caries rates are usually higher than the national average level, probably because of socio-economic conditions [10, 11, 12, 13]. The Podlaskie province is a well-known agricultural region. In 2010, the available income and expenditure was lower than the national average (92.5%) in this province [14]. Social and economic factors, such as the level of education and family income are well documented determinants of the development and progression of dental caries [15].

The presented study demonstrates high values of the DMFT in the surveyed children in the Podlaskie region, both in 2003 and 2010. However, over 7 years, in children living in urban areas, oral health improved, as opposed to rural areas where a deterioration of oral health occurred. It is difficult to

clearly identify the reasons for this situation. It is assumed that among the reasons for the lower number of teeth with caries in the urban area are the preventive programmes with supervised brushing of teeth with fluoride gel conducted regularly in primary schools by school nurses. There are constantly visible inequalities in the access of children from different backgrounds to the prevention programmes and health education programmes run in schools [16].

On the other hand, the distribution of the D, M and F components has clearly changed. It was noticed that in 2003 there were more filled teeth in children living in the urban areas, while in 2010 the F (filled teeth) component was higher in children from the rural areas. This situation could reflect a wider access to dental care in the rural areas after 2003.

In Poland, the dental care system is divided into private and public sectors (National Health Fund). Access to the private sector is easy but the cost has to be paid by the patient; on the other hand, the public sector is free of charge, but access is difficult due to long queues and not all dental procedures are included. Since 2003, there has been a growing tendency in the number of dental practices providing treatment in the public sector, in both urban and rural areas [17]. Bromlik et al. [15] also reported a consistently increasing rate in the treatment index in Polish 12-year-olds from rural areas. If this trend continues, some improvement can be expected in the dental health of people living in rural areas, as the development of new carious lesions is strictly dependent on the presence of active caries lesions.

The differences between the dental status of children in the rural areas vs. urban areas are still significant, and remain to the disadvantage of rural areas. This is only a part of a bigger issue concerning social and physical differences in urban and rural settings. Generally, life in rural areas is less convenient and this may have consequences for the quality of life. According to the literature, there is higher unemployment, a lower level of education and a poorer social and health service in the rural areas [18]. It should also be emphasized that residence in rural areas involves worse health status parameters, and dentition is only a part of the general health status [18, 19]. These factors are strong determinants for oral health in young people from the rural areas, and in this respect, it is assumed that behavioural and socio-economic factors play a very important role. More attention should be directed towards raising awareness and promoting health-related behaviours that are generally beneficial to the oral health. Portuguese survey evaluated the impact of socio-economic factors on the progression and development of dental caries in schoolchildren and showed their strong correlation [20].

In order to compare the intensity of caries expressed in the DMFT index in the Podlaskie region with other countries and European regions with similar economic and historical status (Eastern Bloc countries), we referred to similar epidemiological studies (WHO monitoring) of Montenegro, Russia and Croatia [21, 22, 23]. In all these studies, groups of 12-year-olds were monitored. A study conducted by the Northern State Medical University in Arkhangelsk, north-west Russia, in a group of 355 students showed the mean value of DMFT = 2.95, and its components D=1.56, M=0.03, F=1.34 [22]. These values are consistent with those obtained in the presented study in 2010 (Fig. 1). The Russian researchers also emphasized the differences between urban and rural areas, where in the former there was a greater rate of filled teeth

and, on the other hand, in the latter there occurred mostly teeth with active caries [22]. Another study provided by the University of Zagreb in 2009–2010 revealed similar DMFT values in the described age group equal to 4 [23]. In 2006 in Montenegro, the obtained results of the DMFT values also did not exceed 3.43 [23]. These data appear to be consistent with the presented results. This shows that the steps towards the individualization of WHO objectives and targets, depending on the country and region, are correct. Historically and economically determined differences between the countries of the former Communist bloc in Europe and the other, highly developed countries, are reflected in the health of their inhabitants.

## CONCLUSIONS

The presented comparison of the DMFT values between 2003–2010 shows that over the years a reduction in the number of 1.4 teeth occurred. The WHO objective for 2020 will therefore be very difficult to achieve. The dental health of 12-year-olds from the rural and urban of the Podlaskie region varies considerably. Among children from the rural areas, the dental caries progression is more visible and has not improved during the years 2003–2010. These findings should lead to the development of prevention programmes for the inhabitants of rural areas.

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