

O.V. Skyba, V.Ya. Skyba, A.E. Dienga, H.O. Babenia, S.A. Shnaider,

A.O. Savvova<sup>1</sup>, V.I. Sebov<sup>1</sup>

SE "The Institute of stomatology and maxilla-facial surgery National academy of medical sciences of Ukraine", Odessa, <sup>1</sup>Odessa National Medical University, Odessa

## MINERALIZING POTENTIAL DYNAMICS OF CHANGES IN THE ORAL LIQUID IN CHILDREN WITH TYPE 1 DIABETES MELLITUS DURING THE PREVENTIVE MEASURES

e-mail: oksanadenga@gmail.com

The research is dedicated to evaluate in children with type 1 diabetes mellitus oral liquid mineral composition in the process of using developed therapeutic and prophylactic complex. Clinical examinations involved 57 children aged 9–12 years, including 45 children with type 1 diabetes mellitus and 12 practically healthy children. At the same time, the condition of the hard tissues of the teeth was assessed. To assess the effect of developed complex on the biochemical parameters of the oral liquid, 45 children with type 1 diabetes mellitus were examined. The use of the proposed complex in children with type 1 diabetes mellitus increased the remineralizing properties of the oral liquid by increasing the content of calcium, phosphorus and magnesium macroelements in it, and also led to an increase in the activity of antioxidant and antimicrobial protection, a decrease in the intensity of lipid peroxidation.

**Key words:** dental indicators, biochemical markers, children, metabolic disorder, preventive complex.

О.В. Скиба, В.Я. Скиба, А.Е. Дєньга, Г.О. Бабєня, С.А. Шнайдер,

А.О. Саввова, В.І. Себов

## ДИНАМІКА ЗМІН МІНЕРАЛІЗУЮЧОГО ПОТЕНЦІАЛУ РОТОВОЇ РІДИНИ У ДІТЕЙ З ЦУКРОВИМ ДІАБЕТОМ 1 ТИПУ У ПРОЦЕСІ ЛІКУВАННЯ

Дослідження присвячене вивченню мінерального складу ротової рідини у дітей, які страждають на цукровий діабет 1 типу, у процесі застосування розробленого нами лікувально-профілактичного комплексу. У клінічних обстеженнях брало участь 57 дітей віком 9–12 років, з них 45 дітей із цукровим діабетом 1 типу і 12 практично здорових дітей. У цьому оцінювалися стан твердих тканин зубів. Для оцінки впливу ЛПК на біохімічні показники ротової рідини було обстежено 45 дітей з цукровим діабетом 1 типу. Використання запропонованого ЛПК у дітей з цукровим діабетом 1 типу підвищувало ремінералізуючі властивості ротової рідини за рахунок збільшення вмісту в ній макроелементів кальцію, фосфору та магнію, а також призводило до збільшення активності антиоксидантного та антимікробного захисту, нормалізації системи «перекисне окислення ліпідів».

**Ключові слова:** стоматологічні показники, біохімічні маркери, діти, метаболічне порушення, профілактичний комплекс.

*The work is a fragment of the research project: "Correction of pathogenetic mechanisms of metabolic disorders in oral tissues in patients depending on environmental and nutritional factors that affect carbohydrate and lipid metabolism", state registration No. 0118U0006966.*

Clinical observations indicate that the development of caries lesion usually occurs most intensively in children in the first years after teeth eruption, which coincides with the period of immature enamel, when its secondary mineralization has not yet been completed [1]. Most often, dental caries progresses with disorders in the endocrine system, especially in type 1 diabetes mellitus when all types of metabolism, including mineral metabolism are disturbed [5, 11, 13]. On the other hand, the hyperglycemia that develops in this case affects the state of the oral cavity – an increase in the level of glucose in the oral liquid contributes to the reproduction of microflora, which also contributes to the development of dental caries [4, 7]. This gives reason to include in complex therapy and drugs that reduce the degree of dysbacteriosis.

Therefore, for the implementation of a full-fledged secondary mineralization of teeth, the mineral composition of the oral liquid is very important. If the mineral composition of the enamel is violated, its resistance decreases and the risk of its demineralization with development of dental caries increases.

**The purpose** of the study was to investigate the mineral composition of the oral liquid in children with type 1 diabetes mellitus in the process of carrying out the proposed therapeutic and preventive measures.

**Materials and methods.** Clinical studies involved 57 children aged 9–12 years, who assessed the state of hard tissues of the teeth and the biochemical parameters of the oral liquid, 12 were practically healthy children.

For a comparative assessment of the state of hard tissues of the teeth, 57 children aged 9–12 years were examined, of which 45 children suffered from type 1 diabetes mellitus (DM 1) and 12 practically healthy children.

The revealed significant differences in the state of dental hard tissues in children with type 1 diabetes mellitus and those without somatic pathology necessitated the development of a set of measures to prevent dental caries in children with type 1 diabetes mellitus. Complex consisted of preparations that was administered to the children in 3 stages:

–1st stage consisted of “Laktiale” (JSC “Farmak”, Ukraine, Kiev) that was taken 1 gram per day after meals for 1 month 2 times per year, “Alfavit” (LLC “RECORDATI UKRAINE”, Ukraine, Kyiv) that was taken according to the instructions for 1 month 2 times per year, “Quertulin-gel” (NPA “Odesskaya biotekhnologiya”, Ukraine, Odessa) that was taken 2 times a day with a mouthguard for 1 month and elixir “Lysomuroid” (NPA “Odesskaya biotekhnologiya”, Ukraine, Odessa) that was taken in the following way – mouth rinse 3–4 times a day after meals for 1 month.

–2nd stage started after 2 months break after 1st stage and consisted of “Cardonat” (LLC “Sperco Ukraine”, Vinnytsia, Kyiv) that was taken by 1 capsule 2 times a day for 1 month 2 times per year, “Enterosgel” (LLC “TNK SILMA” Russia, Moscow) that was taken by 1 tablespoon 2 times a day 2 hours before meals for 2 weeks with a break of 1 month (2 times a year), “Quertulin-gel” that was taken 2 times a day with a mouthguard for 1 month and elixir “Lysomuroid” that was taken in the following way – mouth rinse 3–4 times a day after meals for 1 month.

–3rd stage consisted of “Ascorutin” (PJSC “Technolog”, Ukraine, Uman) that was taken by 1 pill. 2 times a day for 2 weeks 1 time per year, “Quertulin-gel” that was taken 2 times a day with a mouthguard for 1 month and elixir “Lysomuroid” that was taken in the following way – mouth rinse 3–4 times a day after meals for 1 month.

One of the proposed complex effectiveness evaluating aspects was the content of macroelements study in the oral liquid, which affect the remineralization of enamel in the process of carrying out preventive measures in children with type 1 diabetes mellitus.

To test the proposed preventive complex and evaluate its effect on the biochemical parameters of the oral liquid, 45 children with DM 1 were divided into 2 groups. 25 children (main group) received the proposed complex. Comparison group 20 children underwent only sanitation of the oral cavity and hygienic measures. Children with DM 1 were also under the supervision of an endocrinologist. Biochemical studies of children oral liquid were carried out before use of complex, after 6 and 12 months.

State of teeth hard tissues was evaluated by indices of DMFT, DMFS, caries lesion, filling, extracted.

For biochemical studies oral liquid was taken in the morning, an empty stomach by spit in centrifuge test tubes. In the supernatant was determined that calcium content, phosphorus and magnesium [2, 12].

The content of Malon Dialdehyde (MDH) in the oral liquid was determined by a color reaction with thiobarbituric acid in accordance with the method developed by Stalnoy I.D., Garishvili T.G. [2]. The activity of the catalase was determined by Karolyuk M.A. method [6], the activity of urease according to the method of GavriloVA L.M. [6], Lizozyme activity according to Levitsky A.P. method [6].

The results were processed by variational statistical methods of analysis using the Microsoft Office Excel 2016 software. Statistical processing of the experimental study results was carried out by the methods of variation analysis using the Student's test. The difference was considered statistically significant at  $p < 0.01$  [3].

**Results of the study and their discussion.** Carried out clinical studies of the state of hard teeth tissues in 9–12-year-old children with type 1 diabetes mellitus, showed that the incidence of caries is higher in both, prevalence and intensity (table 1).

Table 1

State of hard teeth tissues in children with type 1 diabetes,  $M \pm m$ 

Groups of examined children	DMFT	DMFS	Caries lesion	Filling	Extracted/missing
Healthy children	2.43±0.32	2.43±0.35	0.71±0.10	1.67±0.25	0.05±0.007
Children with diabetes mellitus 1 type	4.69±0.35 $p < 0.005$	4.69±0.41 $p < 0.005$	3.62±0.40 $p < 0.001$	0.93±0.10 $p < 0.005$	0.14±0.005 $p < 0.001$

Note,  $p$  – the index of the reliability of differences relative to the group of healthy children.

In children with diabetes mellitus 1type the “caries lesion” component prevails in the structure of the DMF index is noteworthy, while in healthy children the “filling” component prevails. Already at the age of 9–12 years, the number of extracted teeth in children with somatic pathology was 2.8 times higher than in healthy children.

The study results of the oral liquid calcium content of children with type 1 diabetes mellitus are shown in figure 1.

It is important to emphasize that the initial level of the studied indicator in children of the studied groups was reduced. In 6 months after only the sanitation of the oral cavity in children of the comparison group, the calcium content in the oral liquid practically did not change ( $p_1 > 0.1$ ), and after 12 months it became even lower (by 28.1 %,  $p_1 > 0.05$ ). Children of the main group, 6 and 12 months after the application of the full course of the developed complex, we noted a significant increase in the calcium content in the oral liquid (by 36.2 % and 43.1 %, respectively,  $p_1 < 0.05$ ). These results may indicate the activation of the remineralizing function of the oral liquid of children with DM 1 after the proposed scheme for the prevention of caries lesion.

The results of the study of the phosphorus content in the oral liquid of the observed children are presented in fig. 2.

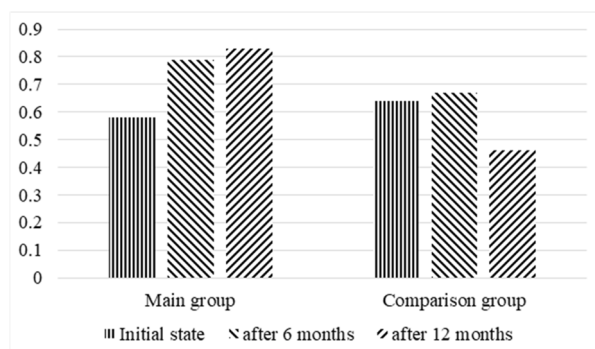


Fig.1. The content of calcium in the oral fluid of children with DM 1, mmol/l.

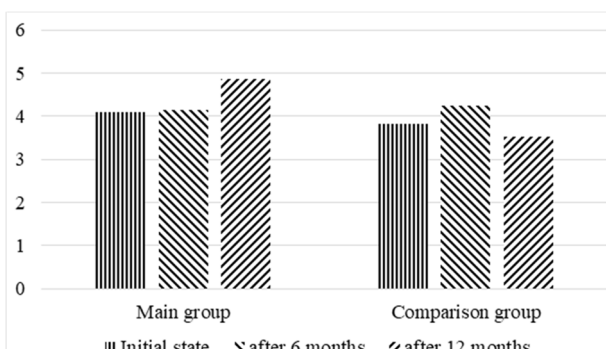


Fig.2. The content of inorganic phosphorus in the oral fluid of children with DM 1, mmol/l.

The oral liquid content of phosphorus children in the comparison group, who underwent only sanitation of the oral cavity, did not undergo significant changes at all stages of observation ( $p_1 > 0.1$ ). In the oral liquid of the main group patients, who additionally received a prophylactic complex in stages, after 12 months an increase in the content of inorganic phosphorus by 19.4 % was recorded, but the changes in relation to the initial level were unreliable ( $p = 0.1$ ). Comparing the content of phosphorus in children from different survey groups, a significant difference was found (by 27.9 % more in the main group,  $p_1 < 0.01$ ).

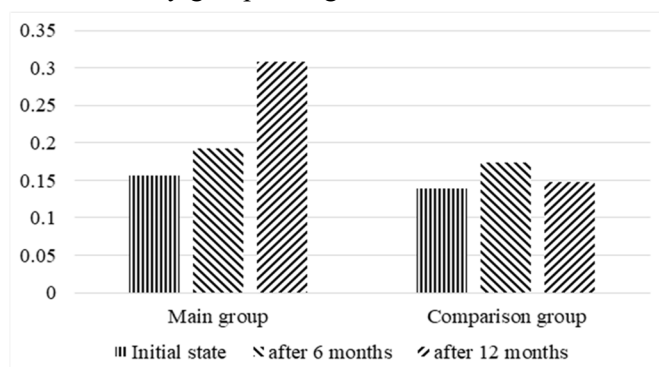


Fig.3. The content of magnesium in the oral liquid of children with DM 1, mmol/l.

Studies of the phosphorus content also confirmed an increase in the remineralizing ability of the oral liquid in children with DM 1 under the influence of regular courses of the therapeutic and prophylactic complex.

Fig. 3 presents the results of determining the magnesium content in the oral liquid of children under our supervision.

Magnesium is an activator of enzymatic processes and is necessary for the mineralization of hard tooth tissues. In the comparison group, after sanitation at all stages of the study, the studied indicator did not change significantly ( $p_1 > 0.01$ ). At the same time, in the oral fluid of the main group, already after 6 months, there was a tendency to increase the level of magnesium (by 22.3 %,  $p_1 > 0.1$ ), and after 12 months the magnesium content increased almost 2 times ( $p_1 < 0.001$ ).

Remineralizing potential of the oral liquid was increase after the implementation of therapeutic and preventive measures in the main group of children with DM 1 is evidenced by our determination of the acid resistance of enamel using the enamel resistance test, the indicators after 12 months changed from 6–7 points to 1–3 points ( $p < 0.05$ ).

Table 2 shows study results in the oral liquid of children with DM 1 of enzymes that also affect the processes of mineralization in the oral cavity.

The activity of saliva lysozyme is an indicator of nonspecific antimicrobial protection state of the oral cavity system. As our studies have shown, in the oral liquid of children with DM 1 activity of lysozyme is reduced by 5.6 times compared with the activity of the enzyme in healthy children.

Biochemical parameters of the oral liquid of children with DM 1, M±m

No.	Indices	Healthy	Children with DM 1 (before treatment)	Children with DM 1 (after 12 months)
1	MDH content, $\mu\text{mol/l}$	0.33±0.03	0.42±0.04 $p>0.05$	0.34±0.02 $p>0.1$ $p_1>0.05$
2	Catalase activity, $\text{mkat/l}$	0.22±0.02	0.12±0.01 $p<0.001$	0.15±0.01 $p<0.05$ $p_1<0.05$
3	Lysozyme activity, $\text{units/l}$	0.061±0.006	0.011±0.003 $p<0.001$	0.026±0.002 $p<0.001$ $p_1<0.01$
4	Urease activity, $\text{micro-cat/l}$	4.83±0.30	18.94±0.89 $p<0.001$	14.46±1.22 $p<0.001$ $p_1=0.005$

Note.  $p$  – the index of the reliability of differences relative to a group of healthy children;  $p_1$  – the index of the reliability of differences relative to the indicator before treatment.

On the contrary, urease activity, which indirectly reflects the degree of microbial contamination of the oral cavity, increases almost 4 times in DM 1 group. After 12 months from the start of preventive measures in the oral liquid of children, the activity of lysozyme increased by more than 2 times and the activity of urease decreased by 24 % ( $p_1<0.01$ )

In group of children with DM 1 in the oral liquid was an increase in the content of MDH, the end product of lipid peroxidation (by 27.3 %,  $p>0.05$ ), on the background of a significant decrease in the activity of the antioxidant enzyme catalase (1.8 times,  $p<0.001$ ). After the courses of developed complex, we noted a slight increase in catalase activity and a decrease in the content of MDH, which indicated the normalization of the system “lipid peroxidation – antioxidant protection”.

The morphological structure and mineral composition of tooth enamel is not constant and can change under the influence of various factors: concomitant pathology, characteristics of mineral metabolism in the body, composition and properties of saliva, nutrition, etc. [5]. Numerous clinical and experimental studies have established that the complete mineralization of enamel after teeth eruption occurs due to the intake of minerals from saliva [10, 14, 15]. As the tooth functions, minerals are constantly supplied from the oral liquid to the enamel. After 2–4 years, the optimal content of mineral substances is observed in it and its compaction occurs [8, 9]. In our study, it has been shown that the use of the therapeutic and prophylactic complex proposed by us in the group of children with type 1 diabetes mellitus increased the remineralizing properties of the oral liquid by increasing the content of calcium, phosphorus and magnesium macroelements in it. In the oral liquid was an increase in the activity of the antimicrobial enzyme lysozyme, a decrease in the content of malondialdehyde on the background of an increase in the activity of catalase, an antioxidant defense enzyme. The conducted studies indicate a fairly high efficiency of the proposed treatment and prophylactic complex. The obtained results, in our opinion, should be taken into account in order to assess the effectiveness of preventive measures, it is recommended to evaluate biochemical markers researched oral liquid.

### Conclusions

1. The the therapeutic and prophylactic complex increased the remineralizing properties of the oral liquid in children by increasing the content of calcium, phosphorus and magnesium macroelements in it.
2. The increase in the activity of the antimicrobial enzyme lysozyme, a decrease in the content of malondialdehyde on the background of an increase in the activity of catalase, an antioxidant defense enzyme was observed in the oral liquid.

### References

1. Borodovitsina SI, Savelyeva NA, Tabolina YeS. Profilaktika stomatologicheskikh zabolevaniy: uchebnoye posobiye. Ryazan: OTSiOP. 2019;264. [in Russian]
2. Granchuk A, Granchuk G, Gudumak VS. Aktivnost metabolicheskikh protsessov v mandibulyarnykh kostnykh tkanyakh belykh kryy pri ispolzovanii koordinatsionnykh soyedineniy tsinka (eksperimentalnoye issledovaniye, etap 1). Mezhdunarodnyy nauchno-issledovatel'skiy zhurnal. 2019;12–2(90):196–200. DOI: 10.23670/IRJ.2019.90.12.041 [in Russian]
3. Lang TA, Sesik M. Kak opisyyvat statistiku v meditsine. Moskva: Prakticheskaya meditsina. 2016; 480. [in Russian]
4. Skiba AV, Denga AV, Skiba VyA. Sostoyaniye tkaney polosti rta u bolnykh sakharnym diabetom 2 tipa. Innovatsii v stomatologii. 2017;1:7–9. [in Russian]
5. Syrtsov VK, Sulayeva ON, Zidrashko GA, Aliyeva YeG, Sidorova IV, Gromokovskaya TS, et al. Gistologiya, tsitologiya i embriologiya emali. Zaporozhye. 2015; 40. [in Russian]

6. Tsvyakh OO. Vplyv stresu na stan prooksydantno–antyoksydantnoyi systemy shlunku shehuriv pry nestachi ta nadlyshku melatoninu. Visnyk problem biolohiyi i medytsyny. 2013; 3:254–258. [in Ukrainian]
7. Alves C, Menezes R, Brandão M. Salivary flow and dental caries in Brazilian youth with type 1 diabetes mellitus. Indian J Dent Res. 2012;23(6):758–762. DOI: 10.4103/0970-9290.111254.
8. Caruso S, Bernardi S, Pasini M, Giuca MR, Docimo R, Continenza MA, et al. The process of mineralization in the development of human tooth. European Journal of Paediatric Dentistry. 2016;17(4):322–326.
9. Costa R, Medeiros da Nóbrega J, de Andrade Dantas E, Ribeiro IL, Correia Lima LN, Rabello PM, et al. Use of the Chronological Dental Mineralization Table of Nicodemo, Moraes and Medici Filho to Estimate Age by Undergraduate Dentistry Students. Brazilian Research in Pediatric Dentistry and Integrated Clinic 2016, 16 (1): 235–247. DOI: 10.4034/PBOCI.2016.161.25 17
10. Gittings S, Turnbull N, Henry B, Roberts CJ, Gershkovich P. Characterisation of human saliva as a platform for oral dissolution medium development. Eur. J. Pharm. Biopharm. 2015;91:16–24. DOI: 10.1016/j.ejpb.2015.01.007
11. Jawed M, Khan RN, Shahid SM, Azhar A. Protective effects of salivary factors in dental caries in diabetic patients of Pakistan. Exp Diabetes Res. 2012;2012:947304. DOI: 10.1155/2012/947304.
12. Kaskova LF, Novikova SC, Anopriyeva NM, Akzhitova AA. Changes in indices of chemical composition and mineralizing properties of oral fluid in children with intestinal dysbiosis. World of Medicine and Biology. 2020;2(72):67–70. DOI: 10.26724/2079-8334-2020-2-72-67-70
13. Saghiri MA, Sheibani N, Kawai T, Nath D, Dadvand S, Amini SB, et al. Diabetes negatively affects tooth enamel and dentine microhardness: An in-vivo study. Arch Oral Biol. 2022;139:105434. DOI: 10.1016/j.archoralbio.2022.105434.
14. Schulz A, Lang R, Behr J, Hertel S, Reich M, Kümmerer K, et al. Targeted metabolomics of pellicle and saliva in children with different caries activity. Sci Rep. 2020;10(1):697. DOI: 10.1038/s41598-020-57531-8.
15. Zhao D, Tsoi JK, Wong HM, Chu CH, Matinlinna JP. Paediatric Over-the-Counter (OTC) Oral Liquids Can Soften and Erode Enamel. Dent J (Basel). 2017;5(2):17. DOI: 10.3390/dj5020017.

Стаття надійшла 31.08.2021 р.

DOI 10.26724/2079-8334-2022-3-81-168-172

UDC 616. 314. 1. – 073. 7(477. 54 – 25)

**Yu.O. Slynko, I.I. Sokolova, K.I. Karpenko, N.M. Udovychenko, S.I. Herman,  
T.V. Tomilina, K.V. Skydan  
Kharkiv National Medical University, Kharkiv**

## GENDER ASPECTS OF THE DENTAL STATUS IN THE ADULT POPULATION OF THE KHARKIV REGION

e-mail: sdent\_irina@ukr.net

This study is devoted to analysis of the prevalence of small dental defects in the adult population of the Kharkiv region by gender. Orthopantomograms of 1269 patients of both genders, aged 18 to 84 years, were analyzed. The condition of the dentition in women is better than that of men, namely: small dentition defects (DDs) in women were less than by 1.10 times, large ones – less than by 1.16 times, and the DDs absence, conversely, occurred by 1.3 times more frequently than in men, but the established differences were not statistically significant ( $\chi^2=8.859$ ,  $p=0.012$ ). The study performed also showed that women had smaller DDs in the lower and upper jaws, frontal and lateral areas more frequently than men, but there was no statistical difference between the prevalence of small DDs with regard to topographic and quantitative characteristics and the gender ( $p>0.05$ ).

**Key words:** dentition defects, prevalence, gender differences, gender gap.

**Ю.О. Слинко, І.І. Соколова, К.І. Карпенко, Н.М. Удовиченко, С.І. Герман,  
Т.В. Томіліна, К.В. Скидан**

## ГЕНДЕРНІ АСПЕКТИ СТАНУ ЗУБНИХ РЯДІВ У ДОРΟΣЛОГО НАСЕЛЕННЯ ХАРКІВСЬКОГО РЕГІОНУ

Дослідження присвячене аналізу поширеності дефектів зубних рядів у дорослого населення Харківського регіону в залежності від статі. Проаналізовано ортопантомограми 1269 пацієнтів обох статей у віці від 18 до 84 років. Загалом стан зубного ряду у жінок кращий, ніж у чоловіків, а саме: поширеність малих дефектів зубних рядів (ДЗР) у жінок була меншою у 1.10 раза, великих ДЗР – у 1.16 раза, ніж у чоловіків, а відсутність будь-яких ДЗР, навпаки, була виявлена у 1.3 раза частіше, ніж у чоловіків. Проте, встановлені відмінності не були статистично значущими ( $\chi^2=8.859$ ,  $p=0.012$ ). Проведене дослідження також показало, що жінки мали меншу кількість ДЗР на нижній та верхній щелепах, а у фронтальній та бічній областях – більшу, ніж у чоловіків. Але статистичної різниці між поширеністю малих ДЗР щодо топографічних та кількісних характеристик та статі не було ( $p>0.05$ ).

**Ключові слова:** дефекти зубних рядів, поширеність, гендерні відмінності, гендерний розрив.

*The study is a fragment of the research project “Formation and implementation of modern scientific approaches to the diagnosis, treatment and prevention of dental pathology in children and adults”, state registration No. 0118U000939.*

Almost 40 years ago, the World Health Organization drew attention to the need for in-depth analysis of gender differences in all areas of medicine. But even today, these issues need in-depth study due to lack of information for both preventive and curative aspects of medicine.