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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии  
საქართველოს სამედიცინო სიახლენი

## GEORGIAN MEDICAL NEWS

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**GMN: Georgian Medical News** is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

**GMN: Медицинские новости Грузии** - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

**GMN: Georgian Medical News** – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

### WEBSITE

[www.geomednews.com](http://www.geomednews.com)

## К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman (Кириллица)**, для текста на грузинском языке следует использовать **AcadNusx**. Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - <http://www.spinesurgery.ru/files/publish.pdf> и [http://www.nlm.nih.gov/bsd/uniform\\_requirements.html](http://www.nlm.nih.gov/bsd/uniform_requirements.html) В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректур авторам не высылаются, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

**При нарушении указанных правил статьи не рассматриваются.**

## REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or computer-printed on a single side of standard typing paper, with the left margin of 3 centimeters width, and 1.5 spacing between the lines, typeface - **Times New Roman (Cyrillic)**, print size - 12 (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: [http://www.nlm.nih.gov/bsd/uniform\\_requirements.html](http://www.nlm.nih.gov/bsd/uniform_requirements.html)  
[http://www.icmje.org/urm\\_full.pdf](http://www.icmje.org/urm_full.pdf)

In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

**Articles that Fail to Meet the Aforementioned  
Requirements are not Assigned to be Reviewed.**

## ავტორთა საქურაღებოლ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დაიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx**. შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრაფიების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შედეგების ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფხიხლებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

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## SIGNS OF ORAL CAVITY MICROCIRCULATORY DISORDERS IN ADOLESCENTS WHO SMOKE

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### Abstract.

Smoking is one of the most common harmful habits that can lead to the development of pathological processes in various organs and systems. At the same time, smoking in childhood and adolescence especially contributes to the deterioration of the general somatic condition, increases the risk and determines the severity of the course of respiratory diseases, which in the future has an impact on the development and functioning of the respiratory system, becomes the cause of dependent conditions and complicates the course of accompanying pathology. It is believed that disruption of the microcirculatory channel can be one of the key links in the development of pathological processes in the oral cavity. Therefore, improving the quality of diagnosis of lesions of the microcirculatory bed of periodontal tissues in the early stages of the inflammatory process became the goal of our work.

**Material and methods:** All patients were divided into 2 groups: the main group adolescents from 14 to 17 years old who smoke, and the control group - adolescents who have never smoked. Determination of the degree of damage to the vascular bed of periodontal tissues in adolescents was carried out with using biochemical analysis of oral fluid to detect in it prognostic markers of microcirculation disorders in periodontal tissues with determination of the level of arginine, nitrates, citrulline, urea. The index of micro crystallization of oral fluid, the rate of saliva secretion and the pH of the oral fluid were detected also.

**Results:** The results and their analysis indicate certain differences in the biochemical profile of the oral fluid of adolescents who smoke and adolescents who do not have this habit. The following values of the investigated indicators were obtained. Interquartile indicators of the level of arginine in the main group are 6.19-13.63, in the control group - 9.01-12.12; nitrates – 98.2-174.84 and 96.3-179.39, citrulline – 10.20-17.39 and 7.31-14.38, urea – 10.2-15.9 and 11.1-17.7 in accordance with the specified procedure. Such a situation may indicate the presence of an early biochemical response, which appears some time before clinical manifestations, since individuals with an intact periodontium were selected for participation in this study.

**Conclusions:** Smoking is an unconditional factor that worsens the morpho-functional condition of the mucous membrane of the oral cavity not only in adults, but also in children. Yes, a reliable difference between smokers and non-smokers was determined for arginine and citrulline indicators; no significant differences were found between the parameters of nitrates and urea.

**Key words.** Smoking, microcirculatory disorders, adolescents.

### Introduction.

Smoking is one of the most common harmful habits [1,2], which leads to a negative effect in human organism and can be fully regarded as a risk factor for life-threatening diseases.

It was established that a long history of smoking leads to a decrease in the average life expectancy of this contingent by 22 years and a threefold increase in the mortality rate. But, despite this, a rapid increase in the number of smokers is determined, which, according to forecasts, will lead to the death of about 10 million people annually by 2030 [3]. According to American researchers, smoking in childhood and adolescence contributes to the deterioration of the general somatic condition, increases the risk and determines the severity of the course of respiratory diseases, which in the future has an impact on the development and functioning of the respiratory system, becomes the cause of dependent conditions and complicates the course of concomitant pathology [4]. There are sad statistics about the use of tobacco by children and adolescents. Thus, it is known that every day 2,500 children under the age of 18 use their first cigarette, and more than 400 of them become new, permanent smokers, and half of them will die from this addiction in the future [5]. The situation is worsened by the fact that in childhood and adolescence, a person searches for his society, forms an emotional and cognitive space for adult life. At this time, attempts and experiments are especially relevant, sometimes without understanding their vital risks [6]. Most people who use tobacco started in their teens. As statistics show, those who start smoking at a younger age are more likely to become addicted to nicotine and have greater problems with quitting smoking [7]. According to the 2017 survey, 9.7% of final graders, 5.0% of tenth graders, and 1.9% of eighth graders had used cigarettes in the past. Analyzes of the 2012 National Youth Tobacco Survey (NYTS) found that 20.8% of adolescent tobacco users reported having a need to use tobacco within 30 minutes of waking, which is classified as a classic symptom of nicotine dependence. This study also reported data on 41.9% of adolescents who reported a strong craving for tobacco [8]. Other studies have found that the degree and frequency of nicotine use do not affect the ability to quit. Thus, irregular smoking among adolescents is associated with the same level of difficulty in quitting as with daily smokers [9].

The determination of the specific mechanisms of the influence of smoking addiction on the state of the microcirculatory bed, in particular microcirculation, is relevant and timely, for the further formation of therapeutic and preventive tactics, in relation to periodontal tissue diseases associated with tobacco smoking in adolescents. The aim of our study was to improve the quality of diagnosis of lesions of the microcirculatory bed of periodontal tissues in the early stages of the inflammatory process for the further formation of therapeutic and preventive tactics regarding diseases of periodontal tissues associated with tobacco smoking.

### Materials and Methods.

All patients went to the dentist for a preventive examination. Dental status was determined after an examination with using

a dental mirror and a probe. The patients were divided into 2 groups: the main group - 19 adolescents from 14 to 17 years old who smoke cigarettes, and the control group - 20 adolescents from 14 to 18 years old who have never smoked. Oral fluid for biochemical analysis was collected from patients in the morning on an empty stomach by spitting into a measuring tube. In order to avoid the formation of increased concentrations of nitrates and nitrites in the oral fluid, patients were recommended to refrain from consuming foods containing dyes (sausages, sausage, ketchup, early ripening vegetables, etc.) for 3 days before the start of the study and during its conduct. It was also not recommended to use mouth rinses and stay in direct sunlight for a long time. Determination of the degree of injury to the vascular bed of periodontal tissues in adolescents was carried out with using a biochemical analysis of oral fluid to identify prognostic markers of microcirculation disorders in periodontal tissues. Thus, for this, the amount of arginine was determined by the method of S. Sakaguchi (reaction with  $\alpha$ -naphthol) [10]. For this purpose, permutedite was placed in the absorption column, 5 ml of the solution under investigation was slowly passed through it, then washed with NaCl solution (0.3%). To determine arginine, 2 ml of the solution was taken, and 0.5 ml of a cold solution of  $\alpha$ -naphthol and urea was added (0.2% solution of  $\alpha$ -naphthol in absolute alcohol, which was diluted 1:4 with a 10% urea solution before use). After 2 minutes, 0.2 ml of sodium hypobromite solution (0.66 ml of bromine in 100 ml of 5% NaOH solution) was added. The solution was left for 20 minutes at 0°C, then quickly brought to room temperature and the optical density was measured on a SF-46 spectrophotometer at a wavelength of 525 nm. The quantitative content of citrulline was determined according to the method of AG Gornall and A.Hunter (reaction with diacetylmonooxime in a strongly acidic medium) [11]. To determine citrulline, 0.7 ml of the material sample was incubated with 0.1 ml of urease (Sigma, USA) solution of 15 mg/ml for 15 minutes at 37°C. Then 0.2 ml of trichloroacetic acid (20%) was added and centrifuged (2 min, 12,000 rpm) and the reaction with diacetyl monooxime was carried out. The quantitative content of urea was determined by the diacetylmonooxime method, using a standard set of reagents from the company "Felicit" Ukraine. The concentration of nitrates and nitrites was determined using the reaction with the Griess-Ilosvay reagent. The quantitative determination of nitrites is based on spectrophotometry of the dye, which is created in the visible and ultraviolet part of the spectrum, since the optical density (specific gravity) of the dye is proportional to the concentration of nitrite ions. The concentration of nitrates and nitrites is determined in the sum.

One of the integral indicators of the homeostasis of the oral cavity is the mineralizing potential of the oral fluid, which was assessed by its microcrystallization. The evaluation of microcrystallization was carried out in average scores depending on the types of crystal formation. Assessment of the mineralizing potential of oral fluid: 0.0-1.0 – very low; 1.1-2.0 – low; 2.1-3.0 – satisfactory; 3.1-4.0 – high and 4.-5.0 – very high. To study indicators of microcrystallization and mineralization potential oral fluid was obtained in the amount of 0.2-0.4 ml was taken

from the bottom of the oral cavity using a sterile pipette without stimulation two hours after eating and rinsing the oral cavity with distilled water. Three drops of oral fluid were placed on a slide pretreated with alcohol and dried at room temperature. After drying, the drops were examined under a microscope. Determination of the types of microcrystallization was carried out depending on the detected types of crystal formation.

Statistical processing of the data was performed using the Statistica for Windows 8.0 software package. Statistical processing was performed using the methods of variational statistics. The conformity of the distribution to normality was determined by the Shapiro-Wilk's test, which showed that the samples are close to the normal distribution. Methods of descriptive statistics (determination of numerical characteristics of variables - arithmetic mean (M), mean sampling error (m), determination of the reliability of differences (p), which were tested via the Student-Fisher t-test in representative samples) were used. Correlation between indicators was assessed using Spearman's correlation coefficient (r). The difference in values between comparative indicators was considered significant at  $p < 0.05$ .

The study was conducted in compliance with the basic bioethical provisions of the Council of Europe Convention on Human and Biomedical Rights (April 4, 1997), the Helsinki Declaration of the World Medical Association on the Ethical Principles of Scientific Medical Research with Human Participation, and the Order of the Ministry of Health of Ukraine.

## Results.

The results and their analysis indicate certain differences in the biochemical profile of the oral fluid of adolescents who smoke and adolescents who do not have this habit (Table 1). So, for example, there is a significant difference between the indicators of arginine and citrulline, but there are no differences between the indicators from the side of nitrates and urea.

**Table 1.** Changes in the biochemical profile of oral fluid in patients of the main and control groups.

	Interquartile range	Average value	Error
<b>Arginine</b>			
Main group	6.19-13.63	8.10	0.64
Control group	9.01-12.12	11,11*	0.67
<b>Nitrates</b>			
Main group	98.2-174.84	142.77	6.09
Control group	96.3-179.39	131.55	5.51
<b>Citrulline</b>			
Main group	10.20-17.39	11.97	0.31
Control group	7.31-14.38	11,14*	0.30
<b>Urea</b>			
Main group	10.2-15.9	13.28	0.34
Control group	11.1-17.7	14.39	0.40

Note: \* - significant difference with the control group,  $p < 0.05$

The index of microcrystallization of oral fluid, the rate of saliva secretion and the pH of the oral fluid are presented in Table 2.

**Table 2.** Indicator of microcrystallization of oral fluid and biophysical properties of oral fluid in the studied groups ( $M \pm m$ ).

Group	Indicator of microcrystallization	Salivation rate, ml/min	pH, units
A group of non-smokers	2.44±0.18	0.38±0.03	6.51±0.28
A group of smokers	1.88±0.12*	0.14 ± 0.01*	6.22 ± 0.21*

Note: \* - significant difference with the control group,  $p < 0.05$

## Discussion.

Smoke contains four thousand active substances that cause quite diverse and specific changes in the oral cavity [12,13]. At the same time, the authors associate the main effects of smoking with the activation of bacterial aggression and, as a result, increased changes in the microbiota of the oral cavity. There are references about disorders in the soft tissue of oral cavity [14].

It should be noted that any exposure to nicotine among youth is a cause for concern. In order to determine the effect of smoking on subgingival bacteria, other confounding factors that would dilute or interfere with the effects of smoking should be eliminated, especially those associated with gingivitis and periodontitis. The same situation has arisen around the relationship between quality of life and the health of the oral cavity, which has been discussed from a broader perspective for many years, since pathological changes in the oral cavity, in particular periodontal tissues, have a direct impact on the daily life of patients [15]. It is believed that the quality of life should be defined as something peculiar to individuals, their most personal characteristics, related to both the constitutional aspects of hereditary nature and those acquired in the course of their life [13] and taking into account these concepts, special attention deserves determination of factors and indicators for measuring the standard of living of a person, correlating it with the state of dental health. In dentistry, this relationship is strongly emphasized by the fact that the health of the oral cavity has a direct and inverse effect on a person's life in its physical and psychosocial aspects [16].

This coincides with the opinion of other specialists in this direction, who indicate that higher concentrations of L-arginine and L-citrulline are observed in inflamed gum tissues, thereby suggesting that changes in the concentration of nitric oxide (NO), and therefore in microcirculation, occur in patients in gums with gingivitis [17,18]. So, influence of detected changes of arginine and citrulline characterized by consequent reduce nitric oxide (most important endogenous substance for vasodilatation) that realised in vasoconstriction of microcirculatory bed vessels and ischemia development in oral cavity. Disturbance of organ function in oral cavity as result of formed ischemia leads to estimated changes of saliva production (both quantitative and qualitative) with reduced self-protective property of saliva influence that realize in start of pathological processes in both soft and dense tissues of oral cavity.

Such a situation may indicate the presence of an early biochemical response that appears a certain time before clinical manifestations, since individuals with an intact periodontium were selected for participation in this study. Therefore, taking

into account the obtained results, it is possible to note the leading role of early biochemical markers of damage to the vascular bed of periodontal tissues in adolescents who smoke, and to use them as a prognostic criterion for the possibility of inflammation in this area. Of course, such data should be compared with the determination of the condition of the oral cavity, its microbiocinosis [19,20]. This, in turn, allows for a purposeful approach to the choice of treatment and prevention tactics at the pre-clinical stage, as well as at the early stages of the inflammatory process, which is provoked by smoking.

Oral fluid, performing the function of a multifaceted and quite indicative evaluation criterion, both of the state of the oral cavity in particular, and of the body as a whole, can be a diagnostic sign of any disease at its preclinical stage [21]. Therefore, determining the biophysical processes of salivation allows diagnosing a pathological condition and making appropriate preventive and therapeutic decisions, using the buffering, protective and other functions of this biological substance [22]. The availability and non-invasiveness of taking the necessary amount of mixed saliva contribute to the possibility of wide implementation of methods of determining the properties of oral fluid in the practice of scientific research.

As can be seen, the deterioration of the rate of salivation completely depends on the presence of smoking addiction. Despite the experience of addiction, there is a sharp decrease in this indicator compared to the control group. At the same time, no significant shifts in the pH of mixed saliva were observed. The influence of smoking experience on clinical indicators of oral cavity health deserves special attention. These data should be useful in formulating a strategy for the diagnosis and prevention of major dental diseases in children with different periods of smoking addiction.

At the same time, the importance of establishing a stable pattern of oral health before adolescence and beyond can be challenging for lifestyle changes during this period of life [13]. In adolescence, lack of time and forgetfulness are often cited as reasons for bad oral hygiene habits [23]. Children's personal self-esteem can be associated with positive oral health behaviors.

Periodontal destruction, alveolar bone loss and gingival recession were previously found to be significantly increased in smokers compared to non-smokers [24] and it was concluded that periodontal differences between smokers and non-smokers were observed. Our study did not assess significant changes in saliva status that could be explained by compensatory hypersalivation, but requires further investigation.

Changes in the dental status of adolescents with smoking addiction revealed in the study indicated certain aspects of the risk of developing dental diseases in this group of patients with the prevalence of periodontal inflammation. The most vulnerable, with a short history of smoking, were periodontal tissues. This may indicate a direct effect of tobacco smoke on the microcirculation of the gums. However, it should be noted that such a mechanism of action must be confirmed by an experimental evidence base, which, in turn, creates a promising scientific direction for further research. In addition, further studies are needed to evaluate biophysical and biochemical

changes in oral fluid or even changes in the structure of paranasal sinus walls [25-28] and depending on inflammation [29-32]. We believe that the lack of certain changes in the main group was associated only with a short period of addiction to smoking, and over time the situation may shift in the direction of negative changes. This also requires further studies in this patient group. A comprehensive record of maintaining oral hygiene in proper condition [33-36], determination of the level of total protein, hydrogen sulfide, and nitrogen metabolites [37-40] is necessary to prevent the development of inflammatory diseases when creating periodontal care [41-46], as most significant detected changes arginine and its precursor citrulline have received much interest in the past two decades because of their potential effects on whole-body nitric oxide production and augmentation of NO-dependent signalling pathways [47], described in our work changes of saliva property proves about much more various consequences of biochemical changes in microcirculatory bed vessels.

Thus, analyzing the obtained results of a comprehensive study, it becomes clear the mutual relationship between the habit of smoking and the state of periodontal tissues in both clinical and biophysical aspects. Therefore, the planning of the following diagnostic and treatment-prophylactic measures for adolescents should be carried out taking into account this addiction.

### Conclusion.

Smoking is an unconditional factor that worsens the morphofunctional state of the mucous membrane of the oral cavity in adolescents. There is a significant difference between the indicators of arginine and citrulline, but there are no differences between the indicators from the side of nitrates and urea. Simultaneously, pathological process is characterized by reducing salivation rate, pH and indicator of microcrystallization of oral fluid,

The research is promising in terms of the future development of diagnostic and therapeutic methods that could reduce or even eliminate the negative impact of tobacco smoking in adolescents.

### Conflict of interest.

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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