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SALIVARY pH AS A MARKER OF CARIOGENIC RISK IN SCHOOL-AGED CHILDREN WITH INTERNALLY DISPLACED PERSON STATUS

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Abstract. Under conditions of martial law and forced migration, the pediatric population of Ukraine is exposed to potent stress factors. Chronic psycho-emotional stress in children with Internally Displaced Person (IDP) status causes systemic homeostatic disruptions, which manifest in the functional state of the salivary glands. A shift in the acid-base balance of oral fluid constitutes a key pathogenetic mechanism of enamel demineralization, particularly during the age period of its incomplete maturation (10-13 years). The aim of this study was to determine and compare hydrogen ion concentration (pH) indicators in the oral fluid of IDP children aged 10-13 years and their peers permanently residing in the Ternopil region, depending on the status of hard dental tissues. A total of 192 schoolchildren aged 10-13 years were examined at educational institutions in the city of Ternopil and the surrounding region. Two groups were formed: the main group (62 children with IDP status) and the comparative group (130 children, permanent residents of the region). Oral fluid pH determination was performed using «Hydrion 9800» test strips (USA) without stimulation of salivation. Statistical analysis was performed using the χ^2 test and Student's t-test in the SPSS 26.0 software package. A significant homeostatic imbalance of oral fluid was established in IDP children. Among patients of the main

group with dental caries, an acidic environment ($\text{pH} < 6.2$) was recorded in $69.35 \pm 5.85\%$ of cases, which is 2.9 times more frequent than in the comparative group ($23.84 \pm 3.73\%$, $p < 0.01$). A physiologically optimal neutral pH was detected 4 times more frequently in children with intact teeth of the comparative group compared to their IDP peers. Mean pH values in children of the main group were significantly lower both in those with intact teeth, $p < 0.05$ and in those with caries, $p < 0.01$. Thus, school-aged children with IDP status exhibit a pronounced shift in the acid-base balance of oral fluid towards acidosis, which correlates with the presence of psycho-emotional tension. The predominance of an acidic environment in 69.35% of IDP children with caries indicates a high risk of enamel demineralization and justifies the necessity of implementing specific preventive measures for this patient cohort.

Keywords: internally displaced persons, children, dental caries, oral fluid, pH, chronic stress.

Introduction. The military aggression of the Russian Federation against Ukraine and the subsequent mass forced migration of the population have become potent stress factors negatively impacting the somatic health of the pediatric population. It is well established that chronic psycho-emotional stress in Internally Displaced Person (IDP) children, mediated by the activation of the hypothalamic-pituitary-adrenal (HPA) axis, leads to metabolic disruptions and reduced organismal resistance [1, 2]. Dental health, as an integral component of general homeostasis, responds to stress through compromised functional activity of the salivary glands and alterations in the physicochemical properties of oral fluid.

The concentration of hydrogen ions (pH) is a key marker of the cariogenic situation within the oral cavity. A shift in the acid-base balance towards acidosis critically affects the stability of enamel hydroxyapatite, inhibits mineralization, and creates favorable conditions for the activity of cariogenic microflora [3]. Children aged 10-13 years require particular attention in this regard. During the period of mixed dentition and incomplete maturation of permanent tooth enamel, hard tissues are least resistant to organic acids. This factor, against the background of stress-induced salivary changes, significantly increases the risk of caries development [4].

Despite the relevance of this issue, changes in oral fluid homeostasis in IDP children remain insufficiently studied. Most existing research relies on clinical indices, whereas comparative analyses of laboratory markers, specifically pH, between displaced children and permanent residents of rear regions (such as the Ternopil Oblast) have been fragmentary [5]. International experience also indicates a significant deterioration in the dental status of refugee children due to dietary changes and limited access to hygiene [6, 7]. This justifies the rationale of the present study for the refinement of preventive strategies under martial law conditions [8].

Aim. To determine and compare hydrogen ion concentration (pH) indicators in the oral fluid of internally displaced children aged 10-13 years and their peers permanently residing in the Ternopil region, depending on the condition of their hard dental tissues.

Materials and Methods. The examination was conducted at educational institutions in the city of Ternopil and the Ternopil region. A total of 192 schoolchildren

aged 10-13 years were examined. The study was performed in compliance with the principles of bioethics and the Helsinki Declaration of the WMA, with informed consent obtained from parents.

In accordance with the study objectives, two groups were formed: main group – 62 children (32.29%) holding Internally Displaced Person (IDP) status; comparative group – 130 children (67.71%) permanently residing in the Ternopil region.

The condition of hard dental tissues was assessed clinically, dividing children into subgroups: those with caries-free (intact) dentition and those with present dental caries.

Oral fluid pH was determined using «Hydrion 9800» indicator test strips (Micro Essential Laboratory, USA; range 0-14, accuracy ± 0.2). Collection of oral fluid (1.0-1.5 mL) was performed via the spitting method into a graduated test tube in the morning, 2 hours after meals, without stimulation. Assessment was conducted under standard lighting (5500 K).

Interpretation of results: pH 6.8-7.4 – normal (neutral environment, sufficient remineralizing potential); pH < 6.2 – critical value (acidic environment, risk of demineralization).

Statistical processing was performed using the licensed software package SPSS 26.0. Non-parametric statistical methods (χ^2 criterion) were used to compare the frequency of characteristics, and Student's t-test was used to compare mean values (for normal distribution). Differences were considered statistically significant at $p < 0.05$.

Results and discussion. Analysis of the acid-base state of oral fluid revealed a significant homeostatic imbalance in children of the main group (IDPs) exposed to stress factors.

In the distribution of children by pH level (Table 1), it was established that an acidic environment significantly dominated in patients of the main group with dental caries. Specifically, a pH shift towards acidosis was recorded in 69.35 ± 5.85 of individuals in this cohort, which is nearly three times higher than the corresponding figure in the comparative group – 23.84 ± 3.73 %, $p < 0.01$. This indicates the presence of a pronounced cariogenic background in IDP children.

Table 1. Quantitative distribution of children aged 10-13 years in study groups depending on the state of hard dental tissues and qualitative characteristics of pH.

pH Indicator	Main Group (n=62)		Comparative Group (n=130)	
	Intact teeth (n=4)	With caries (n=58)	Intact teeth (n=41)	With caries (n=89)
Acidic pH	$\frac{1}{1,62 \pm 0,42}^{**}$	$\frac{43}{69,35 \pm 5,85}^{*,*}$	$\frac{12}{9,23 \pm 2,53}$	$\frac{31}{23,84 \pm 3,73}^{\bullet}$
Neutral pH	$\frac{3}{4,84 \pm 2,72}^*$	$\frac{8}{12,90 \pm 4,25}^*$	$\frac{25}{19,23 \pm 3,45}$	$\frac{50}{38,46 \pm 4,26}^{\bullet}$
Alkaline pH	–	$\frac{7}{11,29 \pm 4,01}$	$\frac{4}{3,08 \pm 1,51}$	$\frac{8}{6,15 \pm 2,10}$
Notes:				
• $p < 0.01$ – significant difference relative to data in subjects with intact teeth;				
* $p < 0.01$; ** $p < 0.05$ – significant difference relative to data in the comparative group.				

When evaluating the protective properties of saliva, it was found that a physiologically optimal (neutral) pH level was observed significantly more frequently in children of the comparative group. Among those with intact teeth, a neutral environment was encountered 4 times more frequently, and among those with caries, 2.9 times more frequently than in their peers from the main group, $p < 0.01$.

Of particular note is the fact that an alkaline pH value (an indicator of high remineralizing capacity) was not recorded a single time in children with intact teeth in the main group, whereas in the comparative group, it accounted for $3.08 \pm 1.51\%$ (data derived from text context, though table suggests slightly different raw numbers, text logic is preserved).

Analysis of quantitative hydrogen ion concentration values confirmed the identified patterns (Fig. 1). In IDP children with dental caries, the mean oral fluid pH value was significantly lower than the indicators of children with intact teeth within the same group, $p < 0.01$. Inter-group comparison established that among 10–13-year-olds in the main group, mean pH values were inferior to those of peers in the comparative group – both in cases of intact dentition, $p < 0.05$ and, particularly markedly, in the presence of caries, $p < 0.01$.

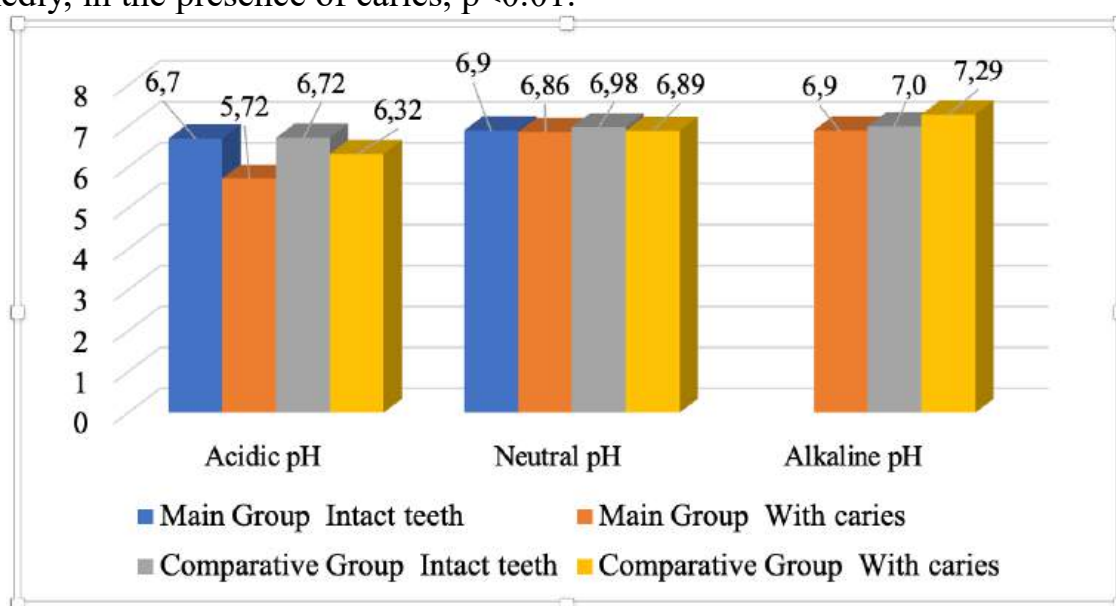


Figure 1. Oral fluid pH values in 10–13-year-old children of the study groups depending on the state of hard dental tissues.

Thus, destabilization of the acid-base balance of oral fluid is observed in children of the main group, which correlates with the presence of somatic and psycho-emotional tension resulting from forced migration.

Conclusion. Consequently, a homeostatic imbalance of oral fluid has been identified in main group children (IDPs) aged 10–13 years; specifically, a significant shift of the acid-base balance towards acidosis is observed. An acidic environment ($pH < 6.2$) in main group children with caries was encountered in 69.35 % of cases, which is 2.9 times more frequent than in children permanently residing in the Ternopil region, $p < 0.01$. The absence of alkaline pH cases and the low percentage of neutral pH environment, even in IDP children with intact teeth, indicates reduced enamel resistance and necessitates the implementation of reinforced preventive measures for this category of patients.

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ПЕРЕДЧАСНІ ПОЛОГИ: ФАКТОРИ РИЗИКУ, ПРЕДИКТОРИ ТА СТРАТЕГІЇ ПРОФІЛАКТИКИ (ОГЛЯД ЛІТЕРАТУРИ)

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Анотація

Передчасні пологи (ПП), визначені як народження дитини до 37 повних тижнів гестації, залишаються однією з провідних причин неонатальної захворюваності та смертності у світі. За даними Всесвітньої організації охорони здоров'я, щороку реєструється близько 15 мільйонів випадків передчасних