UDC 616.2-007.1-084.81
DOI: 10.56871/RBR.2023.10.96.004

INCREASING FUNCTIONAL RESISTANCE OF TEETH TO CARIES BY MEANS OF HOME ROUTINES IN ADOLESCENTS OF ST. PETERSBURG

© Mikhail M. Shvetsov[1], Andrey K. Iordanishvili[2, 3], Anastasia N. Belogortseva[4]

[1] The International Academy of Sciences of Ecology, Human Safety and Nature (MANEB). Bolshoy Ave., Vasilievsky Island, 74, Saint Petersburg, Russian Federation, 199106
[2] North-Western State Medical University named after I.I. Mechnikov. Kirochnaya str., 41, Saint Petersburg, Russian Federation, 191014
[3] Military Medical Academy named after S.M. Kirov. Akademician Lebedeva st., 6, Saint Petersburg, Russian Federation, 194044
[4] Children's dental polyclinic No. 3. Bryusovskaya str., 2, lit. A, Saint Petersburg, Russian Federation, 195271

Contact information: Mikhail M. Shvetsov — dentist-surgeon, maxillofacial surgeon. E-mail: mishas140692@gmail.com ORCID ID: 0000-0003-3230-0334

For citation: Shvetsov MM, Iordanishvili AK, Belogortseva AN. Increasing functional resistance of teeth to caries by means of home routines in adolescents of St. Petersburg // Russian biomedical research (St. Petersburg). 2023; 8(3): 26-30. DOI: https://doi.org/10.56871/RBR.2023.10.96.004

Received: 13.06.2023 **Revised: 10.07.2023** **Accepted: 21.09.2023**

Abstract. To date, the prevention of caries in children and adolescents is an urgent medical and social problem of modern healthcare. The paper evaluates the dynamics of functional resistance of tooth enamel in adolescents living from birth in St. Petersburg and the possibility of its improvement at home. 38 adolescents aged 15 to 17 years were under observation for 9 months, who were periodically examined once a quarter to assess the functional resistance of tooth enamel, which was performed using a TER test. The 1st control group of the study included young men who carried out their usual 2-fold generally accepted individual oral hygiene per day. The 2nd main group of the study included young men who, after carrying out individual oral care, additionally used a remineralizing ASEPTA gel for teeth. At the beginning of the clinical study, the indicators of functional resistance of tooth enamel to acid were almost the same in patients of groups 1 and 2 and were, respectively, 2.47 ± 0.18 and 2.52 ± 0.17 cont. units. In the boys of group 1, during the study period, there was a tendency to improve the functional resistance of tooth enamel to 2.40 ± 0.19 units, while in the boys of group 2, the functional resistance of tooth enamel significantly increased to 1.10 ± 0.20 units, which indicates the effectiveness of the remineralizing ASEPT gel used by them. The daily use of remineralizing ASEPT gel for teeth by young men of the 2nd main group at home during a 9-month study made it possible to increase the digital indicators of tooth enamel resistance by 43.65%, which is an important factor in preventing the development of dental caries.

Key words: adolescents; teeth; enamel; functional resistance of enamel; tooth decay; oral hygiene; fluorides; dental care products and items; remineralizing agents.

ИССЛЕДОВАНИЕ ФУНКЦИОНАЛЬНОЙ РЕЗИСТЕНТНОСТИ ЭМАЛИ ЗУБОВ У ПОДРОСТКОВ САНКТ-ПЕТЕРБУРГА И ВОЗМОЖНОСТЕЙ ЕЕ ПОВЫШЕНИЯ В ДОМАШНИХ УСЛОВИЯХ

© Михаил Максимович Швецов[1], Андрей Константинович Иорданишвили[2, 3], Анастасия Николаевна Белогорцева[4]

[1] Международная академия наук экологии, безопасности человека и природы (МАНЭБ). 199106, г. Санкт-Петербург, Большой пр. Васильевского острова, 74
[2] Северо-Западный государственный медицинский университет им. И.И. Мечникова. 191014, г. Санкт-Петербург, ул. Кирочная, 41
[3] Военно-медицинская академия им. С.М. Кирова. 194044, г. Санкт-Петербург, ул. Академика Лебедева, 6
[4] Детская стоматологическая поликлиника № 3. 195271, г. Санкт-Петербург, ул. Брюсовская, 2, лит. А

Контактная информация: Михаил Максимович Швецов — врач стоматолог-хирург, челюстно-лицевой хирург. E-mail: mishas140692@gmail.com ORCID ID: 0000-0003-3230-0334

Для цитирования: Швецов М.М., Иорданишвили А.К., Белогорцева А.Н. Исследование функциональной резистентности эмали зубов у подростков Санкт-Петербурга и возможностей ее повышения в домашних условиях // Российские биомедицинские исследования. 2023. Т. 8. № 3. С. 26–30. DOI: https://doi.org/10.56871/RBR.2023.10.96.004

Поступила: 13.06.2023 **Одобрена: 10.07.2023** **Принята к печати: 21.09.2023**

Резюме. В настоящее время вопросы профилактики кариеса у детей и подростков представляют актуальную медико-социальную проблему современного здравоохранения. В работе проведена оценка динамики функциональной резистентности эмали зубов у подростков, проживающих с рождения в г. Санкт-Петербурге, и возможности ее повышения в домашних условиях. Под наблюдением в течение 9 месяцев находились 38 подростков в возрасте от 15 до 17 лет, которые 1 раз в квартал осматривались на предмет оценки функциональной резистентности эмали зубов, которая выполнялась с помощью ТЭР-теста. В 1-ю (контрольную) группу исследования вошли юноши, осуществлявшие обычную для них двукратную общепринятую индивидуальную гигиену полости рта в сутки. Во 2-ю (основную) группу исследования вошли юноши, которые после осуществления индивидуального ухода за полостью рта дополнительно использовали гель для зубов реминерализующий АСЕПТА. В начале клинического исследования показатели функциональной резистентности эмали зубов к кислоте были у пациентов 1-й и 2-й группы практически одинаковыми и составляли, соответственно, 2,47 ± 0,18 и 2,52 ± 0,17 усл. ед. У юношей 1-й группы за период исследования отмечалась тенденция к улучшению функциональной резистентности эмали зубов до 2,40 ± 0,19 усл. ед., то время как у юношей 2-й группы функциональная резистентность эмали зубов достоверно повышалась до 1,10 ± 0,20 усл. ед., что свидетельствует об эффективности используемого ими геля для зубов реминерализующего АСЕПТА. Ежедневное применение в домашних условиях юношами 2-й (основной) группы геля для зубов реминерализующего АСЕПТА в ходе 9-месячного исследования позволило обеспечить повышение цифровых показателей резистентности эмали зубов на 43,65%, что является важным фактором профилактики развития кариеса зубов.

Ключевые слова: подростки; зубы; эмаль; функциональная резистентность эмали; кариес зуба; гигиена полости рта; фториды; средства и предметы ухода за зубами; реминерализующие средства.

INTRODUCTION

Nowadays, conscripts are subjected to high requirements for their health, including dental health [1]. At the same time, the state of dental health among young recruits in the Armed Forces of the Russian Federation leaves much to be desired. This is due to their significant need for dental treatment due to dental caries and non-carious lesions, as well as treatment of periodontal diseases (gingivitis, localized periodontitis), which is mainly due to the need to maintain adequate oral hygiene [2, 3]. It is noted in the literature that even future doctors, i.e. students of dental faculties of medical universities of the country, are not always conscious of maintaining their dental health, which especially concerns the adequate use of dental and oral care items [4, 5]. Fluoride prophylaxis plays an important role in the prevention of the main dental pathology — dental caries [6, 7]. At the same time, a high prevalence of dental caries in children and adults in St. Petersburg is known [8, 9], which is promoted by insufficient fluoride ion content in drinking water [10, 11]. Therefore, any measures that can increase the resistance of teeth to dental caries in adolescents are an urgent task of practical medicine [12].

AIM

To evaluate the dynamics of functional resistance of tooth enamel in adolescents of St. Petersburg and the possibilities of its increase in home conditions.

MATERIALS AND METHODS

38 young men aged 15 to 17 years old, living since birth in St. Petersburg, were under observation for 9 months. They were examined once a quarter to assess the functional resistance of tooth enamel, using the enamel resistance test proposed by V.R. Okushko [13]. Young men were examined in depth on the first day of their visit to a dentist, and then every 3 months, that is, a total of 4 times for each patient examined. According to the methodology, in adolescents the enamel resistance study was conducted on one of the central incisors of the upper jaw, for which the crown of the tooth was cleaned from possible plaque, dried, and then 1 % HCl solution was applied, creating a drop of up to 2 mm in diameter on the surface of the crown. After 5 s the drop was washed off with distilled water, the crown of the tooth was dried with a cotton ball and a drop of 1% solution of methylene blue was applied to the place of etching, which was immediately removed with a cotton ball and the acid resistance of enamel was evaluated in points, i.e. its resistance, by the intensity of coloration formed on the crown part of the tooth. The result was recorded by comparing it with the standard 10-point scale of shades of blue color from 0 points (with complete absence of staining of the etched part of the tooth crown) to 10 points (with the most intense staining in the etched part of the tooth crown in blue color).

It was decided to increase the functional resistance of tooth enamel of young men living in St. Petersburg by means of their home use of ACEPTA remineralizing tooth gel (VERTEX,

St. Petersburg, Russia). To study the effectiveness of this remineralizing gel, all young men were divided into 2 groups. The 1st (control) group of the study consisted of 15 men who performed the usual twice daily individual oral hygiene, namely dental care with a manual toothbrush and toothpaste used by them. The 2nd (main) group of the study included 23 young men who performed individual oral care with the use of ACEPTA remineralizing dental gel, which, according to the abstract, contains biomimetic hydroxyapatite that promotes rapid and effective mineralization of tooth enamel [14, 15].

Using a toothbrush, the young men spread the gel over the surface of the teeth, allowed it to adhere to the hard tissues of the teeth for 1-2 minutes, and then spit out the excess gel without rinsing the mouth. Patients were warned that individual dental care should have been performed in the morning after breakfast and in the evening after dinner before going to bed. After application of the remineralizing gel, they were advised not to eat or drink for half an hour.

The study fully complied with the ethical standards of the Committee on Human Experiments of the Helsinki Declaration of 1975, its revised version of 2000, and was approved by the Ethical Committee of the International Academy of Sciences of Ecology, Safety of Man and Nature (Protocol No. 3 of 23.03.2023).

Reliability of differences between the mean values of independent samples was assessed using the parametric Student's criterion for normal distribution and nonparametric Mann-Whitney criterion for non-normal distribution. The test for normality of distribution was evaluated using the Shapiro–Wilk test. Pearson's c2 criterion with the Mantel–Haenszel likelihood correction was used for statistical comparison of fractions to assess the reliability of differences. In all statistical analysis procedures, the achieved level of significance (p) was considered, and the critical level of significance was 0.05.

RESULTS

The study of tooth enamel resistance in young men of the 1st and 2nd groups at the beginning showed that the indexes of functional resistance of tooth enamel to acid were practically the same and were 2.47±0.18 and 2.52±0.17 units, respectively ($p \geq 0.05$). After 3 months from the beginning of the clinical study and until the end of the study, a tendency toward a decrease in the functional resistance of tooth enamel was observed in the young men of group 1 (Fig. 1). After 9 months from the beginning of the study, the functional resistance of tooth enamel to acid was 2.40±0.19 ($p \geq 0.05$) in this group of young men. Although such a numerical index characterizes high structural and functional resistance of enamel [13], it should be said that, despite the regular oral hygiene performed by the patients of group 1, no positive dynamics of this index was observed, which may contribute to the development of dental caries in them.

In young men of the 2nd group throughout the clinical study a reliable tendency to increase the functional resistance of tooth enamel to acid was revealed (Fig. 1). Thus, after 3, 6 and 9 months of the study in the patients of the 2nd group the indices of functional resistance of tooth enamel were equal to 2.09±0.19; 1.76±0.18 and 1.10±0.20 units, respectively ($p \leq 0.01$). Figure 2 shows the dynamics of enamel resistance test parameters in young men from the control and main study groups during the clinical study.

DISCUSSION

Everyday life of the studied young men living in the city of St. Petersburg, due to the consumption of potable water used by them during the usual individual oral care, contributes to a decrease in tooth enamel resistance, which is shown in the example of patients from the 1st control group of the study. Lack of positive dynamics of functional enamel resistance may be a predisposing factor in the development of dental caries in young men, although the numerical index of the enamel resistance test after 9 months from the beginning of the clinical study showed the presence of high structural and functional resistance of enamel in them.

Daily application of ACEPTA remineralizing tooth gel by the young men of the 2nd group of the study during the clinical trial allowed to provide positive dynamics of the numerical indexes of tooth enamel resistance, which was significantly different from the similar ones in the 1st group of young men, although these indexes, according to the evaluation recommendations of the enamel resistance test [13, 16], also characterized high structural and functional resistance of enamel. But at the same time for the young men of the 2nd group of the study we can reliably speak about the favorable dynamics of the indicators of the test of enamel resistance, which indicates an increase in the functional resistance of enamel, which, obviously, will contribute to the prevention of dental caries development in them.

CONCLUSION

1. In young men living in St. Petersburg, with the generally accepted individual measures for oral care, there is insufficient positive dynamics of functional and functional resistance of tooth enamel, which may be a predisposing factor for the development of dental caries.

2. The use of modern domestic ACEPTA remineralizing tooth gel containing biomimetic hydroxyapatite allowed to increase the functional resistance of tooth enamel by

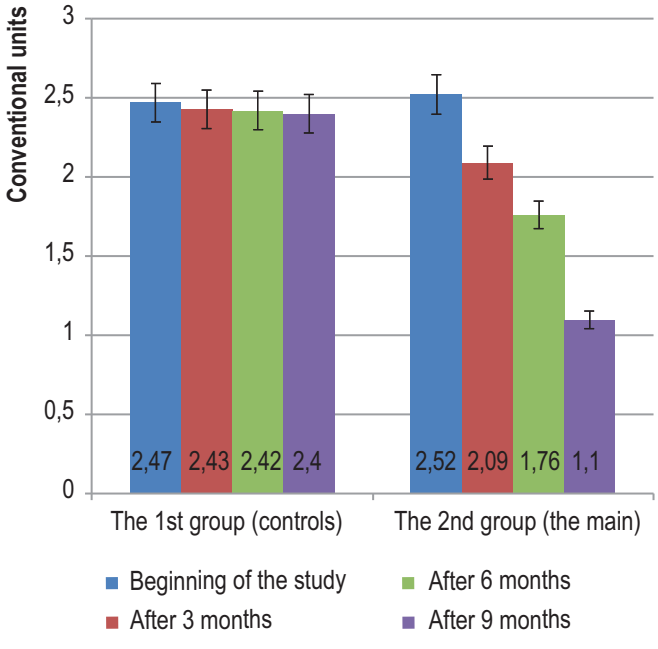

Fig. 1. Indicators of functional resistance of tooth enamel to acid in examined young men of the control and main study groups during the clinical trial

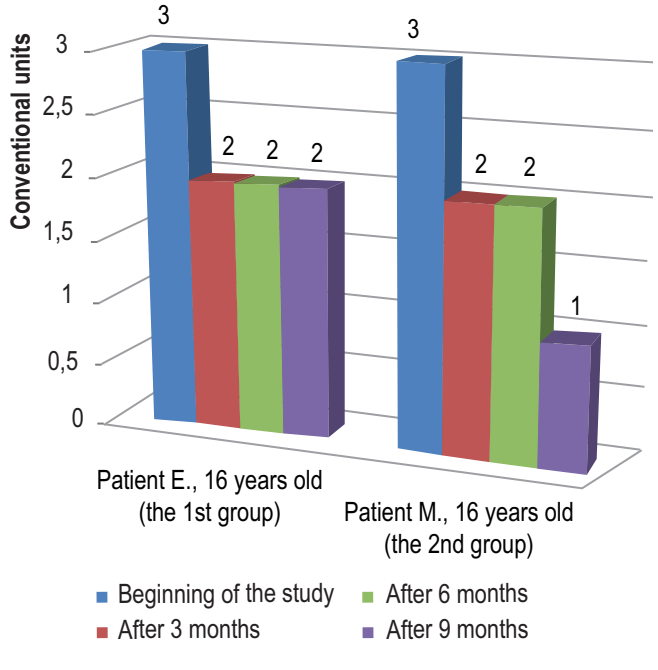

Fig. 2. Dynamics of indicators of functional resistance of tooth enamel to acid in two examined young men from the 1st and the 2nd study groups during the 9-month clinical trial

43.65% during a 9-month clinical study. It is an important factor in the prevention of dental caries development, so it can be recommended to adolescents living in St. Petersburg to include the use of ACEPTA remineralizing tooth gel in individual oral care measures.

ADDITIONAL INFORMATION

Author contribution. Thereby, all authors made a substantial contribution to the conception of the study, acquisition, analysis, interpretation of data for the work, drafting and revising the article, final approval of the version to be published and agree to be accountable for all aspects of the study.

Competing interests. The authors declare that they have no competing interests.

Funding source. This study was not supported by any external sources of funding.

Consent for publication. Written consent was obtained from the patient for publication of relevant medical information within the manuscript.

ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

Вклад авторов. Все авторы внесли существенный вклад в разработку концепции, проведение исследования и подготовку статьи, прочли и одобрили финальную версию перед публикацией.

Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

Источник финансирования. Авторы заявляют об отсутствии внешнего финансирования при проведении исследования.

Информированное согласие на публикацию. Авторы получили письменное согласие пациентов на публикацию медицинских данных.

REFERENCES

1. Postanovleniye Pravitel'stva RF ot 04.07.2013 g. № 565 (red. ot 01.06.2020) «Ob utverzhdenii Polozheniya o voyenno-vrachebnoy ekspertize. [Decree of the Government of the Russian Federation dated 04.07.2013 No. 565 (as amended on 01.06.2020) "On approval of the Regulation on military medical examination"]. (in Russian).
2. Iordanishvili A.K., Soldatkina A.S. Zabolevaniya polosti rta u lits molodogo vozrasta. [Diseases of the oral cavity in young people]. Institut stomatologii. 2015; 3(68): 50–1. (in Russian).
3. Rogaleva L.V., Gorshkov L.K., Iordanishvili A.K. MANEB: Chetvert' veka sluzheniya ekologii i obshchestvu. [Maneb: A quarter of a century of ministry of ecology and society]. Ekologiya i razvitiye obshchestva. 2020; 2-3(33): 24–9. (in Russian).
4. Iordanishvili A.K., Idris A.Ya. Komplayens i zdorov'ye: sotsial'nyy aspekt problemy. [Compliance and health: the social aspect of the problem]. Ekologiya i razvitiye obshchestva. 2019; 3(30): 59–60. (in Russian).
5. Iordanishvili A.K., Soldatkina A.S. Zabolevaniya polosti rta u lits molodogo vozrasta. [Diseases of the oral cavity in young people]. Institut stomatologii.. 2015; 3(68): 50–1. (in Russian).
6. Leont'yev V.K., Ivanova G.G. Metody issledovaniya v stomatologii. Institut stomatologii. [Research methods in dentistry]. 2014; 2(63): 88–90. (in Russian).

7. Banks P. A prospective 20-year audit of a consultant workload. The British orthodontic society clinical effectiveness bulletin. 2010; 25: 15–8.
8. Iordanishvili A.K., Soldatova L.N., Pereverzev V.S., Tishkov D.S. Kariyes zubov u detey megapolisa i prigorodov. [Caries of teeth in children of a megalopolis and suburbs]. Stomatologiya detskogo vozrasta i profilaktika. 2016; 4(59): 73–6. (in Russian).
9. Sofronov G.A., Iordanishvili A.K. Rol' Mezhdunarodnoy akademii nauk ekologii bezopasnosti cheloveka i prirody v sokhranenii okruzhayushchey sredy i zdorov'ya cheloveka. [The role of the International Academy of Sciences of Man and Nature Ecology in the Preservation of Environment and Human Health]. Ekologiya i razvitiye obshchestva. 2019; 2(29): 16–7. (in Russian).
10. Iordanishvili A.K. Meditsina i sovremennaya ekologicheskaya doktrina. [Medicine and modern ecological doctrine]. Stomatologicheskiy nauchno-obrazovatel'nyy zhurnal. 2020; 1–2: 57–61. (in Russian).
11. Alferov Zh.I., Iordanishvili A.K. Rol' Mezhdunarodnoy akademii nauk ekologii, bezopasnosti cheloveka i prirody v razvitii fundamental'nykh issledovaniy. [The role of the International Academy of Sciences of Ecology, Human Security and Nature in the Development of Fundamental Research]. Materialy IV yezhegodnoy nauchno-prakticheskoy konferentsii s mezhdunarodnym uchastiyem «Dekabr'skiye chteniya po sudebnoy meditsine v RUDN: aktual'nyye voprosy sudebnoy meditsiny i obshchey patologii». Moskva: RUDN Publ.; 2020: 8–13. (in Russian).
12. Rogaleva L.V., Iordanishvili A.K. Mezhdunarodnaya akademiya nauk ekologii bezopasnosti cheloveka i prirody: nauchnyye i prikladnyye napravleniya deyatel'nosti. [International Academy of Sciences of Ecology of Human Safety and Nature: Scientific and Applied areas of activity]. Ekologiya i razvitiye obshchestva. 2019; 4(31): 7–11. (in Russian).
13. Okushko V.R. Fiziologiya emali i problema kariyesa zubov. [Physiology of enamel and the problem of tooth decay]. Kishinev: Shchtnitsa Publ.; 1989. (in Russian).
14. Leont'yev V.K. Emal' zubov kak biokiberneticheskaya sistema. [Emalus of teeth as a biokibernetic system]. Moskva: GEOTAR-Media Publ.; 2016. (in Russian).
15. Soldatov V.S., Soldatova L.N., Iordanishvili A.K. Funktsional'naya rezistentnost' emali u patsiyentov v period ortodonticheskogo lecheniya i puti yeye uluchsheniya. [The functional resistance of enamel in patients during orthodontic treatment and ways to improve it]. Institut stomatologii. 2022; 4: 50–1. (in Russian).
16. Khaytsev N.V., Vasil'yev A.G., Trashkov A.P., Kravtsova A.A., Balashov L.D. Vliyaniye vozrasta i pola na kharakter otvetnykh reaktsiy belykh krys pri deystvii khronicheskoy gipoksicheskoy gipoksii. [The influence of age and gender on the nature of the response of white rats under the action of chronic hypoxic hypoxia]. Pediatr. 2015; 6(2): 71–7. (in Russian).

ЛИТЕРАТУРА

1. Постановление Правительства РФ от 04.07.2013 г. № 565 (ред. от 01.06.2020) «Об утверждении Положения о военно-врачебной экспертизе».
2. Иорданишвили А.К., Солдаткина А.С. Заболевания полости рта у лиц молодого возраста. Институт стоматологии. 2015; 3(68): 50–1.
3. Рогалева Л.В., Горшков Л.К., Иорданишвили А.К. МАНЭБ: Четверть века служения экологии и обществу. Экология и развитие общества. 2020; 2-3(33): 24–9.
4. Иорданишвили А.К., Идрис А.Я. Комплаенс и здоровье: социальный аспект проблемы. Экология и развитие общества. 2019; 3(30): 59–60.
5. Иорданишвили А.К., Солдаткина А.С. Заболевания полости рта у лиц молодого возраста. Институт стоматологии. 2015; 3(68): 50–1.
6. Леонтьев В.К., Иванова Г.Г. Методы исследования в стоматологии. Институт стоматологии. 2014; 2(63): 88–90.
7. Banks P. A prospective 20-year audit of a consultant workload. The British orthodontic society clinical effectiveness bulletin. 2010; 25: 15–8.
8. Иорданишвили А.К., Солдатова Л.Н., Переверзев В.С., Тишков Д.С. Кариес зубов у детей мегаполиса и пригородов. Стоматология детского возраста и профилактика. 2016; 4(59): 73–6.
9. Софронов Г.А., Иорданишвили А.К. Роль Международной академии наук экологии безопасности человека и природы в сохранении окружающей среды и здоровья человека. Экология и развитие общества. 2019; 2(29): 16–7.
10. Иорданишвили А.К. Медицина и современная экологическая доктрина. Стоматологический научно-образовательный журнал. 2020; 1-2: 57–61.
11. Алферов Ж.И., Иорданишвили А.К. Роль Международной академии наук экологии, безопасности человека и природы в развитии фундаментальных исследований. Материалы IV ежегодной научно-практической конференции с международным участием «Декабрьские чтения по судебной медицине в РУДН: актуальные вопросы судебной медицины и общей патологии». М.: РУДН; 2020: 8–13.
12. Рогалева Л.В., Иорданишвили А.К. Международная академия наук экологии безопасности человека и природы: научные и прикладные направления деятельности. Экология и развитие общества. 2019; 4(31): 7–11.
13. Окушко В.Р. Физиология эмали и проблема кариеса зубов. Кишинев: Щтница; 1989.
14. Леонтьев В.К. Эмаль зубов как биокибернетическая система. М.: ГЭОТАР-Медиа; 2016.
15. Солдатов В.С., Солдатова Л.Н., Иорданишвили А.К. Функциональная резистентность эмали у пациентов в период ортодонтического лечения и пути ее улучшения. Институт стоматологии. 2022; 4: 50–1.
16. Хайцев Н.В., Васильев А.Г., Трашков А.П., Кравцова А.А., Балашов Л.Д. Влияние возраста и пола на характер ответных реакций белых крыс при действии хронической гипоксической гипоксии. Педиатр. 2015; 6(2): 71–7.