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## ORIGINAL ARTICLE

# Analysis of indicators of caries of permanent teeth in children according to the endemic features of the Poltava region, Ukraine

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## ABSTRACT

**Aim:** This research is focused at analyzing the indicators and substantiating the peculiarities of caries prevention in permanent teeth in schoolchildren of Poltava region, taking into account the endemic features of the Poltava region.

**Materials and Methods:** A comparative study was conducted among 608 pupils of secondary schools in Kremenchuk, who consumed drinking water with fluoride concentrations in the lower limits of the norm, and 1214 pupils of secondary schools in Poltava, who consumed drinking water with fluoride concentrations in the optimal upper limits of the norm.

**Results:** The rates of caries in permanent teeth in children living in a region with fluoride concentrations in drinking water in the optimal-upper normal range are several times lower than in children of the same age living in a region with fluoride concentrations in drinking water in the lower normal range, and a significant increase in the prevalence and intensity of caries is observed from 7 to 9 to 12 years of age, as teeth after eruption are most vulnerable to caries. In a region where the fluoride concentration in drinking water is in the optimal-upper range of the norm, children with early forms of fluorosis have the lowest prevalence and intensity of caries.

**Conclusions:** Endemic features of the region directly affect the prevalence and intensity of the caries process. In regions with a fluoride concentration in drinking water within the optimal upper limits of the norm, prevention of caries in permanent teeth in children should be carried out taking into account the presence of fluorosis.

**KEY WORDS:** children, permanent teeth, caries, fluorosis, prevention

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## INTRODUCTION

The quality of life of the population has several criteria, among which health, in particular the dental status that is formed in childhood, occupies a special place [1, 2]. Dental caries is one of the most common diseases among the world's population, including children. A significant number of studies have been devoted to the study of its risk factors, the mechanisms of its development and dynamics under the influence of preventive measures, the peculiarities of prevalence and intensity among the population of countries with different economic and social development in different historical epochs, starting with the Eneolithic [3-6]. The results of epidemiological studies by scientists from different countries and regions show that despite the preventive orientation of modern dentistry, the dental health of the of the child population remains unsatisfactory [7-12].

It is also a proven fact that the main role in the pathogenesis of caries belongs to the caries resistance of enamel, the mineral base of which includes various chemical elements, the amount of which in the body correlates with their amount in the environment. One of the most important chemical elements involved in the process of tooth mineralization is fluoride, and insufficient amounts of it in drinking water can

change its content in the child's body and, consequently, in the hard tissues of the teeth, which in turn will affect their caries resistance [10, 13-15].

The important role of fluorides in the prevention of dental caries has been substantiated by numerous scientific studies. The use of fluoride remineralizing agents during the eruption of permanent teeth increases the rate and creates optimal conditions for the maturation of hard tissues, and prolonged exposure to fluoride pastes and varnishes prevents demineralization, promotes remineralization, and reduces the growth of dental caries by up to 40% [16-19]. At the same time, consumption of water with excessive fluoride content, as well as excessive intake of this chemical element and its compounds with atmospheric air for a long time, causes endemic fluorosis in the population, especially in children [20-22].

The situation in Poltava region is endemic for fluorosis, as its territory belongs to the Buchatskyi fluorine-bearing hydrogeological province, whose groundwater is characterized by an increased fluoride content [22]. Analytical and statistical studies have shown that more than 30% of the region's population uses drinking water from mine wells with a fluoride content of more than 1.5-4.5 mg/l. In contrast, Poltava drinking water from centralized

water supply sources, according to "Poltavavodokanal", fully meets the requirements of current state, international and European standards and contains fluoride within the optimal upper limits of the norm [23]. In other words, water from centralized water supply sources is safe for the city's adult population, provided that they follow a physiological drinking regimen and consume foods with a high fluoride content in moderation. However, given the sensitivity of the child's body to fluoride, especially during the formation and eruption of permanent teeth, and the increased (compared to adults) need for water, Poltava drinking water is not safe for children, and its use leads to an endemic incidence of fluorosis, which is confirmed by numerous studies [24, 25]. The second largest city in Poltava region (Kremenchuk) is supplied with water through the "Kremenchukvodokanal" distribution system from the Kremenchuk reservoir of the Dnipro river. Kremenchuk drinking water from centralized water supply sources is also treated in accordance with the requirements of current national, international and European standards and contains fluoride within the lower limits of the norm [23].

The presence of endemic fluorosis in a certain category of the population in the Poltava region and the use of drinking water with a different fluoride content by children in the largest settlements of the region prompted us to conduct this study to substantiate the peculiarities of caries prevention in permanent teeth in schoolchildren in this region.

## AIM

This research is focused at analyzing the indicators and substantiating the peculiarities of caries prevention in permanent teeth in schoolchildren of Poltava region, taking into account the endemic features of the Poltava region.

## MATERIALS AND METHODS

To achieve this goal, a comparative study was carried out among 608 pupils of secondary schools in Kremenchuk, who consumed drinking water with fluoride concentration in the lower limits of the norm, and 1214 pupils of secondary schools in Poltava, who consumed drinking water with fluoride concentration in the optimal upper limits of the norm.

Depending on the endemic characteristics of the region and the prevalence of fluorosis, three groups were identified: Group I – 608 schoolchildren from Kremenchuk, Group II – 772 residents of Poltava who did not have a fluorosis prevalence, and Group III – 442 students from Poltava who had early signs of fluorosis on their teeth.

Schoolchildren in each group were also divided into subgroups according to age, namely

- the first clinical group: Subgroup 1- 297 students aged 7 to 9 years, Subgroup 2 – 150 children aged 12 years, and Subgroup 3 – 161 children aged 17 years;
- the second clinical group: 1 subgroup – 499 people aged 7 to 9 years, 2 subgroup – 109 people aged 12 years and 3 subgroup – 164 people aged 17 years;
- the third clinical group: 1 subgroup – 174 people aged

7 to 9 years, 2 subgroup – 144 people aged 12 years and 3 subgroup – 124 people aged 17 years.

The study in all groups began with a thorough examination of complaints and anamnesis, during which special attention was paid to finding out the child's place of birth, water source, feeding pattern, etc. The intensity of caries in permanent teeth was determined using the CFE index, which was the total sum of carious (C), filled (F) and extracted (E) teeth in one examined person. To assess the presence and intensity of dental fluorosis, the criteria of the Dean index were used, which were recorded on the basis of visual assessment of the two most affected teeth. In case of unequal lesions, the lower of the two criteria was recorded. Parents disclaimed the presence of somatic and infectious diseases in schoolchildren.

The examination of pupils of Poltava city was performed on the basis of the Municipal Enterprise "City Children's Clinical Dental Polyclinic of Poltava City Council", and pupils of Kremenchuk city – on the basis of the Municipal Non-Profit Medical Enterprise "City Children's Dental Polyclinic" in compliance with the basic provisions of the "Rules for Ethical Principles for Scientific Medical Research Involving Human Participants" approved by the Declaration of Helsinki (1964-2013). ), ICH GCP (1996), EEC Directive No. 609 of November 24, 1986, Orders of the Ministry of Health of Ukraine No. 690 of September 23, 2009, No. 944 of December 14, 2009 and No. 616 of August 03, 2012. The parents of all schoolchildren were informed in advance about the aims, organization, and methods of the study and signed an informed consent for their children to participate in it. The examinations were performed with complete anonymity of the patients and minimal psychological distress on their side.

Statistical processing of the research results was carried out using generally accepted statistical methods. The reliability of the results was assessed by the Student's reliability criterion. Differences in parameters were considered significant at  $p \leq 0.05$ .

## RESULTS

The results of the examination of the prevalence and intensity of caries in permanent teeth of the examined schoolchildren are presented in the Tables 1 and 2.

Analyzing the results, we see that children of the first group, that is, residents of Kremenchuk, had the highest caries prevalence in each age subgroup. In pupils of the second group, the prevalence and intensity of caries were significantly lower at 7-9 years of age by 40% and 8 times; at 12 years of age – by 24% and three times; at 17 years of age – by 10% and two times, respectively. Schoolchildren in the third group had the lowest disease incidence. The prevalence and intensity of caries in them, compared to children in the first group, were significantly lower by 45% and 18 times at the age of 7-9 years, by 31% and 4 times at the age of 12 years, and by 22% and 4.4 times at the age of 17 years, respectively.

The analysis of the dependence of dental caries indicators on the presence of fluorosis manifestations showed that in

**Table 1.** Prevalence of caries among the surveyed

	1 subgroup	2 subgroup	3 subgroup
I group	49,83 ± 2,90	85,33 ± 2,89***	92,55 ± 2,07****
II group	9,42 ± 1,31*	61,47 ± 4,66*,***	82,81 ± 1,73*,****
III group	4,60 ± 1,59*,**	54,17 ± 2,31*,***	70,45 ± 3,27*,**,****

Notes: \* – significance of differences ( $p \leq 0.05$ ) in relation to group I;

\*\* – significance of differences ( $p \leq 0.05$ ) in relation to group II;

\*\*\* – significance of differences ( $p \leq 0.05$ ) in relation to subgroup 1;

\*\*\*\* – significance of differences ( $p \leq 0.05$ ) in relation to subgroup 2.

**Table 2.** Intensity of caries among the surveyed

	1 subgroup	2 subgroup	3 subgroup
I group	1,28 ± 0,09	4,50 ± 0,19***	5,15 ± 0,16****
II group	0,16 ± 0,02*	1,31 ± 0,13*,***	2,92 ± 0,14*,****
III group	0,07 ± 0,03*,**	1,13 ± 0,18*,***	1,18 ± 0,19*,**

Notes: \* – significance of differences ( $p \leq 0.05$ ) relative to group I;

\*\* – significance of differences ( $p \leq 0.05$ ) in relation to group II;

\*\*\* – significance of differences ( $p \leq 0.05$ ) in relation to 1 subgroup;

\*\*\*\* – significance of differences ( $p \leq 0.05$ ) in relation to 2 subgroups.

each age subgroup, children of the third group, i.e., residents of Poltava with fluorosis, had the lowest incidence. The prevalence and intensity of caries in them, compared to children of the second group, were significantly lower by 5% and 2.3 times at the age of 7-9 years and by 12% and 2.5 times at the age of 17 years, respectively. In schoolchildren aged 12 years, the difference in dental caries indicators depending on the presence of fluorosis manifestations is present, but not significant ( $p > 0.05$ ).

The analysis of the dependence of caries incidence on the age of children showed that in the first group of subjects the prevalence of caries at 7-9 years was 49.83% with an intensity of 1.28 teeth, significantly increasing by 36% and 3, 5 times by the age of 12, reaching 85% and 4.5 teeth per subject, which corresponds to a high prevalence and high intensity of dental caries according to the WHO grading, and by 7% and 1.14 times from 12 to 17 years.

The same pattern was found in the second group of subjects, where the prevalence of caries at the age of 7-9 years was 9.42% with an intensity of 0.16 teeth, significantly increasing by 52% and 8 times by the age of 12 years, reaching 61.47% and 1.31 teeth per subject, which corresponds to the average prevalence and low intensity of dental caries according to the WHO grading, and from 12 to 17 years – by 21% and 2.2 times, respectively.

Among children in the third group, the probable increase in caries prevalence was 50% from 7 to 9 to 12 years of age and reached 54.17%, which corresponds to the average caries prevalence according to the WHO grading, and 16% from 12 to 17 years of age. The intensity of caries from 7-9 to 12 years of age increased significantly by 16 times and reached 1.13 teeth per examinee, which corresponds to a very low level of dental caries intensity according to the

WHO grading. The difference in caries intensity between 12 and 17 year olds is not significant ( $p > 0.05$ ).

Thus, the analysis of our studies shows that the rates of caries in permanent teeth in children living in a region with fluoride concentrations in drinking water in the optimal upper limits of normal are several times lower than in children of the same age living in a region with fluoride concentrations in drinking water in the lower limits of normal. In both of these regions, a significant increase in the prevalence and intensity of caries is observed from 7-9 to 12 years of age, as teeth after eruption are most vulnerable to caries, which proves the need to implement caries prevention programs for permanent teeth at the stage of immature enamel.

We also found that in a region with fluoride concentrations in drinking water in the optimal-upper normal range, children with early forms of dental fluorosis have the lowest prevalence and intensity of caries, which should be taken into account when implementing prevention programs.

## DISCUSSION

The data published in this article are the result of research aimed at analysing the indicators and substantiating the specifics of caries prevention in permanent teeth in schoolchildren of Poltava region, taking into account the endemic characteristics of the Poltava region.

The relevance of scientific research is determined by the fact that the main role in the pathogenesis of caries is played by the caries resistance of enamel, the mineral base of which includes various chemical elements, including fluoride, an insufficient amount of which in drinking water can change its content in the child's body, and therefore in the hard tissues of the teeth, which in turn will affect their caries resistance [10, 13-15].



This is consistent with our findings that students in Kremenchuk secondary schools who consumed drinking water with fluoride concentrations in the lower normal range had the highest caries incidence (both prevalence and intensity) at 7-9 years of age, 12 years of age, and 17 years of age. In contrast, students in Poltava secondary schools who consumed drinking water with fluoride concentrations in the optimal-upper limits of normal had significantly lower caries rates at each of these ages.

It is well known that drinking water with an optimal fluoride content helps to reduce the incidence of caries. At the same time, given the sensitivity of the child's body to fluoride, especially during the formation and eruption of permanent teeth, drinking water with a fluoride concentration in the optimal upper limits of the norm is not safe for children, and its consumption leads to an endemic incidence of fluorosis [24, 25].

From this perspective, the results of our studies on the incidence of dental caries among pupils of secondary schools in Poltava, who consumed drinking water with a fluoride concentration in the optimal upper limits of

the norm, are interesting, consistent with the results of studies by other authors [11] and, again, prove that the optimal fluoride content in drinking water helps to reduce the incidence of caries among children, even if they have manifestations of the initial forms of fluorosis on their teeth.

The generalised results of our studies once again prove the fact that, despite the preventive orientation of modern dentistry, the dental health of the children's population remains unsatisfactory [7, 8, 10-12].

## CONCLUSIONS

Our research results show that caries prevention is still a leading area of development in pediatric dentistry and that programs for the prevention of caries in permanent teeth at the stage of immature enamel remain particularly appropriate. Endemic features of a region have a direct impact on the prevalence and intensity of the caries process. In regions with fluoride concentrations in drinking water in the optimal-upper limits of the norm, prevention of caries in permanent teeth in children should be carried out taking into account the presence of fluorosis.

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#### CONFLICT OF INTEREST

The Authors declare no conflict of interest

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