

# EPIDEMIOLOGICAL INDICATORS OF DENTAL MORBIDITY OF CHILDREN AS AN INDICATOR OF ADVERSE ENVIRONMENTAL INFLUENCE

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## ABSTRACT

**The aim:** Is to study the ecological and hygienic situation in the living area of 6-year-old children in terms of drinking water (micro- and macroelements), to identify its relationship with the state of mineral metabolism in children's mouths, prevalence and intensity of temporary and permanent caries.

**Materials and methods:** Clinical and laboratory studies were to study the objective condition of the teeth -intensity of dental caries according to the recommendations of the WHO and the method of T.F. Vinogradova. The hygienic condition of the oral cavity was determined by the indices Silness-Loe, Stallard.

**Results:** The results of our studies have shown that the proposed therapeutic and prophylactic complex, which includes drugs of endogenous (Vitafluor) and exogenous use (osteovitis, deep fluoridation, toothpastes "Splat junior" and "Lacalut fluor"), improves the hygienic state of the oral cavity, increases mineralizing the potential of the oral fluid and, as a result, helps to reduce the intensity of dental caries in children.

**Conclusions:** The data obtained indicated a high caries prophylactic efficacy of the proposed therapeutic and prophylactic complex for 6-year-old children living in the zone of hypophosphorus.

**KEY WORDS:** dental caries, children, mineralization, oral fluid

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## INTRODUCTION

Epidemiological studies conducted in various countries around the world show a high prevalence of dental caries among the population, which in some countries reaches 100% [1, 2]. According to WHO experts, about 98% of the world's population suffers from dental caries and there is a tendency to increase the number of cases of dental caries from early childhood. In Ukraine, the prevalence of dental caries in young children reaches 95% [3, 4].

On average in Ukraine the prevalence of caries reaches 48.0% in the central part of the country and 97.7% – in its western regions.

The reasons for such differences are both socio-economic and environmental factors, of which the geochemical. To date, it has been proven that the mineral composition of drinking water and the surrounding atmosphere are important for the formation of a full-fledged structure of tooth enamel from external factors [5, 6].

The incidence of dental caries in young children is associated with the level of ecological and hygienic safety of the region of residence. The most significant risk factors for the development of dental caries in children are fluoride deficiency in drinking water, the reduction of the optimal level of which (less than 0.1 mg per 1 liter) leads to the

development of dental caries in children. It is also shown that the lack of other macro- and microelements in the body (calcium, magnesium, iron, etc.) can contribute to the development of caries of temporary and permanent teeth [7-9].

Therefore, when considering the problem of dental caries, the most important pathogenetic factor is the lack of fluoride in drinking water, the main role of which is associated with its participation in the development of teeth and bone formation. Insufficient fluoride content in drinking water can lead to disruption of tooth mineralization in children, especially in the age group of 6 years, as this age is the beginning of the formation of permanent occlusion. The consequence of such disorders is the development of caries in permanent erupting teeth [10-13].

Clinical and laboratory studies conducted by a number of authors indicate the deterioration of dental health of children from environmentally unfavorable regions, which is manifested in an increase in the prevalence and intensity of carious process of temporary and permanent teeth. Based on this, it is proposed to use epidemiological indicators of dental morbidity as indicators of adverse environmental effects.

## THE AIM

The aim of the research was to study the ecological and hygienic situation in the living area of 6-year-old children in terms of drinking water (micro- and macroelements), to identify its relationship with the state of mineral metabolism in children's mouths, prevalence and intensity of temporary and permanent caries and to choose the optimal caries-prophylactic complex for children living in the area of hypofluorosis.

## MATERIALS AND METHODS

This study was conducted at the orthopedic dentistry department I. Horbachevsky Ternopil National Medical University, Ukraine, and was approved by the ethics committee of the I. Horbachevsky Ternopil National Medical University, which determined that the general ethical rules of humane treatment of patients were observed when working with patients in accordance with the requirements of the Tokyo Declaration of the World Medical Association and the International Recommendations of the Helsinki Declaration of Human Rights.

A complex of toxic-hygienic and clinical-laboratory researches has been carried out. Toxic and hygienic studies included a study of the composition of drinking water in Ternopil – the region of residence of 6-year-old children. Drinking water was tested according to the state standards of Ukraine. 178 children aged 6 years living in Ternopil took part in epidemiological researches. Clinical and laboratory studies were to study the objective condition of the teeth -intensity of dental caries according to the recommendations of the WHO and the method of T.F. Vinogradova. The hygienic condition of the oral cavity was determined by the indices Silness-Loe, Stallard.

To assess the functional activity of the salivary glands, the rate of salivation was determined. We studied biomarkers in the oral fluid of children, which characterize the state of mineral balance, which is most indicative in assessing the degree of "cariogenicity" of oral fluid. The calcium content in the oral fluid was determined by the method of Karakashov and Vichev in the modification of VK Leontiev and VB Smirnova by reaction with orthocresolphthaleincomplexone. Inorganic phosphorus in mixed saliva was determined by the method of Boltz and Luke in the modification of VK Leontieva, VP Brishalina.

To study the effectiveness of treatment and prevention complex selected 50 children with high intensity dental caries. Children were divided into two clinical groups depending on the prescribed set of treatment and prevention measures: 1st – comparison group (20 children); 2nd group – the main (30 children). Children of the main group for the purpose of endogenous prevention of dental caries were prescribed Vitaphthorum (manufacturer "Technologist", Ukraine, Uman, Cherkasy region), for local prevention – osteovitis in the form of dental applications (manufacturer "Odessa Biotechnology", Ukraine, Odessa). Splat junior and Lacalut fluor toothpastes (manufactured by Lacalut, Germany) were prescribed for individual oral

hygiene. One of the main components of caries prevention measures was the training of proper brushing skills and daily adult-controlled oral care.

Carried out deep fluoridation according to Knappvost – sealing of enamel microcracks with magnesium fluoride silicate and suspension. Evaluation of the effectiveness of the proposed treatment and prevention complex was determined by the degree of reduction of dental caries for 2 years. Statistical data processing was performed by the method of correlation analysis using the Pearson correlation coefficient, the method of statistical groupings, the method of Montsevichute-Eringen and Student. The results were processed on an IBM PC in the packages "Statgraphic – 2, 3" and "Statistica -5".

## RESULTS

Characterizing the drinking water of water sources in Ternopil, it is necessary to note a number of indicators that can affect the structure of the enamel and contribute to the demineralization of tooth enamel. First of all, it is insufficient mineralization of water, the lowered maintenance in it of fluorine and the raised maintenance of nitrites. Thus, the total mineralization of water, carried out mainly due to calcium, was lower than normal (390 mg/dm<sup>3</sup> and 1000 mg/dm<sup>3</sup>, respectively). The fluorine content in drinking water did not exceed 0.2 mg/dm<sup>3</sup> (at an optimal content of 1.5 mg/dm<sup>3</sup>), and the iodine concentration was 0.0 at a conditional rate of 0.4-4 µg/g. Of the toxic elements significantly exceeded the limit values of nitrites – 0,0138 mg/dm<sup>3</sup> (at the standard value – 0,002 mg/dm<sup>3</sup>), the ammonia content slightly exceeded the norm. The content of such important for the body macro- and micronutrients as sulfates, chlorides, copper and zinc was lower than the normative values, in particular sulfates and chlorides – almost 20 times. The iron content at a rate of 0.3 mg/dm<sup>3</sup> exceeded the normative values in the well by 7.5 times.

Based on the results of the study of geochemical parameters, it should be noted that among the factors that can lead to impaired tooth mineralization and, consequently, affect the demineralization of teeth and the development of caries in permanent erupting teeth – the main and indisputable factor is insufficient fluoride. into the body with drinking water. As for calcium, insufficient intake of it with drinking water, as well as a result of its increased metabolism in the body, further leads to the development of calcium deficiency in calcified tissues. In addition, with insufficient intake of calcium with drinking water and food, to maintain normal blood levels, it is extracted from the main depot (bones, teeth), causing demineralization of bones and hard tissues of the teeth. Deficiency of elements such as calcium, iron, selenium, iodine and increased intake of nitrites reduces the body's natural resistance.

Insufficient fluoride content in drinking water and the general unfavorable background of the environment can lead to impaired mineralization of teeth and, as a consequence, the development of caries in permanent erupting teeth. This was the justification for the study of the condition of

the teeth in the age group of 6 years, because this age is the beginning of the formation of permanent occlusion. For the full formation of enamel in permanent teeth erupting in children living in the area of hypophthora, it is necessary to provide additional fluoride in the child's body, as well as other elements involved in the mineralization of teeth.

To study the prevalence of caries in children living in Ternopil, 178 6-year-old children living in different parts of the city were examined. The results of studying the prevalence of dental caries in children of Ternopil, which is a zone of hypophthorosis, showed that the prevalence of caries among 6-year-old children was 75%. From these children, a representative group was selected that accurately represents the composition of the studied population, in the amount of 30 children (14 boys and 16 girls) to study the main indicators of the intensity of caries in them. The intensity of caries was studied separately for boys and girls, and the average statistical indicators of the groups of children examined were also derived.

We found that the average indicators of the intensity of dental caries in boys were higher than in girls. I also drew attention to the fact that in all the children we examined, carious cavities were revealed in the first permanent teeth, which, as you know, erupt only at 6 years old. Children with high caries intensity (HCI) accounted for almost 37% and their average caries intensity was very high – more than 10, and in boys, carious lesions in 1 permanent molars were found much more often (more than 3 times) than in girls.

Due to the fact that one of the risk factors for the development of caries is dental plaque, plaque accumulation on the teeth, the hygienic state of the oral cavity was studied in children. The results of the study of the Silness-Loe hygienic index (the presence of plaque in the cervical part of the tooth) showed that in boys it is  $2.02 \pm 0.18$ , in girls –  $1.53 \pm 0.15$ . In children with NCI, the Silness-Loe hygiene index was significantly higher than the group average ( $1.75 \pm 0.26$ ), which indicated a lower level of oral hygiene. Determination of the Stallard hygienic index (detection of plaque on the vestibular surface of the tooth crown) indicated a rather low level of oral hygiene. So, in boys of 6 years of age it was  $1.67 \pm 0.17$ , in girls –  $1.07 \pm 0.09$ .

The study of the correlation between the intensity of caries and the level of hygiene of the oral cavity using the Pearson coefficient showed that the correlation coefficient for the Silness-Loe indicator was 0.785, and for the Stallard indicator – 0.688. There is a fairly high correlation between the intensity of dental caries and the level of oral hygiene. Pearson's correlation coefficient approached 1 – an absolute positive correlation: the higher the intensity of dental caries, the higher the indicators of hygiene indices indicating an unsatisfactory state of the oral cavity. At the same time, high indicators of the correlation coefficient were observed when comparing the intensity of dental caries and the Silness-Loe index, which indicates the poor quality of teeth cleaning – the presence of plaque in the cervical part of the tooth.

As you know, saliva is a complex biological fluid, it provides mineralization of teeth after their eruption and

provides an optimal composition during functioning. The study of the functional activity of the salivary glands in 6-year-old children showed that the rate of salivation in them is  $0.66 \pm 0.05$  ml/min., that is, it fits into the normal level of salivation (fluctuations in the rate of salivation – from 0.45 to 0.96 ml/min). It is known that the mineralizing function of saliva is based on mechanisms that prevent the release of its constituent components from the enamel and facilitate the entry of such components from saliva into the enamel. These mechanisms provide a state of dynamic balance of the enamel composition and the surrounding biological fluid – saliva, which is maintained at the required level due to the resultant of two processes – dissolution of enamel hydroxyapatite crystals and their formation.

The study of the mineral homeostasis of saliva showed that in the oral fluid of children, violations of the ratio of the main mineral components that are involved in the mineralization of teeth were revealed. So, the calcium content in the oral fluid was  $0.39 \pm 0.06$  mmol/L, the phosphorus content –  $4.12 \pm 0.43$  mmol/L (normally mixed saliva contains calcium – 4-8 mg/100 ml, phosphorus – 10-25 mg/100ml).

Thus, the ratio of calcium and phosphorus indicated a decrease in the calcium content and the prevalence of phosphates in the oral fluid – the phosphate content was 10.6 times higher. Determination of the Ca/P coefficient was  $0.09 \pm 0.01$ . Considering that hydroxyapatite is the main solid compound of calcium and phosphorus, which are found in the body under physiological conditions, the data obtained indicate that the processes of demineralization of tooth enamel prevail over remineralization.

Based on the above, we proposed a caries prophylactic complex to study the effectiveness of which the children were divided into 2 groups. The main group (30 children) received the intended complex for 2 years; children of the comparison group (20 children) were recommended an oral care regimen, which was controlled by adults. The children were followed up for 2 years with periodic examinations every 6 months. To study the caries-prophylactic action of the proposed complex, the rate of salivation was determined. In the comparison group, it was  $0.64 \pm 0.04$  ml/min, after 2 years of observation –  $0.61 \pm 0.07$  ml/min ( $p > 0.05$ ). In the main group, the initial level of salivation rate was  $0.68 \pm 0.05$  ml/min, after 2 years of observation –  $0.48 \pm 0.05$  ml/min ( $p < 0.01$ ). Studies carried out at various stages of observation showed that the rate of salivation in both groups of children did not change significantly, and remained within normal values. However, the smallest indicators in relation to the initial level were recorded in the children of the comparison group, studied after 2 years of observation.

Determination of the hygienic state of the oral cavity – the Silness-Loe index showed that in the comparison group its output level was  $2.05 \pm 0.21$ , and after 2 years –  $2.75 \pm 0.26$  ( $p < 0.05$ ). In the main group of children, the initial level of the Silness-Loe index was  $1.85 \pm 0.19$ , and after 2 years of observation –  $1.38 \pm 0.14$  ( $p < 0.05$ ). Determination of the Stallard hygienic index of children of the comparison group showed its initial level of  $1.45 \pm 0.14$ , after 2 years

–  $1.97 \pm 0.21$  ( $p < 0.05$ ). In the main group of children, the output level of this index was  $1.39 \pm 0.12$ , after 2 years –  $1.32 \pm 0.14$  ( $p > 0.05$ ) ( $p$  – significance of differences in relation to the initial level  $< 0.05$ ).

The group indicators of the hygienic state of the oral cavity in children of both groups at the beginning of the study were included in the framework of “satisfactory” hygiene. The level of oral hygiene in children of the main group has significantly increased: the number of children with “very good” hygiene has increased. This indicates that children have significantly improved oral care. In children of the comparison group, the indicators of oral hygiene practically remained at the initial level. After 2 years of observation, only in children of the comparison group, indicators of the oral hygiene state indicated a worsening of the situation, both according to the Silness-Loe index and the Stallard.

We studied the state of the mineralizing potential of the oral fluid in children at the initial stage and after the end of the research. Determination of the calcium content in the oral fluid showed that in the comparison group its output level was  $0.41 \pm 0.07$  mmol/L, after 2 years of observation –  $0.35 \pm 0.06$  mmol/L ( $p > 0.05$ ). In the main group of children, the output level of calcium was  $0.37 \pm 0.05$  mmol/L, and after 2 years of observation –  $0.58 \pm 0.06$  mmol/L ( $p < 0.02$ ). As for phosphorus, its output level in the comparison group and the main group of children was  $4.32 \pm 0.47$  mmol/L and  $3.82 \pm 0.39$  mmol/L, respectively. At the end of the study, the phosphorus content in the comparison group and the main group was  $4.25 \pm 0.42$  mmol/L and  $3.97 \pm 0.38$  mmol/L, respectively ( $p > 0.05$ ).

Calculation of the Ca/P coefficient at the initial stage in the comparison group and the main group was  $0.094 \pm 0.009$  and  $0.096 \pm 0.011$ , respectively. At the final stage of the study, this coefficient was  $0.082 \pm 0.008$  ( $p > 0.05$ ) in the comparison group and  $0.135 \pm 0.015$  ( $p < 0.05$ ) in the main group of children. Analyzing the results obtained, it should be said that in the children of the comparison group, the calcium content in the oral fluid, although insignificantly, decreased, and the phosphorus content practically did not change, which was reflected in the Ca/P ratio. This coefficient decreased significantly, but not to the level reliability of differences in relation to baseline.

In the main group of children, a significant increase in the content of calcium in the oral fluid was observed, while the concentration of phosphates practically did not change. Therefore, the calcium-phosphorus ratio increased significantly (the differences are significant in relation to the initial level). The data obtained served as the basis for believing that the intensity of the processes of demineralization in children decreased and the intensity of the processes of mineralization of the enamel of the teeth increased. In the children of the comparison group, there was a tendency to a decrease in the oral fluid of the main minerals involved in the mineralization of teeth, in particular, calcium and phosphorus, and, most importantly, a decrease in the calcium-phosphorus coefficient – the main indicator of the activity of mineral metabolism.

## DISCUSSION

The main indicator of the effectiveness of the use of caries prophylactic complex is the increase in the intensity of dental caries. The results of his research showed that by the beginning of the research, the indicators of the intensity of caries in children of both groups did not differ significantly. Thus, the intensity of caries in children of the comparison group at the initial stage was  $6.51 \pm 0.48$ , in the main group of children –  $6.43 \pm 0.61$ . At the final stage of the study, the intensity of dental caries in children of the comparison group and the main group was  $8.16 \pm 0.75$  and  $6.93 \pm 0.61$ , respectively. So, the increase in the intensity of dental caries for 2 years of observation in the comparison group was  $1.65 \pm 0.12$ , in the main group –  $0.50 \pm 0.06$  ( $p < 0.01$ ) (the reliability was calculated in relation to the indicators recorded in comparison group).

Clinical studies have shown that the use of a caries prophylactic complex for 2 years led to a decrease in the increase in the intensity of dental caries by more than 3 times (reduction of dental caries was 70%), due to an increase in the intensity of mineral metabolism (an increase in calcium content and an increase in calcium-phosphorus coefficient), improving the hygienic state of the oral cavity.

## CONCLUSIONS

The data obtained indicated a high caries prophylactic efficacy of the proposed therapeutic and prophylactic complex for 6-year-old children living in the zone of hypoparathyroidism. The results of our studies have shown that the proposed therapeutic and prophylactic complex, which includes drugs of endogenous (Vitafluor) and exogenous use (osteovitis, deep fluoridation, toothpastes “Splat junior” and “Lacalut fluor”), improves the hygienic state of the oral cavity, increases mineralizing the potential of the oral fluid and, as a result, helps to reduce the intensity of dental caries in children.

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#### Conflict of interest:

*The Authors report no conflict of interest.*

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