# GEORGIAN MEDICAL NEWS

ISSN 1512-0112

NO 9 (354) Сентябрь 2024

ТБИЛИСИ - NEW YORK


ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

**GEORGIAN MEDICAL NEWS**

Monthly Georgia-US joint scientific journal published both in electronic and paper formats of the Agency of Medical Information of the Georgian Association of Business Press. Published since 1994. Distributed in NIS, EU and USA.

**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 ВИНИТИ 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 ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

**WEBSITE**

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
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. Корректура авторам не высылается, 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 compu-ter-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.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 საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ 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. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის 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 ფჩხილებში 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.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

*GEORGIAN MEDICAL NEWS*
*No 7-8 (352-353) 2024*

*Содержание:*

*GEORGIAN MEDICAL NEWS*
*No 9 (354) 2024*

# ANALYSIS OF BLOOD PARAMETERS IN TYUMEN RESIDENTS WITH COVID-19 IN CATAMNESIS AND/OR VACCINATED AGAINST A NEW CORONAVIRUS INFECTION

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## Abstract.

Currently, much is known about the causative agent of Covid-19. The situation with the spread of a new coronavirus infection is under control. Preventive measures against this disease have been developed and are being actively implemented. Despite this, the scientific search for the study of Covid-19 continues. In particular, the problem of early diagnosis of this disease using routine research methods is relevant. Since not every medical institution has the opportunity to conduct an expensive examination of the patient during his initial treatment. In this regard, in the presented work, the authors systematized the data of indicators of general and biochemical blood analysis. 151 people were included in the study. All the people lived in the territory of Tyumen. Depending on the presence of Covid-19 and vaccination against the new coronavirus infection, patients were divided into four groups. Research on such a design is being carried out for the first time. The results obtained were processed using the SPSS 21 computer program. Statistical processing was performed using the Student's t-test. The normal distribution or the Gaussian curve. The values at $p<0.05$ were considered statistically significant.

In the course of the study, the results were obtained, which, in general, do not contradict the literature data. However, it is noteworthy that in patients who underwent Covid-19, the neutrophil content in the general blood test was significantly higher, and the cholesterol level in the biochemical blood test, on the contrary, was significantly lower in comparison with patients of other groups. A similar result has not been described in the literature before. In the future, it is planned to carry out statistical processing of the available data using multivariate analysis. The results of this study may be useful to doctors, senior students of medical educational institutions, since when managing a patient, it is necessary to take into account the peculiarities of his catamnesis.

**Key words.** New coronavirus infection, general blood test, biochemical blood test, vaccination, hemoglobin, erythrocytes, platelets, total cholesterol, glucose.

## Introduction.

A new highly infectious virus, also known as Covid-19 and SARS-CoV-2, was first reported in Wuhan, China, in December 2019 [1]. In a short time, the virus has spread all over the world. In this regard, WHO declared Covid-19 a pandemic on March 11, 2020. The causative agent of Covid-19 is a single-stranded RNA from the Coronaviridae family. It is a human enveloped β-coronavirus that shares 80% of the human SARS-CoV-1 genetic sequence and 96.2% of the bat coronavirus RaTG13 genetic sequence. The virus shell is covered with a spike-like glycoprotein consisting of S1 and S2 subunits. One of the mechanisms of virus penetration into the body is realized through the S1 subunit, since S1 of the virus binds to the angiotensin converting enzyme 2 (ACE 2) of the host and CD14 [2].

ACE 2 is a common host cell receptor for SARS-CoV and SARS-CoV-2. Since ACE 2 is diffusely distributed in many human tissues, this causes a wide range of clinical manifestations of Covid-19 with a diverse prognosis. The clinical manifestations of Covid-19 range from asymptomatic to acute respiratory distress syndrome (ARDS). It is believed that severe ARDS is caused by an inflammatory cytokine storm [3].

The main method of diagnosing this disease is to perform a polymerase chain reaction (PCR). Along with this, there is evidence of the use of other methods, such as radiological, biochemical, biomarker and hematological studies, which are important for risk stratification, patient monitoring and outcome prediction.

However, not all medical institutions have the necessary equipment of the material and technical base for one or more (if necessary) of the above studies, which means that the search for routine laboratory predictors for the diagnosis of Covid-19 can help identify a group of patients with an increased risk of developing severe forms of Covid-19. Similar scientific searches have already been conducted. The following results were obtained.

In a study involving 144 patients (residents of Italy) diagnosed with Covid-19 in anamnesis, in which 70 people died during their stay in the hospital, and 74 survived and were discharged. It was found that among the deceased patients there were significantly higher values of serum glucose, aspartate aminotransferase (AST), creatine kinase (KK), lactate dehydrogenase (LDH), urea, creatinine, troponin, prothrombin time (PTV), international normalized ratio, activated partial thromboplastin time (APTT), D-dimer, C-reactive protein (CRP), ferritin and leukocytes (especially neutrophils), while albumin, hemoglobin (HGB) and lymphocyte values were significantly reduced. In multiple regression analysis, LDH, CRP, neutrophils, lymphocytes, albumin, and APTT remained significant predictors of hospital death [4].

In another study [5], which included 186 patients diagnosed with Covid-19, it was found that the most significant parameters are the width of the distribution of erythrocytes, ferritin, LDH, D-dimer, CRP, PTV and creatinine levels. The authors proved that these parameters are important for predicting not only hospitalization in the intensive care unit, but also the mortality of patients admitted to the intensive care unit.

Along with this, a number of authors [6] conducted a prospective observational cohort study in Pakistan. The study included patients who had a positive PCR test result for Covid-19 and who were subsequently hospitalized. The study established the relationship between poor glycemic control and elevated levels of CRP, LDH, ferritin, erythrocyte sedimentation rate (ESR), troponin, KK, KK-MB, AST, alanine aminotransferase (ALT), creatinine and D-dimers. The authors proved that poor glycemic control is a risk factor for the development of multisystem complications in patients with Covid-19. Similar results were obtained in a number of other papers [7-10].

The authors of another study [11] showed that the elderly and the male sex are under serious threat, both from the point of view of Covid-19 and from the point of view of disease progression. It was found that low levels of lymphocytes and leukocytes, high levels of CRP and ferritin were effective in diagnosing this disease.

Mertoglu C. et al. [12] serum levels of KK-MV and bilirubin were analyzed. It was possible to prove that these indicators were significantly higher in people with severe Covid-19.

Analysis of peripheral blood data showed that patients with Covid-19 had lower levels of erythrocytes, lymphocytes, platelets, HGB and higher neutrophil content, and the value of ESR [13]. Similar results were obtained by the authors of other scientific papers [14-16].

In a number of studies, the level of total cholesterol (OH) was analyzed among the indicators of biochemical blood analysis. The authors agree that the level of OH is significantly higher in patients who survived Covid-19 [15,17].

**Aim.** To conduct a retrospective analysis of blood parameters in Tyumen residents with a history of Covid-19 and/or vaccinated against Covid-19.

## Materials and Methods.

The study included people who live in the territory of Tyumen. The study group consisted of men and women aged 18 to 65 years. The total number of participants is 151 people. Participants either underwent Covid-19 in the period October-December 2020 or were vaccinated against Covid-19 in the period May-July 2021. Depending on this, all participants were divided into 4 subgroups:

1 subgroup (31 people) – did not have Covid-19 and were not vaccinated against Covid-19 (control group).

2 subgroup (30 people) – underwent Covid-19 in the period October-December 2020 but were not vaccinated against Covid-19.

3 subgroup (56 people) – did not have Covid-19 but were vaccinated against Covid-19 in May-July 2021.

4 subgroup (34 people) – underwent Covid-19 in October-December 2020 and were vaccinated against Covid-19 in May-July 2021.

There were no hospitalized patients among the participants who underwent Covid-19, all persons received outpatient therapy, the severity of the disease corresponded to a mild or moderate degree.

The data was collected between October and November 2021. Blood samples were taken from all participants, except for the passport part and the catamnesis data, for general (UAC) and biochemical blood analysis.

The following parameters were evaluated in the UAC: leukocytes (WBC), erythrocytes (RBC), hemoglobin (HGB), hematocrit (HCT), average erythrocyte volume (MCV), average hemoglobin content in erythrocyte (MCH), average hemoglobin concentration in erythrocyte (MCHC), platelets (PLT), distribution of erythrocytes by volume (RDW-CV), platelet size distribution width (PDW), mean platelet volume (MPV), thrombocrit (PCT), neutrophils (NEU), lymphocytes (LYM), monocytes (MONO), eosinophils (EOS), basophils (BASO), immature granulocytes (IG), neutrophils (NEU%), lymphocytes (LYM%), monocytes (MONO%), eosinophils (EOS%), basophils (BASO%), immature granulocytes (IG%), ESR.

Total cholesterol (TC) and glucose levels were analyzed in a biochemical blood test.

The study was conducted on the basis of the Tyumen State Medical University. The study was approved by the local Ethics Committee of the Tyumen State Medical University (Protocol No. 1 dated 09.17.2021). The results were processed using the computer program SPSS 21. Statistical processing of the results was performed using the Student's t-test. According to generally accepted rules, the values at $p<0.05$ were considered statistically significant when conducting biomedical research.

## Results and Discussion.

When assessing the UAC indicators, no significant differences were found between individuals of different analyzed groups (Table 1).

As can be seen from table 1, the indicator “mean platelet volume (MPV)” in individuals of the 1st subgroup was slightly higher than normal. MPV is an indicator reflecting platelet volume. Normally, platelet volume decreases as cells age, and an increase in this indicator indicates that young forms predominate in the population of this type of cell. It is known that platelets are blood cells that participate in inflammatory reactions, have an antimicrobial effect, and activate immune cells (lymphocytes, neutrophils, macrophages). Participants in group 1 are people who have not had Covid-19 and have not been vaccinated against this disease, which means that it can be assumed that their immune system worked hard during the pandemic. As a result, this was reflected in an increase in MPV.

HGB have been analyzed and described in more detail in the literature, this study also made an attempt to study in more depth the changes in these indicators. Statistical processing of the material showed that the level of leukocytes in participants in subgroups 1, 3 and 4 was significantly higher than in individuals in subgroup 2 ($p<0.005$). The percentage of neutrophils was also significantly higher in individuals of subgroup 2 than in participants of subgroups 3 and 4 ($p<0.005$). The results obtained do not contradict the literature data. These changes

***Table 1.*** *Results of general blood test indicators (N = 151 people).*

| Analyzed index | Designation, units change | Norm | M ± E | | | |
|---|---|---|---|---|---|---|
| | | | Study group No. | | | |
| | | | 1 | 2 | 3 | 4 |
| Leukocytes | WBC, $10^9$/l | 4.00-8.80 | 6.21 ± 0.25 | 5.15 ± 0.17 | 6.48 ± 0.29 | 6.78 ± 0.22 |
| Neutrophils | NEU, $10^9$/l | 1.80-7.70 | 3.44 ± 0.18 | 3.01 ± 0.14 | 3.31 ± 0.23 | 3.52 ± 0.13 |
| Lymphocytes | LYM, $10^9$/l | 1.20-3.50 | 2.17 ± 0.13 | 1.59 ± 0.09 | 2.43 ± 0.12 | 2.38 ± 0.15 |
| Monocytes | MON, $10^9$/l | 0.10-1.00 | 0.44 ± 0.03 | 0.37 ± 0.02 | 0.55 ± 0.03 | 0.63 ± 0.02 |
| Eosinophils | EOS, $10^9$/l | 0.00-0.45 | 0.12 ± 0.01 | 0.16 ± 0.01 | 0.17 ± 0.02 | 0.23 ± 0.02 |
| Basophils | BAS, $10^9$/l | 0.00-0.20 | 0.03 ± 0.004 | 0.03 ± 0.01 | 0.04 ± 0.01 | 0.03 ± 0.003 |
| Neutrophils | NEU, % | 50.00-70.00 | 55.14 ± 1.57 | 57.94 ± 1.68 | 49.8 ± 1.69 | 52.3 ± 1.64 |
| Lymphocytes | LYM, % | 20.00-40.00 | 35.18 ± 1.66 | 31.11 ± 1.62 | 38.68 ± 1.62 | 34.56 ± 1.85 |
| Monocytes | MON, % | 4.00-12.00 | 9.05 ± 1.92 | 7.25 ± 0.44 | 8.34 ± 0.31 | 9.3 ± 0.34 |
| Eosinophils | EOS, % | 1.00-5.00 | 2.05 ± 0.26 | 3.17 ± 0.27 | 2.65 ± 0.26 | 3.39 ± 0.27 |
| Basophils | BAS, % | 0.00-2.50 | 0.53 ± 0.05 | 0.53 ± 0.06 | 0.42 ± 0.05 | 0.44 ± 0.04 |
| Red blood cells (EC) | RBC, $10^{12}$/l | 3.50-5.20 | 4.45 ± 0.07 | 4.86 ± 0.06 | 4.77 ± 0.07 | 4.57 ± 0.06 |
| Hemoglobin | HGB, g/l | 117-153 | 130.71 ± 1.8 | 131.63 ± 1.79 | 130.83 ± 2.55 | 126.76 ± 1.57 |
| Hematocrit | HCT, % | 33.00-45.00 | 39.15 ± 0.46 | 40.68 ± 0.43 | 40.52 ± 0.71 | 38.99 ± 0.45 |
| Wed. EC volume | MCV, fl/ | 72.00-100.00 | 86.39 ± 1.02 | 83.75 ± 1.14 | 83.39 ± 2.1 | 85.5 ± 0.97 |
| Wed. HGB content in EC | MCH, pg | 26.00-35.00 | 29.42 ± 0.29 | 27.17 ± 0.41 | 27.53 ± 0.39 | 29.59 ± 1.84 |
| Wed. conc. HGB in EC | MCHC, g/l | 300-380 | 333.71 ± 2.25 | 324.83 ± 3.99 | 322.58 ± 2.17 | 308.45 ± 12.63 |
| Distribution of EC by volume | RDW-CV, % | 12.00-15.00 | 12.83 ± 0.24 | 12.8 ± 0.16 | 13.43 ± 0.19 | 13.15 ± 0.15 |
| Platelets (TC) | PLT, $10^9$/l | 150-400 | 279.16 ± 8.6 | 225.57 ± 10.08 | 278.68 ± 10.86 | 298.76 ± 5.95 |
| Wed. shopping center volume | MPV, fl. | 8.00-11.00 | 11.9 ± 2.44 | 9.41 ± 0.26 | 10.08 ± 0.19 | 9.76 ± 0.19 |
| Width of shopping center size distribution | PDW, fl. | 9.00-20.00 | 14.38 ± 0.4 | 14.49 ± 0.48 | 14.41 ± 0.27 | 14.94 ± 0.35 |
| Thrombocrit | PCT, % | 0.20-0.50 | 0.22 ± 0.02 | 0.23 ± 0.01 | 0.28 ± 0.01 | 0.24 ± 0.01 |
| EC sedimentation rate | ESR, mm/hour | 2-20 | 11.55 ± 1.18 | 9.3 ± 0.92 | 9.95 ± 1.08 | 7.94 ± 0.77 |

***Table 2.*** *Results of biochemical blood test (N = 151 people).*

| Analyzed indicator, mmol/l | Norm | M±E | | | |
|---|---|---|---|---|---|
| | | Study group no. | | | |
| | | 1 | 2 | 3 | 4 |
| Glucose | 4.20-6.10 | 4.88 ± 0.09 | 4.92 ± 0.09 | 4.57 ± 0.07 | 4.70 ± 0.06 |
| Total cholesterol | 3.60-6.20 | 4.60 ± 0.07 | 3.97 ± 0.06 | 4.58 ± 0.1 | 4.53 ± 0.15 |

are associated with the influence of the Covid-19 pathogen on the human body. The content of erythrocytes, in turn, was significantly lower in individuals of subgroup 1 compared to participants in other subgroups ($p<0.005$). This can also be explained by the influence of the Covid-19 pathogen on the human body. Since the participants in group 1 are people who do not have a history of Covid-19 and have not been vaccinated against Covid-19.

After the CBC indicators were analyzed, the main indicators of the biochemical blood test were studied. The data is presented in table 2.

As can be seen from table 2, the analyzed indicators - glucose and TC levels - were within physiological norms. Statistical processing of the material showed that the level of glucose in the blood was significantly higher in individuals of subgroup 2 than in the rest of the study participants ($p<0.005$). In turn, the level of TC, on the contrary, was statistically significantly lower in individuals of subgroup 2 compared to participants in other subgroups ($p<0.005$). As with the analysis of UAC indicators, the results obtained do not contradict literature data and are explained by the influence of the Covid-19 pathogen on the human body.

## Conclusion.

In the course of the work carried out, the results were obtained, which generally did not contradict the available data in the literature. Due to the fact that the study was dominated by young people, and there were no those who suffered a severe degree of Covid-19, there were no pronounced deviations from the norm in the indicators of general and biochemical blood analysis. However, the trends that have been established emphasize that under the influence of an infectious agent, in particular, the causative agent Covid-19, specific symptom complexes develop in the body, which are reflected in changes in the indicators of general and biochemical blood analysis. The results of this study may be useful to doctors of different specialties, since when managing a patient, it is worth taking into account the peculiarities of his catamnesis.

This study was supported by the West-Siberian Science and Education Center, Government of Tyumen District, Decree of 20.11.2020, No. 928-rp.

## REFERENCES


1. Khandait H, Gandotra G, Sachdeva S, et al. Covid-19 and hematology - what do we know so far?. SN comprehensive Clinical Medicine. 2020;2:2631-2636.
2. Ulrich H, Pillat MM. CD147 as a target for Covid-19 treatment: suggested effects of azithromycin and stem cell engagement. Stem Cell Reviews and Reports. 2020;16:434-440.
3. Huyut M.T, İlkbahar F. The Effectiveness of Blood Routine Parameters and Some Biomarkers as a Potential Diagnostic Tool in the Diagnosis and Prognosis of Covid-19 disease. International immunopharmacology. 2021;98:107838.
4. Bonetti G, Manelli F, Patroni A, et al. Laboratory predictors of death from coronavirus disease 2019 (Covid-19) in the area of Valcamonica, Italy. Clinical Chemistry and Laboratory Medicine (CCLM). 2020;58:1100-1105.
5. Medeiros K.S, Macêdo L.T.A, Souza W.F, et al. Guillain-Barré syndrome associated with SARS-CoV-2 infection: a scoping review. Revista da Associacao Medica Brasileira. 2021;67:318-334.
6. Ashiq K, Bajwa M.A, Tanveer S, et al. A comprehensive review on gout: The epidemiological trends, pathophysiology, clinical presentation, diagnosis and treatment. JPMA. The Journal of the Pakistan Medical Association. 2021;71:1234-1238.
7. Amgalan A, Othman M. Hemostatic laboratory derangements in Covid-19 with a focus on platelet count. Platelets. 2020;31:740-746.
8. Erol A.T, Aşar S, Sabaz M.S, et al. Risk Factors for 28-day Mortality Among Covid-19 Patients in an Intensive Care Unit of a Tertiary Care Center in Istanbul. Med. J. Bakirkoy. 2021;17:100-107.
9. Guan W, Ni Z, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. The New England journal of medicine. 2020;382:1708-1720.
10. Li H, Wang B, Ning L, et al. Transient appearance of EDTA dependent pseudothrombocytopenia in a patient with 2019 novel coronavirus pneumonia. Platelets. 2020;31:825-826.
11. Huyut M.T, Fatih İ. The effectiveness of blood routine parameters and some biomarkers as a potential diagnostic tool in the diagnosis and prognosis of Covid-19 disease. International immunopharmacology. 2021;98:107838.
12. Mertoglu C, Huyut M.T, Arslan Y, et al. How do routine laboratory tests change in coronavirus disease 2019?. Scand. J. Clin. Lab. Invest. 2021;81:24-33.
13. Mo P, Xing Y, Xiao Y, et al. Clinical characteristics of refractory Covid-19 pneumonia in Wuhan, China. Clin. Infect. Dis. 2020;16:270.
14. Zhang J.J, Cao Y.Y, Tan G, et al. Clinical, radiological, and laboratory characteristics and risk factors for severity and mortality of 289 hospitalized Covid-19 patients. Allergy. 2021;76:533-550.
15. Huyut M.T, Huyut Z, İlkbahar F, et al. What is the impact and efficacy of routine immunological, biochemical and hematological biomarkers as predictors of Covid-19 mortality?. International immunopharmacology. 2022;105:108542.
16. Al-Saadi A.K.D, Abdulnabi MA. Hematological changes associated with Covid-19 infection. Journal of clinical laboratory analysis. 2022;36:e24064.
17. Gameil M.A, Marzouk R.E, Elsebaie A.H, et al. Long-term clinical and biochemical residue after Covid-19 recovery. Egyptian liver journal. 2021;11:74.