

Dynamics of the main dental parameters in preschool children with caries on the background of long-term use of a probiotic preparation

L.P. Kiselnikova, E.I. Tom

Moscow State University of Medicine and Dentistry A. I. Evdokimova, Moscow, Russian Federation

ANNOTATION

Relevance. For decades, bacteria called probiotics have been added to some foods for their health benefits. In dental practice, the use of probiotics may be useful in the fight against caries and inflammatory periodontal diseases. The interest of dentists in probiotics is based on their ability to adhere and colonize various oral tissues.

Target. To evaluate the clinical efficacy of a probiotic preparation based on the *S. salivarius* M18 strain in preschool children.

Materials and methods. For the study, two groups of children were formed (45 children in each), aged 3 to 6 years, with multiple dental caries, who underwent oral cavity sanitation, four times the treatment of teeth with fluorine varnish. The children of the main group were prescribed two courses of taking a probiotic preparation for resorption based on the *S. salivarius* M18 strain (1st course - from February 16 to May 16, 2021 and 2nd course - from October 26, 2021 to January 26 2022). In children from the comparison group, the probiotic preparation was not used. Before the start of the study, after 3 months, after 6 months and after 12 months, the Fedorov-Volodkina hygiene index, kpu(h), ICDAS-II index, and PMA index were assessed in children from both groups. Additionally, food diaries were kept in both groups. Statistical data processing was carried out by the methods of variation statistics using the Friedman criterion ($p \leq 0.05$ was taken as a significant difference).

Results. The use of two three-month courses of a probiotic preparation based on the *S. salivarius* M18 strain during a year of observation in preschool children led to a significant improvement in the hygiene index by 2.2 times, stabilization of the initial forms of caries by the ICDAS II index by 2.3 times, and reduction caries by 81%, reduction in the prevalence of gingivitis (decrease in the PMA index by 72.9%).

Conclusion. The obtained results of a clinical study confirm the effectiveness of the use of a probiotic preparation based on *S. salivarius* M18 strains in preschool children with caries as a correction and stabilization of dental status.

Key words: caries in primary teeth, probiotics, oral health, *S. salivarius* M18, food diaries.

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Changes in the main dental parameters of preschoolers with caries affected by long-term probiotic

LP Kiselnikova, EI Toma

A. I. Yevdokimov Moscow State University of Medicine and Dentistry, Moscow, Russian Federation

ABSTRACT

Relevance. For several decades, they have added bacteria called probiotics to some foods for their positive effects on human health. In dental practice, probiotics may help fight caries and inflammatory periodontal diseases. Dentists are interested in probiotics because of the latter's ability to adhere to and colonize various oral tissues.

Purpose. To evaluate the clinical effectiveness of *S. salivarius* M18 probiotic in preschool children.

Material and methods. The study formed 2 groups (45 children in each) of children aged 3 to 6 years with multiple dental caries who underwent dental treatment and 4-fold fluoride varnish application. The main group took

2 courses of *S. salivarius* M18 probiotic lozenges (the 1st course from February 16 to May 16, 2021, and the 2nd course from October 26, 2021, to January 26, 2022). The children of the comparison group did not use the probiotic. We evaluated the Hygiene Index by Fedorov-Volodkina, dmf(t) rate, ICDAS-II index, and PMA index in children of both groups at the baseline and after 3, 6 and 12 months. Additionally, both groups kept food diaries. The statistical data processing was performed variance analysis of using the Friedman test (significant differences were at $p \leq 0.05$).

Results. The year of observation in preschool children showed that two 3-month courses of an *S. salivarius* M18 probiotic intake led to a significant improvement in the hygiene index by 2.2 times, 2.3-fold stabilization of initial caries according to the ICDAS II index, caries decrease by 81%, gingivitis prevalence reduction (PMA index decrease by 72.9%).

Conclusion. The study results confirm the effectiveness of *S. salivarius* M18 probiotic in preschoolers with caries as a means of dental status correction and stabilization.

Key words: dental caries in primary teeth, probiotics, oral health, *S. salivarius* M18, food diaries.

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INTRODUCTION

Probiotics are defined as "live microorganism quantities benefit the health of the host" [1]. The impact of probiotics on human health in everything world has been proven for many years, and the concept of "protecting with diversity" by using beneficial bacteria to maintain homeostasis of body systems is successfully used in general medicine, for example, in the treatment of diseases of the gastrointestinal tract [2]. It is known that the mechanisms of action of probiotics combine local and systemic phenomena, including adhesion, aggregation, inhibition of microbial growth, production of salivarcins, and immunomodulation [3]. Thus, probiotics can have both preventive and curative effects.

In Russia, the use of probiotics is widely used in pediatric practice [4]. However, in dentistry there are isolated studies on this topic, and the greatest attention is paid to the use of probes.

otic drugs are given in the treatment of inflammatory periodontal diseases [5]. In Russia, for the

first time, the effect of the use of probiotics on changes in the composition of the microbiocenosis of the tooth biofilm and factors of local immunity in children of early childhood was studied in 2013. The study showed a reliably identified microbiological, clinical and immunological efficacy of using baby milk with probiotics based on lactobacilli (LAB) [6].

When exposed to the microflora of the oral cavity, probiotic additives maintain a stable symbiosis between different types of bacteria, restore dysbiotic processes in the biofilm associated with diseases of the oral cavity. Regular intake of live probiotic bacteria can

reduce the risk of caries and prevent its development in preschool children [7].

Currently, the development of probiotics for use in dentistry continues to challenge generate interest among researchers, biotechnological

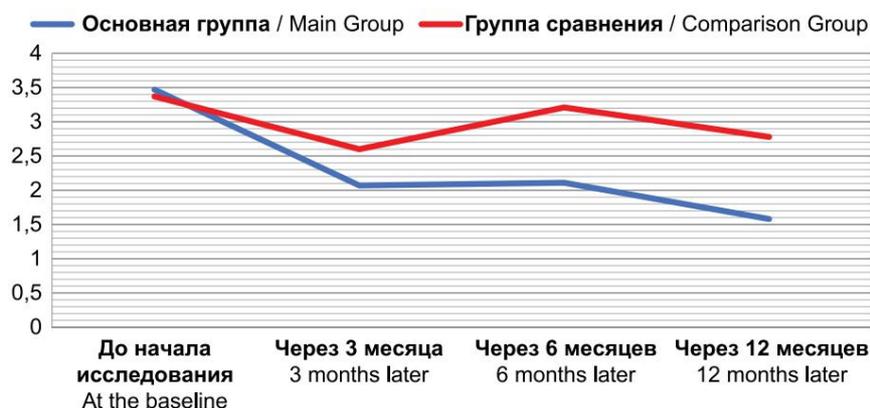
companies and consumers. A key factor for the conversion of any bacterial strain into a probiotic is a reliable assessment of its safety profile. The strain of *Streptococcus salivarius* M18, which was originally isolated from a healthy adult and evaluated for its probiotic properties for use in dentistry in adults and children, fully complies with this requirement. In addition, this strain produces salivarcins, local antibacterial substances that are able to suppress the growth of pathogens of oral infections, namely *Streptococcus* spp., *Porphyromonas* spp., *Actinomyces* spp., *Aggregatibacter* spp. The M18 strain, in the form of lozenges, also produces the enzymes dextranase and ureza, which reduce plaque accumulation and neutralize oral acidity [8].

When exposed to the microflora of the oral cavity, probiotic additives maintain a stable symbiosis between different types of bacteria, restore dysbiotic processes in the biofilm associated with diseases of the oral cavity. Regular intake of live probiotic bacteria can reduce the risk of caries and prevent its development in preschool children [9].

As a rule, small children are usually negative but relate to visiting the dentist, show anxiety during dental intervention. Loss of teeth leads to impaired speech development, psychological discomfort, and reduced quality of life [10].

Thus, the inclusion of a probiotic preparation for resorption as an addition to the complex of therapeutic and preventive measures, probably helps to reduce the risk of developing caries in preschool children.

Target. To evaluate the clinical efficacy of including a probiotic preparation based on the *S. salivarius* M18 strain for resorption in the complex of therapeutic and preventive measures in preschool children.



Rice. Fig. 1. Dynamics of the hygiene index in children of both study groups 1.
Changes in the Hygiene Index in children of both study groups

MATERIALS AND METHODS

For the study, two groups of children (45 children each) aged 3 to 6 years were formed. Criteria for inclusion of patients: availability of voluntary informed consent from a legal representative, children of health groups I, II, III, with multiple caries, age of children from 3 to 6 years. Exclusion criteria: lack of informed voluntary consent from a legal representative, children of health groups IV and V, absence of dental caries, children under 3 years old and over 6 years old. The exclusion criteria were the parents' refusal to participate in the study with their child.

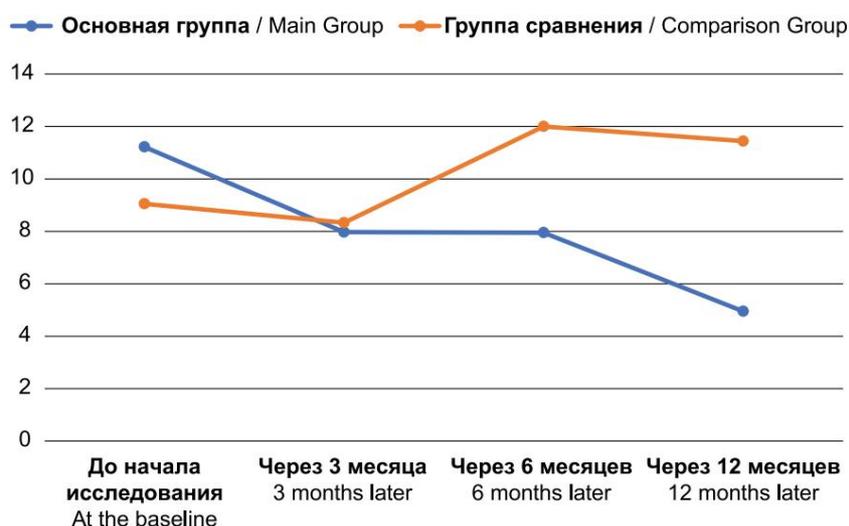
Children of the main group during the year (two three-month courses) took the dietary supplement "DentoBlis", which in its composition contains at least 5×10^8 CFU of the probiotic strain *S. salivarius* M18 and 320 IU of vitamin D3.

The first course of taking the drug lasted from February 16 to May 16, 2021, the second course - from October 26, 2021 to January 26, 2022. During the entire study period, the children of both groups underwent oral cavity sanitation and four times tooth treatment with fluoride varnish. In children from the comparison group,

no biotic preparation was used. The clinical effectiveness of preventive measures was assessed according to the following criteria: hygiene index according to Fedorov-Volodkina, kpu(h) index, ICDAS-II index, PMA index before the start of the study, after 3, 6 and 12 months from the start of the study.

In addition, in each group of children under study, food diaries were kept by legal representatives (parents), the children's diet was assessed before the start of the study (14-day food diary) and after 9 months of the study. The study and analysis of the nutrition of preschool children was carried out with an assessment of the indicators of actual nutrition (daily food set, diet, food habits and taste preferences). The assessment of the nutritional structure was carried out for the main groups of food products: meat, fish, poultry and sausage products; milk and dairy products, eggs; vegetables, fruits, juices, cereals and pasta; bread and bakery products; confectionery. Inclusion

studying the diet among the studied groups of children was due to the theoretical possibility of the influence of probiotic complexes contained in food products on the microbiota of the oral cavity [7].



Rice. Fig. 2. Dynamics of the initial forms of caries (code2 :1.2) according to the ICDAS II index in children of both study groups 2. Changes in initial caries (code2 : 1.2) according to the ICDAS II index in children of both study groups

Table 1. Dynamics of caries intensity in children of both study groups**Table 1.** Changes in caries intensity in children of both study groups

multiplicity Frequency	Main group / Main group Comparison group Uemp.				Uemp.	P
	Average / Mean	Std. off / SD	Mean / Mean	Std. off / SD		
Before admission At the baseline	8.09	3.22	7.92	5.36	982.50	-
After 3 months 3 months later	8.09	3.32	7.92	5.46	577.00	-
After 6 months 6 months later	8.58	3.88	10.28	2.38	148.00	r < 0.001*
After 12 months 12 months later	8.58	3.68	10.5	3.51	877.50	r < 0.001*

*statistically significant differences found

Statistical processing of the data was carried out by methods of variation statistics using the Friedman test ($p \leq 0.05$ was taken as a significant difference).

RESULTS

The oral hygiene index before the start of probiotic use in children of the main group was assessed as very poor - 3.47 ± 0.77 , however, 3 months after taking the probiotic preparation, the index value decreased to 2.07 ± 0.54 , which corresponds to satisfactory level of hygiene. After 6 months, there was a deterioration in the state of oral hygiene to an unsatisfactory level (2.11 ± 0.39). After completing the second course of the probiotic preparation, the children of the main group showed normalization of the hygiene index, it was 1.58 ± 0.32 , which corresponds to a good level of hygiene ($p \leq 0.05$). In children of the comparison group, before the start of the study, the oral hygiene index was assessed as very poor and amounted to 3.37 ± 0.55 , after 3 and 6 months the index corresponded to a poor level - 2.60 ± 0.34 and 3.21 ± 0.47 , respectively. After 12 months from the start of the study, the oral hygiene index remained at a poor level - 2.78 ± 0.25 ($p \leq 0.05$) (Fig. 1).

The indicator of the intensity of caries of temporary teeth before the start of the study in preschool children in the main group was 8.09 ± 3.22 , 3 months after taking the probiotic

plex, this indicator remained unchanged, after 6 months the caries intensity value increased to 8.58 ± 3.88 (an increase was 0.49), after 12 months there was no increase in the caries intensity indicator (8.58 ± 3.78). The reduction of caries in this group was 81%.

In children of the comparison group, the intensity of caries before the start of the study was 7.90 ± 5.36 , after 3 months the indicator remained unchanged, after 6 months in children of this group a significant increase was observed. The difference in the caries intensity index of temporary teeth was 10.28 ± 2.38 (the increase from the beginning of the study was 2.38), which continued to increase after a year and amounted to 10.5 ± 4.5 (the increase was 2.6). It should be noted that due to the sanitation of the oral cavity, the "k" component in the structure of the "kpu(3)" index 12 months after taking the drug significantly decreased in both groups of children: in the main group - 0.00 ± 0.00 and $0, 30 \pm 0.92$, respectively (Table 1).

When studying the ICDAS II index in children of the main group, the initial forms of caries (code 2 : 1.2) before the start of admission were 11.22 ± 3.22 , after 3 months against the background of preventive measures (sanitary and educational work, taking a probiotic drug, application of fluoride varnish) there was a decrease in these criteria to 7.97 ± 3.25 , after 6 months of observation the indicator was equal to 7.95 ± 3.42 , and after 12 months it significantly decreased to 4.95 ± 3.40 ($p \leq 0.05$), which indicates the pronounced effectiveness of the probiotic preparation.

Table 2. Dynamics of the PMA index in children of both groups during the year**Table 2.** Changes in the PMA index in children of both groups during one year

Criteria Criteria %	Before the start of the study At the baseline		In 3 months 3 months later		In 6 months 6 months later		After 12 months 12 months later	
	Main group Main group	Comparison group Comparison group	Main group Main group	Comparison group Comparison group	Main group Main group	Comparison group Comparison group	Main group Main group	Comparison group Comparison group
PMA	77.90 ± 20.98	69.00 ± 0.09	48.00 ± 15.17	48.00 ± 10.46	22.8 ± 8.3	55.0 ± 4.5	5.0 ± 1.3	33.00 ± 1.32
P								

*significant differences at $p < 0.05$ / *statistically significant differences at $p < 0.05$

rat and fluoride-containing varnish for the treatment of initial forms of caries.

In children of the comparison group before the start of the study, the ICDAS II index (code 2 :1.2) was equal to 9.05 ± 2.04 , after 3 months it was 8.33 ± 1.95 , after 6 months it increased to 12.00 ± 2.47 , however, after 12 months there was a slight decrease in the studied parameter 11.44 ± 2.52 ($p > 0.05$) (Fig. 2).

The level of inflammatory periodontal diseases before the start of the study in children of both groups corresponded to a severe degree - $77.90 \pm 20.98\%$ and $69.00 \pm 0.09\%$. Assessing this indicator after 12 months, it should be noted its significant decrease in the main group to $5.00 \pm 2.11\%$ (mild severity) and in the comparison group to $33.00 \pm 1.32\%$ (moderate severity) (Table 2).

Analyzing the diets of children in both groups before the start of the study and after 9 months of the study, it is possible to state a certain diet, which included four to five meals, including snacks, and a similar diet that corresponded to the norms of physiological energy needs and nutrients for various groups of the population of the Russian Federation [11]. However, every third parent gave his child easily digestible carbohydrate-rich water products containing a lot of sugar, sweet tea, and juice as snacks. Bakery and confectionery products were in excess and exceeded the recommended norms by 1.2 times.

The use of fermented milk products containing pro- and prebiotics in children of both groups

BIBLIOGRAPHY

1. Sanders ME. Probiotics: definition, sources, selection, and uses. *Clin Infect Dis*. 2008;46 Suppl 2:S58-61; discussion S144-51.

doi: 10.1086/523341

2. Zaura E, Twetman S. Critical Appraisal of Oral Pre and Probiotics for Caries Prevention and Care. *Caries Res*. 2019;53(5):514-526.

doi: 10.1159/000499037

3. Twetman S, Pedersen AML, Yucel-Lindberg T. Probiotic supplements containing *Lactobacillus reuteri* does not affect the levels of matrix metalloproteinases and interferons in oral wound healing. *BMC Res Notes*. 2018;11(1):759.

doi: 10.1186/s13104-018-3873-9

4. Kramarev SA, Evtushenko VV. Baktoblis® (*Streptococcus salivarius* K12) - innovative therapy and prevention of acute respiratory infections and their complications. *Actual infectology*. 2020;8(1):50-53.

doi: 10.22141/2312-413x.8.1.2020.196172

5. Lukichev MM, Ermolaeva LA. The use of bacteriophages and probiotics in the complex treatment of inflammatory periodontal diseases. *Institute of Dentistry*. 2018;(1):84-87.

Access mode:

<https://instom.spb.ru/catalog/article/12006/>.

Zaitseva OV, Kiselnikova LP, Miloserdova KB, Shavlokhova LA, Tsarev VN, Ippolitov EV. Effective

was within the normal range in 67% of children and amounted to approximately 130-150 ml per day, which allowed us to assume that this fact does not have a significant impact on the reliability of the results of a clinical trial.

CONCLUSION

When studying food rations in preschool children of both groups, no significant differences were noted in the main categories of food consumed. It should be noted that nutrition was mainly balanced in composition and quantity with sufficient fluid intake. The consumption of dairy products was within the normal range, which provides the least possible impact on

the reliability of the obtained clinical results.

The use of two three-month courses of a probiotic preparation based on the *S. salivarius* M18 strain during a year of observation in preschool children led to a significant improvement in the hygiene index by 2.2 times, stabilization of the initial forms of caries by the ICDAS II index by 2.3 times, to the reduction of caries by 81%, reduction in the prevalence of gingivitis (decrease in the PMA index by 72.9%).

Thus, the obtained results of a clinical study confirm the effectiveness of the use of a probiotic preparation based on *S. salivarius* M18 strains in preschool children with caries as a correction and stabilization of dental status.

The role of adapted milk formula with probiotics in the prevention of caries in young children. *Pharmateka*. 2013; (s2-13): 18-23. Access mode:

<https://pharmateka.ru/ru/archive/article/116857>.

Jorgensen MR, Castiblanco G, Twetman S, Keller MK. Prevention of caries with probiotic bacteria during early childhood. Promising but inconsistent findings. *Am J Dent*. 2016;29(3):127-131.

<https://pubmed.ncbi.nlm.nih.gov/27505986/>.

Hale JDF, Jain R, Wescombe PA, Burton JP, Simon RR, Tagg JR. Safety assessment of *Streptococcus salivarius* M18 a probiotic for oral health. *Benef Microbes*. 2022;13(1):47-60.

doi: 10.3920/BM2021.0107

9. Kiselnikova LP, Toma EI. Prospects for the use of probiotics for the prevention of caries and periodontal diseases in children. *Effective pharmacotherapy*. 2021;17(12):24-28.

doi: 10.33978/2307-3586-2021-17-12-24-28

10. Ladodo KS, Borovik TE, Skvortsova VA. The use of products of probiotic action in baby food. *Questions of modern pediatrics*. 2006;5(6):64-70. Access mode:

<https://vsp.spr-journal.ru/jour/article/view/1533/0>.

Federal Service for Supervision of Consumer Rights Protection and Human Welfare. Me

Original article

Todic recommendations "Norms of physiological needs for energy and nutrients for various groups of the population of the Russian Federation". [Electronic resource]. State sanitary

epidemiological regulation of the Russian Federation; 2021 [posted 07/22/2021]. Access mode:

https://www.rospotrebnadzor.ru/documents/details.php?ELEMENT_ID=18979

REFERENCES

- Sanders ME. Probiotics: definition, sources, selection, and uses. *Clin Infect Dis*. 2008;46 Suppl 2:S58-61; discussion S144-51.
doi: 10.1086/523341
- Zaura E, Twetman S. Critical Appraisal of Oral Pre and Probiotics for Caries Prevention and Care. *Caries Res*. 2019;53(5):514-526.
doi: 10.1159/000499037
- Twetman S, Pedersen AML, Yucel-Lindberg T. Probiotic supplements containing *Lactobacillus reuteri* does not affect the levels of matrix metalloproteinases and interferons in oral wound healing. *BMC Res Notes*. 2018;11(1):759.
doi: 10.1186/s13104-018-3873-9
- Kramarev SA, Yevtushenko VV. Bactoblis® (*Streptococcus salivarius* k12) – innovative therapy and prevention of acute respiratory infections and their complications. 2020;8(1):50-53 (In Russ.).
doi: 10.22141/2312-413x.8.1.2020.196172
- Lukichev MM, Ermolaeva LA. The use of bacteriophages and probiotics in the complex treatment of inflammatory periodontal diseases. *The Dental Institute*. 2018;(1):84-87 (In Russ.). Available from:
<https://instom.spb.ru/catalog/article/12006/> 6.
Zaitseva OV, Kiselnikova LP, Miloserdova KB, Shavlokhova LA, Tsarev VN, Ippolitov EV. Efficiency of adapted milk formula with probiotics in the prevention of caries in infants. *Farmateka*. 2013;(s2-13):18-23 (In Russ.). Available from:
<https://pharmateca.ru/ru/archive/article/116857>.
Jorgensen MR, Castiblanco G, Twetman S, Keller MK. Prevention of caries with probiotic bacteria during early childhood. Promising but inconsistent findings. *Am J Dent*. 2016;29(3):127-131. Available from:
<https://pubmed.ncbi.nlm.nih.gov/27505986/>
- Hale JDF, Jain R, Wescombe PA, Burton JP, Simon RR, Tagg JR. Safety assessment of *Streptococcus salivarius* M18 a probiotic for oral health. *Benef Microbes*. 2022;13(1):47-60.
doi: 10.3920/BM2021.0107
- Kiselnikova LP, Toma EI. Prospects for the use of probiotics for the prevention of dental caries and periodontal diseases in children. *Effective pharmacotherapy*. 2021;17(12):24-28.
doi: 10.33978/2307-3586-2021-17-12-24-28
- Ladodo KS, Borovik TE, Skvortsova VA. The use of probiotic products in baby food. Use of foodstuffs with pre- and probiotic actions in infant food. *Current Pediatrics*. 2006;5(6):64-70. Available from:
<https://vsp.spr-journal.ru/jour/article/view/1533/0> 11.
Federal Service for Surveillance on Consumer Rights Protection and Human Wellbeing. Methodological recommendations „Norms of physiological needs for energy and nutrients for various groups of the population of the Russian Federation”. [electronic resource]. State sanitary and Epidemiological regulation of the Russian Federation; [cited 2021 July 22]. Available from:
https://www.rospotrebnadzor.ru/documents/details.php?ELEMENT_ID=18979

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INFORMATION ABOUT AUTHORS

Kiselnikova Larisa Petrovna, Doctor of Medical Sciences, Professor, Head of the Department of Pediatric Dentistry, Moscow State University of Medicine and Dentistry named after A. I. Evdokimova, Moscow, Russian Federation

For correspondence: lpkiselnikova@mail.ru
ORCID: <https://orcid.org/0000-0003-2095-9473>

INFORMATION ABOUT THE AUTHORS

Larisa P. Kiselnikova, DMD, PhD, DSc, Professor, Head of the Department of Pediatric Dentistry, A.I. Evdokimov Moscow State University of Medicine and Dentistry, Moscow, Russian Federation

For correspondence: lpkiselnikova@mail.ru
ORCID: <https://orcid.org/0000-0003-2095-9473>

Author responsible for communication with the editors:

Toma Emilia Igorevna, Assistant of the Department of Pediatric Dentistry, Moscow State University of Medicine and Dentistry named after A. I. Evdokimova, Moscow, Russian Federation

For correspondence: ema095toma@mail.ru
ORCID: <https://orcid.org/0000-0003-0137-9262>

Corresponding author:

Emilia I. Toma, DMD, Assistant Professor, Department of Pediatric Dentistry, A.I. Evdokimov Moscow State University of Medicine and Dentistry, Moscow, Russian Federation
For correspondence: ema095toma@mail.ru
ORCID: <https://orcid.org/0000-0003-0137-9262>