

# **GEORGIAN MEDICAL NEWS**

---

ISSN 1512-0112

NO 5 (374) Май 2026

---

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 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 შედეგის 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.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

E. Didebulidze, L. Nadareishvili, S. Sturua, G. Berishvili, S. Tsertsvadze, N. Janelidze, N. Geliashvili, M. Kutateladze, P.M. Lydyard, M. Tediashvili. EARLY HUMORAL IMMUNE RESPONSES TO BACTERIOPHAGES AND SHORT-COURSE PHAGE THERAPY OUTCOMES IN PATIENTS WITH URINARY TRACT INFECTIONS.....	6-17
Iryna Yevchenko, Andrii Masliuk, Serhii Myronets, Inna Lapchenko, Nataliia Ortikova. CORRELATION OF EMOTIONAL EMPATHY WITH MENTAL HEALTH INDICATORS IN ADULTS TO DETECT PSYCHOLOGICAL WELL-BEING MARKERS.....	18-26
Maksat Seiitkhan, Altyn Saparbek, Aibergen Tleubergenov, Kurmanay Soltanbayeva, Sayazhan Stanova. ENDOSCOPIC ENDONASAL TREATMENT OF PRIMARY INVERTED PAPILLOMA OF THE SPHENOID SINUS: A CLINICAL CASE.....	27-34
Dae-Hwan Lee, Bong-Sik Woo, Jung-Ho Lee. RETROSPECTIVE EVALUATION OF A COMMUNITY-BASED ELASTIC BAND EXERCISE PROGRAM USING A BALANCE PAD IN RURAL OLDER WOMEN.....	35-42
Mohamed Abdelhadi, Muna HM Alhendi, Khalil AlShowaiker, Ahmad Almaimooni, Khaled Aljenae, Sulaiman Hajji, Ramadan Eldamarawy, Neveen Shalaby. A RARE PRESENTATION OF DIFFUSE LARGE B-CELL LYMPHOMA AS SEVERE ACUTE HEPATITIS AND SECONDARY HEMOPHAGOCYTIC LYMPHOHISTIOCYTOSIS IN A YOUNG ADULT: A CASE REPORT.....	43-46
Lian-Ping He, Ling-Ling Zhou, Jing-Jin Yang, Ying-Rui Huang, Guang Chen. ARTIFICIAL INTELLIGENCE-ASSISTED TEACHING MODEL AS A STRATEGY TO ENHANCE CORE COMPETENCIES OF CLINICAL MEDICINE UNDERGRADUATES: A SCIENTIFIC HYPOTHESIS.....	47-51
Diana Sargsyan, Arevhat Badalyan, Sona Harutyunyan, Siranush Hovhannisyan. THE STUDY OF CORRELATIONS OF PSYCHOLOGICAL FACTORS ENSURING THE FAMILY MENTAL HEALTH.....	52-60
Gani Uakkazy, Chingiz Shashkin, Natalya Slivkina, Viktor Tkachev, Mirbanu Aikhozhayeva, Gulbana Khussainova, Raushan Baigenzheyeva, Zilola Mavlyanova, Raikhan Burumbayeva, Mereke Alaidarova, Joseph Almazan, Amangali Akanov. CONTEXTUAL ANALYSIS OF ADAPTED BOXING AND KICK-/KNEE-STRIKE EXERCISE MODULES IN MULTIDISCIPLINARY NEUROREHABILITATION AND NURSING CARE: SECONDARY ANALYSIS OF TWO PROSPECTIVE STUDIES.....	61-70
Turkiyah Mohsin Elias, Anmar B. AL-Dewachi. DETERMINANTS OF DIABETIC FOOT AMONG PATIENTS WITH TYPE 2 DIABETES: A CASE-CONTROL STUDY.....	71-77
Khatuna Kudava. CLINICAL CHARACTERISTICS OF INFECTION-ASSOCIATED PALMOPLANTAR DERMATOSIS IN PREPUBERTAL CHILDREN: AN OBSERVATIONAL STUDY.....	78-81
Renta Sanxhaku, Ditila Doracaj, Delina Xhafaj, Stela Sanxhaku, Andi Gjini, Alban Xhafaj, Edi Grabocka. HOMOCYSTEINE TESTING IN PREVENTIVE HEALTHCARE: COMPARATIVE INSIGHTS AND POLICY IMPLICATIONS FOR ALBANIA.....	82-87
Sara Ali, Marwan Ismail, Praveen kumar, Salma Elnour Mohamed, Weam Alyoubi, Hiba Mohamed, Raghad Alamri, Fatima Mohamed Osman Yasin, Safa Mohamed Abdelrahman, Huda F. Alshaibi, Einas Awad Osman, Akhtamova Shahzoda Fozilovna, Matlyuba Badritdnova, Rihab Akasha, Mohamed Alfaki. PAN-CANCER ANALYSIS OF CHEMOKINE (C-C MOTIF) LIGAND 26 (Ccl26) AS A PROMISING PROGNOSTIC BIOMARKER AND IMMUNOMODULATORY MEDIATOR.....	88-115
Altin Sallahu, Ferat Sallahu. PROGNOSTIC AND PREDICTIVE VALUE OF TUMOR BUDDING, LYMPHOVASCULAR INVASION, AND PERINEURAL INVASION IN COLORECTAL CARCINOMA.....	116-119
Ghukasyan Norayr, Gharibyan Edita, Geokchyan Haykuhi, Vardanyan Ara, Gekchyan Gor, Sahakyan Lusine. SUCCESSFUL PREGNANCY AND TERM DELIVERY AFTER RADICAL SURGERY FOR COLON CANCER: A CASE REPORT.....	120-124
G.N.K. Ganesh, Clara Shertaeva, Galiya Umurzakhova, Malik Sapakbay, Sabina Seidaliyeva. DIGITALISATION OF THE PHARMACEUTICAL INDUSTRY IN KAZAKHSTAN: HOW IS THE SECTOR ADAPTING TO NEW REALITIES? .....	125-130
Klara Kaldygozova, Aigul Sergazina, Gulmira Datkayeva, Sulugaisha Kalen, Maya Maksut. METABOLIC DISORDERS IN CHILDREN SUFFERING FROM ACUTE RESPIRATORY VIRAL INFECTIONS (ARVI): COMPLICATIONS AND PREVENTIVE MEASURES.....	131-140
Anas Alhur, Sarah Ibrahim Al-Atif, Afrah Alhur, Fahad Saud Alshammari, Hozan Muslat Nasser Al-Taweel, Reeuof Abdullah Zarbah, Remas Abdullah Mohammed Al-Shahrani, Shaimaa Ahmed Yahya Al-Abdullah, Jana Jameel Salamah Allah, Dhay Hammad Al-Amer, Alhanouf Sulaiman Alharbi, Ali Ahmed Alzahrani, Sultan Saad Ali Alowaydi, Reema Al Shahrani, Abdulrahman A. Alsaqabi. GENERATIVE AI-ASSISTED DRUG-DRUG INTERACTION CASE SUPPORT AND PHARMACY STUDENTS' COMPETENCE: A MIXED-METHODS STUDY.....	141-151

Sara Abdelmehmoud Omer, Alaa Hanafi Makki Elkhalfifa, Abdelkarim Abobakr Abdrabo, Einas A Osman. ASSOCIATION BETWEEN THYROID HORMONE LEVELS AND ADVANCED LIVER FIBROSIS IN PATIENTS WITH TYPE 2 DIABETES MELLITUS AND NON-ALCOHOLIC FATTY LIVER DISEASE.....	152-157
Lingzhi Bao, Jie Ma. NAVIGATING AI IN MEDICAL EDUCATION: A NARRATIVE REVIEW OF APPLICATIONS, CHALLENGES, AND FUTURE STRATEGIES.....	158-166
Mukasheva Gulbarshyn, Seitmaganbetova Indira, Kurmangali Zhanar K. SOCIODEMOGRAPHIC DETERMINANTS OF PRENATAL CARE ACCESS AMONG PREGNANT WOMEN IN THE MANGYSTAU REGION: A CROSS-SECTIONAL STUDY.....	167-173
Sultan M. Siham, Ali L. Jasim, Amar K. Almajidy. INVESTIGATING THE PERSPECTIVES OF RESPIRATORY PHYSICIANS ON HOW SOCIAL DETERMINANTS OF HEALTH AND HEALTH LITERACY INFLUENCE ASTHMA OUTCOMES: A QUALITATIVE STUDY.....	174-178
Datumyan G.S, Sargsyan M.V, Shaboyan K.R, Hovhannisyan M.E, Sahakyan K.M, Muradyan A.A, Hakobyan A.I, Hovhannisyan H.V. SEVERE UPPER EXTREMITY CRUSH SYNDROME IN A NON-DISASTER SETTING: A CASE REPORT OF SUCCESSFUL MULTIMODAL MANAGEMENT WITH COMPLETE RENAL RECOVERY.....	179-184
Tea Chitadze. TEMPORAL DYNAMICS OF GLOBAL LONGITUDINAL STRAIN AND NT-PROBNP IN THE EARLY DETECTION OF ANTHRACYCLINE-INDUCED CARDIOTOXICITY: A 24-MONTH PROSPECTIVE STUDY IN POSTMENOPAUSAL WOMEN WITH BREASTCANCER.....	185-197
Bodnar-Petrovska O.B, Verenkiotova O.V, Petrovskiy A.V, Krykun V.V, Batryn O.V, Ivakhnenko O.A. COMPARATIVE ANALYSIS OF MATERNAL AND CHILD HEALTH CARE IN THE MEMBER STATES OF THE EUROPEAN UNI ON.....	198-208
Gulbarshyn Mukasheva, Tolkyun Bulegenov, Indira Seitmaganbetova, Aigul Tugelbayeva, Meruyert Malik. QUALITY OF LIFE AMONG YOUNG ADULT PATIENTS WITH CARDIOVASCULAR DISEASE.....	209-215
Marina Zhorobekova, Salima Nayzabekova, Dinara Alieva, Saikal Melisova. MEDICAL AND SOCIAL REHABILITATION OF ELDERLY PATIENTS WITH POST-COVID SYNDROME AND COPD: THE EXPERIENCE OF KYRGYZSTAN.....	216-224
Davit Chakvetadze, Otar Darjanian. PREVALENCE, RISK FACTORS, AND STRUCTURAL CHARACTERISTICS OF DENTOALVEOLAR ANOMALIES IN THE SCHOOL- AGED POPULATION OF KUTAISI.....	225-232
Kurmangaliyeva Klara, Shlymova Raikhan, Askarova Karashash, Darybayeva Aisha, Kazangapova Assem, Sagyndykova Gulnur, Yeshmagambetova Zhanna, Akhmedyarova Elmira. EFFECTIVENESS OF PLASMA EXCHANGE IN THE THERAPY OF DRUG-INDUCED HEPATITIS IN PATIENTS WITH PULMONARY TUBERCULOSIS AND CHRONIC VIRAL HEPATITIS B AND C.....	233-242
Matitaishvili T, Domianidze T, Burjanadze G, Shengelia M, Menteshashvili N. EFFECTS OF LONG-TERM SOCIAL ISOLATION ON MEMORY AND DEPRESSIVE-LIKE BEHAVIOR IN RATS OF DIFFERENT SOCIAL STATUS.....	243-248
Svetlana Trofimova, Aruzhan Mendybayeva, Irina Izbassarova, Aida Bokayeva, Aliya Aituganova. DIFFERENTIAL DIAGNOSIS CHALLENGES OF PULMONARY SARCOIDOSIS IN PRIMARY CARE PRACTICE: THE ROLE OF MULTIDISCIPLINARY AND PERSONALIZED APPROACHES.....	249-254
Farman K. Rafeeq, Zeina A. Al-Thanoon. THE POTENTIAL HEPATOPROTECTIVE EFFECT OF PALMITOLEIC ACID AGAINST KETAMINE-INDUCED LIVER INJURY IN RATS: OXIDATIVE, INFLAMMATORY, AND HISTOPATHOLOGICAL EVALUATION.....	255-261
Zakharov Oleg B, Vasileva Anastasiya A, Idiatullin Ravil M, Maslov Vladimir G, Malashikhina Alyona V, Solomonov Sergei A, Falicheva Anastasiia O, Ruchkina Kseniia A, Popov Vasilii V, Litiuk Daria V, Oshchipok Damir D, Tarusina Viktoriia M, Kulbyakova Maria L, Saryeva Albina R, Torba Danil G, Korotkova Sofia E, Sakharova Viktoriya S, Mamutova Zeyneb M, Yaksun Vasilisa S, Suvorova Sofia M. BEYOND CONTRACTILITY: PHENOTYPIC SWITCHING OF VASCULAR SMOOTH MUSCLE CELLS IN ATHEROSCLEROSIS.....	262-269
A.V. Podobed, V.P. Kurchyn, I. Kobidze. VIDEO-ASSISTED THORACOSCOPIC RESECTION OF THE LEFT BRACHIOCEPHALIC AND SUPERIOR VENA CAVA FOR PRIMARY AND RECURRENT THYMIC TUMORS.....	270-275
Fadia Thamir Ahmed. ASSESSMENT OF MELATONIN USE PATTERNS, SAFETY, AND ATTITUDES TOWARD ITS USE IN ADULT POPULATION.....	276-281
Daniel Godoy-Monzon, Patricio Telesca, Jose Manuel Pascual Espinosa. MID-TERM CLINICAL AND RADIOLOGICAL OUTCOMES OF SHORT-STEM VERSUS CONVENTIONAL-STEM TOTAL HIP ARTHROPLASTY IN PATIENTS WITH OSTEONECROSIS OF THE FEMORAL HEAD: A PROSPECTIVE CASE-CONTROL STU DY.....	282-287

## MEDICAL AND SOCIAL REHABILITATION OF ELDERLY PATIENTS WITH POST-COVID SYNDROME AND COPD: THE EXPERIENCE OF KYRGYZSTAN

Marina Zhorobekova\*, Salima Nayzabekova, Dinara Alieva, Saikal Melisova.

*International University of Kyrgyzstan, Bishkek, Kyrgyzstan.*

### Abstract.

**Aim of study:** The coexistence of chronic obstructive pulmonary disease (COPD) and post-COVID syndrome presents significant clinical and social challenges, particularly among elderly populations in geographically diverse countries such as Kyrgyzstan. This study evaluates medical and social rehabilitation strategies for elderly patients with these conditions, with special emphasis on differences between urban and high-altitude regions.

**Materials and methods:** A mixed-methods approach was employed, combining clinical assessments, spirometry, biomarker analysis (IL-6, TNF- $\alpha$ , CRP), patient-reported outcomes, and semi-structured interviews. The study included a total of 150 participants aged 60 years and older, recruited from urban (Bishkek) and high-altitude (Naryn) regions. Participants were distributed into four groups: COPD (n=35), post-COVID syndrome (n=40), COPD with post-COVID syndrome (n=45), and a control group (n=30). Results demonstrated that patients with both COPD and post-COVID syndrome exhibited the highest inflammatory marker levels, severe lung function decline (average FEV1 48.5% predicted), and greater functional limitations, including mobility impairment and severe dyspnea. **Results:** High-altitude patients experienced lower oxygen saturation, elevated inflammation, and higher fatigue scores, reflecting the additional burden of chronic hypoxia. Rehabilitation outcomes were more favorable in urban settings, where specialized services and oxygen therapy were more accessible. **Conclusions:** The findings emphasize the urgent need for tailored rehabilitation strategies, including altitude-adapted pulmonary rehabilitation, anti-inflammatory therapies, telemedicine, and expanded home-based oxygen care. Strengthening healthcare infra-structure and addressing regional disparities are critical for improving outcomes and quality of life in this vulnerable population.

**Key words.** COPD, post-COVID syndrome, rehabilitation, high-altitude medicine, elderly patients.

### Introduction.

Chronic obstructive pulmonary disease (COPD) and post-COVID syndrome have become major health challenges among the elderly, significantly impacting their quality of life and increasing the burden on healthcare systems worldwide [1]. COPD is a progressive lung disease characterized by persistent airflow limitation, chronic inflammation, and recurrent exacerbations that lead to gradual respiratory decline [2]. Post-COVID syndrome, also known as long COVID, is a condition in which patients continue to experience symptoms such as dyspnea, fatigue, and cognitive dysfunction long after the acute phase of the SARS-CoV-2 infection [3]. When these two conditions coexist in elderly patients, they create a complex clinical scenario requiring specialized rehabilitation strategies.

In Kyrgyzstan, the prevalence of COPD among elderly individuals is rising due to factors such as high rates of tobacco use, environmental pollution, and frequent exposure to respiratory infections. Furthermore, a significant portion of the population lives in high-altitude regions, where chronic hypoxia exacerbates pulmonary dysfunction and contributes to immune dysregulation [4]. These geographical and socio-economic conditions make the rehabilitation of elderly COPD and post-COVID patients particularly challenging, necessitating a tailored approach to medical and social support.

Rehabilitation of elderly patients with COPD and post-COVID syndrome involves a multidisciplinary approach that includes pulmonary rehabilitation, physiotherapy, oxygen therapy, and psychological support [5]. The World Health Organization (WHO) emphasizes the importance of community-based rehabilitation programs that integrate medical care with social support, ensuring that elderly patients receive holistic treatment to improve their functional status and independence [6]. However, in countries like Kyrgyzstan, access to specialized rehabilitation services remains limited, particularly in rural and high-altitude areas, highlighting the need for an evaluation of existing rehabilitation programs and the development of new strategies.

This study aims to analyze the medical and social rehabilitation of elderly patients with COPD and post-COVID syndrome in Kyrgyzstan, focusing on the effectiveness of rehabilitation programs in both urban and high-altitude regions. The research examines the role of primary healthcare providers, rehabilitation centers, and social support systems in facilitating recovery and improving patients' quality of life. Additionally, the study explores the impact of high-altitude conditions on respiratory function and immune response, emphasizing the need for adapted rehabilitation protocols in these environments. By identifying the strengths and weaknesses of current rehabilitation services, this research seeks to provide recommendations for optimizing medical and social support for this vulnerable population.

### Methods.

This study employs a mixed-methods approach, combining qualitative and quantitative research methods to assess the medical and social rehabilitation of elderly patients with COPD and post-COVID syndrome in Kyrgyzstan. The research includes a literature review, patient surveys, clinical assessments, and expert interviews to evaluate rehabilitation strategies, identify barriers, and propose improvements in the healthcare system.

The study was conducted in two regions of Kyrgyzstan: the capital city Bishkek, representing an urban healthcare setting, and the Naryn region, representing a high-altitude environment. The study population was additionally stratified by altitude of residence (low-altitude: Bishkek; high-altitude: Naryn). Clinical groups (COPD, post-COVID syndrome, COPD + post-COVID

syndrome, and control) were present in both altitude strata, allowing comparative analysis of environmental and disease-related factors.

The study was carried out in Bishkek and in the Naryn region. For the analysis, 150 participants aged 60 years and older were included. The patient sample consisted of three clinical groups: COPD (n=35), post-COVID syndrome (n=40), and COPD with post-COVID syndrome (n=45). In addition, 30 older adults without COPD or persistent post-COVID symptoms were included as a comparison group. Control participants were matched by age and geographic region with patient groups.

The control participants were recruited from the same two study areas as the patient groups: Bishkek (n=15) and the Naryn region (n=15). All control participants were aged 60 years or older. None of them had a previous diagnosis of COPD, airflow obstruction on spirometry, or symptoms lasting more than three months after COVID-19. The control group was used as a reference group for inflammatory markers, spirometry results, and symptom scores.

COPD was defined by spirometric evidence of airflow obstruction. Post-COVID syndrome was defined as persistent respiratory or systemic symptoms for more than three months after documented COVID-19. Participants with acute respiratory infection at the time of examination, advanced malignancy, current immunosuppressive treatment, or severe non-respiratory disease that could affect the study outcomes were not included [2, 5].

Data were collected using standardized clinical assessments, blood tests, pulmonary function tests, and patient-reported outcomes.

#### **Pulmonary Function Tests:**

Spirometry was used to measure forced expiratory volume in one second and forced vital capacity. The ratio of these parameters was analyzed to assess airflow limitation and lung function decline. Pulse oximetry was performed to evaluate oxygen saturation levels, particularly in high-altitude patients, where chronic hypoxia may influence rehabilitation outcomes [4].

#### **Inflammatory Biomarkers:**

Blood samples were collected to analyze inflammatory cytokine levels, including interleukin-6 and tumor necrosis factor-alpha. These biomarkers were used to assess the degree of systemic inflammation and immune dysregulation in different patient groups [7,8].

#### **Patient-Reported Outcomes:**

Standardized questionnaires, including the COPD Assessment Test and the Modified Medical Research Council Dyspnea Scale, were administered to assess symptom burden, functional limitations, and quality of life. The Fatigue Severity Scale was used to measure fatigue levels, a common symptom in both COPD and post-COVID patients [3].

#### **Social and Psychological Support Assessment:**

Semi-structured interviews were conducted with patients, caregivers, and healthcare providers to assess the availability and effectiveness of rehabilitation programs, social support networks, and psychological counseling. Special attention was

given to the role of family support, accessibility of rehabilitation centers, and financial barriers to treatment [6].

#### **Comparison of Rehabilitation Approaches:**

Rehabilitation programs in urban and high-altitude settings were compared to evaluate differences in healthcare access, treatment adherence, and patient outcomes. The study assessed clinical and functional status of patients receiving routine rehabilitation care without a structured interventional program. The analysis focused on cross-sectional differences between groups [9].

Descriptive statistics (mean  $\pm$  standard deviation) were used to summarize data. Between-group comparisons were performed using t-tests and chi-square tests as appropriate. Descriptive statistics (mean  $\pm$  standard deviation) were used to summarize data. Between-group comparisons were performed using independent t-tests and chi-square tests as appropriate. Regression analysis was initially planned to explore predictors of rehabilitation outcomes; however, the present study primarily reports cross-sectional group comparisons and correlation analyses [10].

Qualitative data from interviews were transcribed and analyzed thematically. Key themes related to rehabilitation accessibility, barriers to care, and patient satisfaction were identified and categorized. Thematic analysis was used to extract insights into the social and psychological aspects of rehabilitation [11].

The study was conducted in accordance with ethical guidelines for human research. Ethical approval was obtained from the institutional review board of the participating healthcare institutions. Written informed consent was obtained from all participants before enrollment in the study. Confidentiality and anonymity were maintained throughout data collection and analysis [6].

This study has certain limitations, including a relatively small sample size and its focus on a specific geographical region, which may limit the generalizability of the findings. Additionally, the long-term impact of rehabilitation programs requires further longitudinal studies to assess sustained benefits over time [12].

#### **Results.**

This section presents the findings of the study, including differences in immune response, pulmonary function, and rehabilitation outcomes among elderly patients with COPD and post-COVID syndrome. The results are structured into three main subsections: immune and inflammatory markers, pulmonary function decline, and the impact of high-altitude conditions on rehabilitation outcomes.

#### **Changes in Immune Markers and Inflammation Levels:**

Chronic obstructive pulmonary disease (COPD) and post-COVID syndrome are both characterized by persistent systemic inflammation, which plays a crucial role in disease progression and symptom severity. In this study, blood analysis revealed marked elevations in key inflammatory cytokines among patients with COPD, post-COVID syndrome, and those with both conditions. The inflammatory response was most pronounced in patients suffering from both diseases, indicating that chronic lung disease and post-viral immune dysregulation create a synergistic effect leading to more severe inflammation and immune impairment [5].

Among the analyzed inflammatory markers, interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF- $\alpha$ ) were found to be significantly elevated in all patient groups compared to the control group. These cytokines play a pivotal role in sustaining chronic inflammation, oxidative stress, and immune system dysregulation, contributing to lung function deterioration. Elevated C-reactive protein (CRP) levels, a marker of systemic inflammation, further confirmed the heightened immune activation in COPD and post-COVID patients [1].

Descriptive comparative analysis was used to evaluate differences between study groups. Continuous variables are presented as mean  $\pm$  standard deviation, while categorical variables are expressed as percentages. The analysis revealed consistent between-group variations across inflammatory markers, pulmonary function parameters, and functional outcomes. A clear gradient of worsening clinical status was observed from the control group to COPD, post-COVID, and COPD with post-COVID syndrome groups.

The observed differences across groups demonstrate a consistent pattern of disease severity progression. Patients with combined COPD and post-COVID syndrome consistently exhibited the highest levels of inflammatory markers and the most severe impairment in pulmonary function and functional status, compared to single-disease and control groups.

- As shown in Table 1, IL-6 levels were significantly elevated in all diseased groups, with the highest values observed in COPD + post-COVID patients ( $12.4 \pm 3.2$  pg/mL). IL-6 is a key pro-inflammatory cytokine that promotes chronic inflammation and has been directly linked to pulmonary fibrosis and lung function decline in both COPD and post-COVID syndrome [8].
- TNF- $\alpha$  levels, another crucial marker of inflammatory response and immune dysregulation, were also notably increased, particularly in COPD + post-COVID patients ( $8.1 \pm 2.4$  pg/mL). TNF- $\alpha$  is known to induce airway remodeling and worsen alveolar damage, contributing to respiratory distress.
- CRP levels, a nonspecific inflammatory marker, were highest in the COPD + post-COVID group ( $11.3 \pm 3.7$  mg/L), reflecting widespread systemic inflammation. Elevated CRP is associated with higher exacerbation rates and more frequent hospitalizations among COPD patients, and post-COVID syndrome appears to exacerbate this inflammatory state [7].

In addition to increased pro-inflammatory cytokines, lymphocyte counts were significantly reduced in COPD and post-COVID patients, particularly in the combined COPD + post-COVID group ( $20.9 \pm 3.5\%$ ).

- Lymphopenia (low lymphocyte count) is a hallmark of immune exhaustion, commonly observed in chronic inflammatory diseases and post-viral syndromes.
- A lower percentage of lymphocytes is linked to weakened adaptive immunity, making patients more vulnerable to secondary infections and exacerbations [3].
- The reduction in lymphocytes is believed to be driven by chronic immune activation, oxidative stress, and excessive TNF- $\alpha$  and IL-6 signaling, which promote apoptosis (programmed cell death) of immune cells [4].

To investigate the relationship between inflammation and respiratory impairment, a correlation analysis was performed between IL-6 levels and FEV1 (% predicted) (see Figure 1).

- Higher IL-6 levels were associated with lower FEV1 values, indicating that increased systemic inflammation contributes to lung function decline.
- Patients with IL-6 levels above 10 pg/mL exhibited an average FEV1 of 50% predicted, compared to 92% in the control group.
- The steepest decline in lung function was observed in COPD + post-COVID patients, who exhibited both high IL-6 levels and low FEV1 values.

These results reinforce previous findings that persistent immune activation and chronic inflammation play a central role in pulmonary deterioration in COPD and post-COVID patients [9].

The observed increase in IL-6, TNF- $\alpha$ , and CRP, combined with lymphopenia, suggests that COPD and post-COVID patients experience a sustained inflammatory response that worsens respiratory symptoms and accelerates disease progression.

- Persistent inflammation may contribute to increased frequency and severity of exacerbations, particularly in high-risk patients with both COPD and post-COVID syndrome [5].
- Elevated IL-6 and CRP levels may serve as biomarkers to predict disease progression and treatment response, helping clinicians tailor personalized rehabilitation programs.
- Lymphopenia may indicate immune exhaustion, suggesting that immunomodulatory therapies could play a role in improving outcomes for these patients [11].

Future research should focus on targeted anti-inflammatory therapies to mitigate the long-term impact of immune dysregulation and chronic inflammation in COPD and post-COVID patients.

#### Summary of Key Findings:

1. Patients with COPD and post-COVID syndrome exhibit significantly elevated levels of IL-6, TNF- $\alpha$ , and CRP, reflecting chronic systemic inflammation.
2. The highest inflammatory marker levels were observed in the combined COPD + post-COVID group, indicating a compounding effect of these conditions.
3. Lymphopenia was present in all diseased groups, particularly in the COPD + post-COVID group, suggesting immune exhaustion and increased susceptibility to infections.
4. Higher IL-6 levels were inversely correlated with FEV1, confirming that systemic inflammation contributes to lung function decline.
5. Elevated inflammatory markers may serve as predictive biomarkers for disease progression, helping guide personalized rehabilitation and treatment strategies.

#### Pulmonary Function Decline in COPD and Post-COVID Patients:

Pulmonary function decline is a hallmark of COPD and is further exacerbated in patients suffering from post-COVID syndrome. The combined impact of these conditions results in significant respiratory impairment, characterized by reduced airflow, increased airway resistance, and greater functional

limitations. The following section presents spirometry findings that demonstrate the severity of lung function deterioration in affected individuals.

Pulmonary function tests (PFTs) revealed a significant decline in FEV1, FVC, and the FEV1/FVC ratio among COPD and post-COVID patients. The most severe deterioration was observed in individuals diagnosed with both COPD and post-COVID syndrome, with FEV1 values dropping below 50% of the predicted norm. This severe airflow limitation suggests progressive lung damage, heightened airway obstruction, and greater respiratory distress.

FEV1, which measures the volume of air forcibly exhaled in one second, was significantly lower in COPD + post-COVID patients compared to those in the COPD-only or post-COVID-only groups (see Table 2). This indicates a greater degree of airway obstruction, suggesting that post-COVID syndrome may accelerate lung function decline in individuals with pre-existing respiratory disease.

FVC, representing total lung capacity, was also notably reduced in COPD and post-COVID patients. A decline in FVC suggests restrictive changes in lung mechanics, possibly due to fibrosis or persistent inflammation affecting lung elasticity.

**Table 1.** Inflammatory marker levels in study groups.

Group	IL-6 (pg/mL)	TNF- $\alpha$ (pg/mL)	CRP (mg/L)	Lymphocyte Count (%)
Control (n=30)	2.3 $\pm$ 0.8	1.5 $\pm$ 0.6	3.2 $\pm$ 1.1	32.8 $\pm$ 4.2
COPD (n=35)	8.7 $\pm$ 2.1	6.3 $\pm$ 1.8	7.9 $\pm$ 2.5	24.6 $\pm$ 3.8
Post-COVID (n=40)	9.2 $\pm$ 1.9	5.7 $\pm$ 1.6	8.1 $\pm$ 2.3	26.4 $\pm$ 4.1
COPD + Post-COVID (n=45)	12.4 $\pm$ 3.2	8.1 $\pm$ 2.4	11.3 $\pm$ 3.7	20.9 $\pm$ 3.5

Note: Data presented as mean  $\pm$  standard deviation.

**Table 2.** Pulmonary function test results.

Group	FEV1 (% predicted)	FVC (% predicted)	FEV1/FVC Ratio (%)
Control (n=30)	92.4 $\pm$ 5.6	95.2 $\pm$ 4.8	78.3 $\pm$ 3.2
COPD (n=35)	55.7 $\pm$ 8.3	67.9 $\pm$ 7.1	63.1 $\pm$ 4.6
Post-COVID (n=40)	61.2 $\pm$ 7.5	72.1 $\pm$ 6.4	68.9 $\pm$ 3.8
COPD + Post-COVID (n=45)	48.5 $\pm$ 6.9	58.6 $\pm$ 5.7	54.7 $\pm$ 5.2

Note: Data presented as mean  $\pm$  standard deviation

**Table 3.** Functional limitations and dyspnea severity by group.

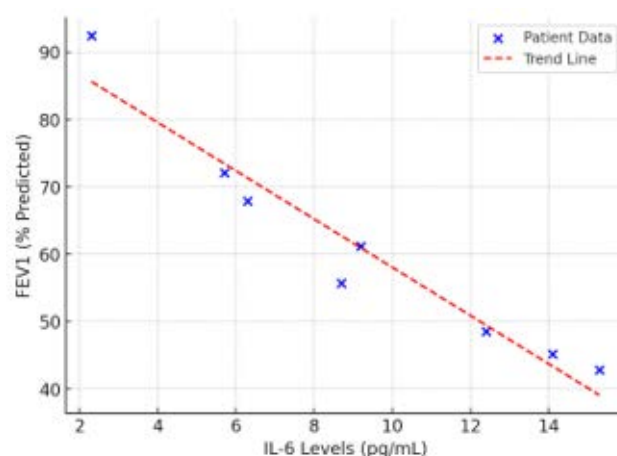
Group	Severe Dyspnea (mMRC $\geq$ 3) (%)	Dyspnea at Rest (%)	Severe Mobility Impairment (%)
Control (n=30)	3%	0%	0%
COPD (n=35)	58%	22%	45%
Post-COVID (n=40)	49%	19%	37%
COPD + Post-COVID (n=45)	73%	45%	70%

Note: Data presented as mean  $\pm$  standard deviation.

**Table 4.** Functional limitations and dyspnea severity by group.

Altitude	Oxygen Saturation (%)	IL-6 (pg/mL)	FEV1 (% of predicted)	Fatigue Score (1-10)
Low-altitude (n=50)	96.1 $\pm$ 1.2	8.9 $\pm$ 2.4	78.4 $\pm$ 5.6	5.1 $\pm$ 1.3
High-altitude (n=50)	91.3 $\pm$ 2.8	12.6 $\pm$ 3.1	72.2 $\pm$ 6.3	7.8 $\pm$ 1.9

Note: Data presented as mean  $\pm$  standard deviation



**Figure 1.** Correlation between IL-6 levels and FEV1 decline.

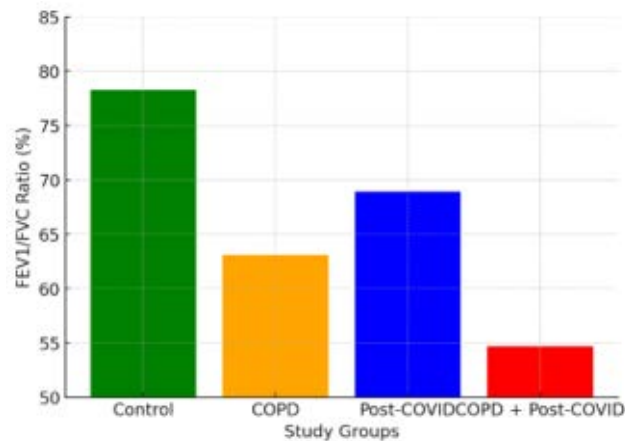


Figure 2. Comparison of FEV1/FVC ratio among study groups.

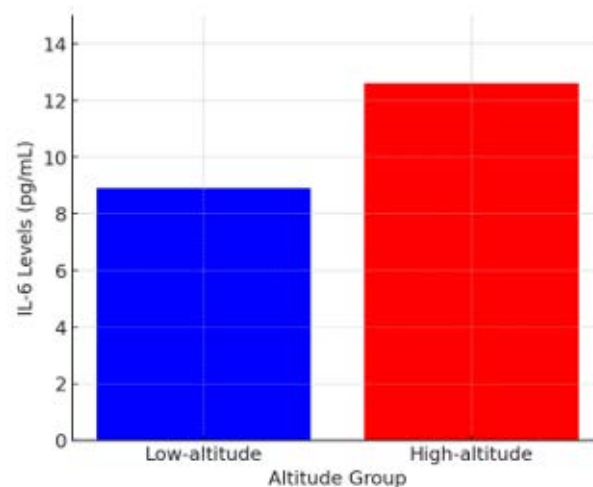


Figure 3. IL-6 Levels in low-altitude vs. high-altitude patients.

The FEV1/FVC ratio, a critical indicator of airflow limitation, was lowest in the COPD + post-COVID group, falling to 54.7%, well below the threshold for moderate to severe obstructive lung disease. This suggests that patients with both conditions experience a greater degree of airway collapse and ventilation inefficiency.

As shown in the Figure 2, the decline in pulmonary function was strongly correlated with worsening respiratory symptoms, particularly dyspnea and functional limitations. Patients with both COPD and post-COVID syndrome reported the highest severity of breathlessness, with many experiencing dyspnea even at rest or during minimal exertion [3].

The Modified Medical Research Council (mMRC) Dyspnea Scale was used to assess the severity of breathlessness among patients. The results revealed that:

- Seventy-three percent of COPD + post-COVID patients reported severe dyspnea (mMRC grade 3 or higher), significantly more than those in the COPD-only (58%) or post-COVID-only (49%) groups.
- Forty-five percent of COPD + post-COVID patients reported dyspnea at rest, indicating severe impairment of respiratory function.
- Patients with higher IL-6 and TNF- $\alpha$  levels had the highest dyspnea scores, suggesting that systemic inflammation

contributes to worsening breathlessness and pulmonary decline [5].

The decline in lung function translated into significant impairments in physical activity and daily living tasks.

- Over seventy percent of COPD + post-COVID patients had severe limitations in activities such as walking, climbing stairs, and performing household chores.
- Fifty-two percent of COPD + post-COVID patients required assistive devices (such as walkers or canes) due to extreme exercise intolerance.
- Patients with lower FEV1 values were significantly more likely to report reduced mobility and dependence on caregivers, emphasizing the role of lung function in maintaining independence [9].

A key finding of this study is that post-COVID syndrome appears to exacerbate pre-existing COPD-related lung function decline, as presented in Table 3. Patients with COPD and a history of severe COVID-19 infection had significantly worse spirometry results than those who had COPD alone.

- COPD patients with a history of severe COVID-19 had an FEV1 decline of an additional 5-10% compared to those without COVID-19 exposure.
- FEV1 decline was more pronounced in patients with persistent post-COVID symptoms such as fatigue, chronic

cough, and pulmonary fibrosis-like changes observed on CT scans [12].

- Persistent inflammation and immune dysregulation may contribute to accelerated lung function deterioration, leading to more frequent COPD exacerbations [10].

#### **Summary of Key Findings:**

- Pulmonary function tests (PFTs) showed significant FEV1 and FVC reductions in COPD and post-COVID patients, with the greatest impairment in those with both conditions.
- The lowest FEV1 values were recorded in COPD + post-COVID patients, with an average FEV1 of 48.5% predicted, indicating severe airflow obstruction.
- Dyspnea was significantly more severe in COPD + post-COVID patients, with 73% reporting mMRC grade  $\geq 3$  and 45% experiencing dyspnea at rest.
- Over 70% of COPD + post-COVID patients reported severe mobility impairments, affecting their ability to perform daily tasks and maintain independence.
- Post-COVID syndrome appears to exacerbate lung function decline in COPD patients, particularly in those with a history of severe COVID-19 infection.

#### **Impact of High-Altitude Conditions on Immune Response and Pulmonary Function:**

High-altitude environments present unique physiological challenges, particularly for elderly patients with pre-existing respiratory conditions such as COPD and post-COVID syndrome. The reduced oxygen availability at elevations above 2000 meters leads to chronic hypoxia, which can trigger systemic inflammation, oxidative stress, and impaired pulmonary function. This section examines the effects of high-altitude living on oxygen saturation, inflammatory markers, and lung function decline, as well as the challenges associated with rehabilitation in these conditions.

Blood oxygen saturation is a critical measure of pulmonary efficiency, reflecting the ability of the lungs to deliver oxygen to the bloodstream. Patients residing in high-altitude regions exhibited significantly lower oxygen saturation levels, indicating chronic hypoxemia.

In addition, IL-6 levels were substantially elevated in high-altitude patients, suggesting a persistent inflammatory response that could contribute to increased disease severity and exacerbation risk in COPD and post-COVID patients.

Comparative descriptive analysis of altitude groups demonstrated noticeable differences in oxygen saturation, inflammatory markers, pulmonary function, and fatigue scores. Patients living at high altitude showed a consistent pattern of reduced oxygenation and increased inflammatory burden compared to low-altitude residents.

We see in Table 4 that oxygen saturation was significantly lower in high-altitude patients, suggesting that chronic exposure to lower atmospheric oxygen levels results in sustained hypoxemia. IL-6 levels were markedly elevated in high-altitude patients, indicating an ongoing inflammatory response (see Figure 3). Hypoxia is known to stimulate inflammatory pathways, further worsening systemic inflammation. FEV1 values were lower in high-altitude residents, suggesting an additional decline in lung function due to chronic oxygen deprivation. Fatigue scores

were significantly higher in high-altitude patients, reinforcing the link between chronic hypoxia, inflammation, and reduced energy levels.

These findings indicate that high-altitude conditions exacerbate both pulmonary dysfunction and systemic inflammation in patients with COPD and post-COVID syndrome. The combination of chronic hypoxia and inflammation may accelerate lung tissue damage, increase the frequency of exacerbations, and contribute to progressive respiratory failure in this vulnerable population.

Managing COPD and post-COVID syndrome in high-altitude environments presents significant challenges, particularly regarding symptom control, treatment access, and rehabilitation options. Patients in these regions face a combination of environmental, medical, and logistical barriers that hinder their ability to manage their condition effectively.

#### **Increased Respiratory Distress and Exacerbations.**

- High-altitude patients reported significantly more frequent episodes of dyspnea and respiratory distress than those living at lower elevations.
- The incidence of COPD exacerbations was higher in high-altitude patients, likely due to hypoxia-induced pulmonary vasoconstriction, which can increase right heart strain and worsen ventilation-perfusion mismatch.
- Patients with both COPD and post-COVID syndrome exhibited the worst outcomes, with a higher frequency of hospital admissions and greater reliance on supplemental oxygen therapy compared to lower-altitude counterparts.

#### **Limited Access to Specialized Rehabilitation Centers.**

- Many high-altitude communities lack access to pulmonary rehabilitation programs, which are essential for improving lung function, exercise tolerance, and quality of life in COPD and post-COVID patients.
- Travel to urban medical centers is often difficult for elderly patients, leading to delays in receiving specialized respiratory care, physiotherapy, and long-term disease management strategies.
- Availability of trained rehabilitation specialists is lower in high-altitude areas, reducing access to integrated care programs that combine medical, physical, and psychological support for patients.

#### **Increased Need for Oxygen Therapy and Home-Based Care.**

- Due to chronic hypoxia, oxygen therapy was more frequently required in high-altitude patients, particularly among those with severe COPD or post-COVID lung complications.
- Portable oxygen concentrators were in high demand among patients living above 2000 meters, with many requiring continuous low-flow oxygen supplementation to prevent desaturation.
- Home-based rehabilitation programs may be necessary for these patients, given the challenges of traveling to distant healthcare facilities for routine therapy and follow-ups.

The findings of this study highlight the need for tailored rehabilitation approaches for COPD and post-COVID patients residing at high altitudes. The unique environmental stressors in

these regions require adaptive strategies to mitigate the effects of chronic hypoxia, improve oxygenation, and enhance overall patient outcomes.

#### **Key recommendations include:**

- Expansion of pulmonary rehabilitation services in high-altitude areas to improve accessibility to structured exercise programs, breathing techniques, and physiotherapy interventions.
- Implementation of telemedicine and remote monitoring programs to provide ongoing medical support to patients who face barriers to in-person care.
- Increased availability of home-based oxygen therapy to support patients with chronic hypoxemia and prevent exacerbations.
- Further research into hypoxia-related inflammation and its long-term impact on lung function decline in high-altitude COPD and post-COVID patients.

#### **Summary of Key Findings:**

- High-altitude COPD and post-COVID patients had lower oxygen saturation levels and higher IL-6 levels, suggesting worsened hypoxia-induced inflammation.
- FEV1 values were significantly lower in high-altitude patients, indicating a greater decline in pulmonary function.
- Fatigue scores were significantly higher in high-altitude patients, suggesting a link between chronic hypoxia, inflammation, and reduced energy levels.
- Respiratory distress was more frequent in high-altitude patients, particularly those with both COPD and post-COVID syndrome, leading to higher exacerbation rates and hospitalizations.
- Limited access to specialized rehabilitation programs posed challenges for managing chronic lung disease in high-altitude areas.
- Oxygen therapy was more frequently required in high-altitude patients due to persistent hypoxemia and increased breathing difficulties.

#### **Discussion.**

This study provides important insights into the effects of post-COVID syndrome and COPD on pulmonary function, immune response, and rehabilitation challenges, particularly in high-altitude environments. The findings highlight the significant impact of systemic inflammation, immune dysregulation, and chronic hypoxia on lung function decline and overall health in elderly patients.

The obtained data are consistent with findings from other high-altitude populations. A recent cross-sectional study in Peru among workers with intermittent high-altitude exposure (3,400 m) and COVID-19 history revealed that 72.2% exhibited spirometric abnormalities, with severe COVID-19, prolonged high-altitude exposure ( $\geq 7$  years), and higher comorbidity burden as independent predictors of spirometric alterations [13]. This aligns with our observation that high-altitude patients experienced more pronounced functional limitations and elevated inflammatory markers. Furthermore, clinical observations from Bolivia emphasize that altitude-specific physiological adaptations must be considered when evaluating pulmonary

function, particularly in patients with overlapping hypoxic conditions such as post-COVID syndrome [14]. The Bolivian experience confirms that chronic hypoxia-related immune dysregulation requires specialized approaches to rehabilitation in high-altitude residents. Regarding rehabilitation strategies, our findings are consistent with research conducted in the High Tatras mountain region (760–1,067 m), where climatotherapy combined with structured pulmonary rehabilitation significantly improved FEV1, exercise capacity (6-MWT), and quality of life in COPD patients [15]. These comparative findings suggest that the challenges observed in Kyrgyzstan reflect broader patterns in high-altitude populations globally, underscoring the need for region-specific approaches to post-COVID and COPD management in mountainous areas.

One of the most striking findings of this study is the elevated levels of inflammatory markers, particularly IL-6, TNF- $\alpha$ , and CRP, in COPD and post-COVID patients. The highest levels were observed in patients with both conditions, suggesting a compounding effect of chronic inflammation and post-viral immune dysregulation.

Inflammation plays a central role in COPD pathophysiology, contributing to airway remodeling, increased mucus production, and progressive airflow limitation [1]. Post-COVID syndrome appears to exacerbate this process by inducing a prolonged immune response, which can lead to further tissue damage, fibrosis, and reduced pulmonary function [3].

The inverse correlation between IL-6 levels and FEV1 suggests that higher systemic inflammation is directly associated with worsening lung function. This supports previous research indicating that IL-6 is not only a marker of disease severity but also an active contributor to pulmonary dysfunction in both COPD and post-COVID patients [5].

Given these findings, anti-inflammatory interventions may play a crucial role in disease management. Targeted therapies aimed at reducing IL-6 and TNF- $\alpha$  levels, such as monoclonal antibodies and corticosteroids, could potentially mitigate disease progression and improve lung function in this vulnerable population [8].

The results confirm that post-COVID syndrome significantly worsens lung function in COPD patients, with FEV1 values declining more steeply in individuals who had a severe COVID-19 infection. This aligns with existing literature suggesting that long-term pulmonary impairment in COVID-19 survivors is due to persistent inflammation, vascular damage, and lung fibrosis [12].

Furthermore, patients with post-COVID syndrome reported higher fatigue scores, increased dyspnea, and greater functional limitations, which may be attributed to residual lung damage and immune dysregulation [9]. This suggests that post-COVID patients with pre-existing respiratory diseases require longer rehabilitation programs and more intensive respiratory therapy compared to those with COPD alone.

These findings underscore the importance of early pulmonary rehabilitation and continuous monitoring of lung function in post-COVID patients. Rehabilitation programs focusing on breathing exercises, physical conditioning, and inflammation control could help mitigate the long-term impact of post-COVID syndrome on respiratory health [10].

The study also highlights the negative impact of chronic hypoxia at high altitudes on pulmonary function and immune response. Patients living in high-altitude environments exhibited lower oxygen saturation, higher IL-6 levels, and more severe lung function decline compared to those living at lower elevations.

Hypoxia is known to increase inflammation by stimulating pro-inflammatory cytokine production and oxidative stress [4]. This may explain why COPD and post-COVID patients living at high altitudes had worse outcomes, including higher rates of respiratory distress and fatigue.

The significant reduction in FEV1 and FVC in high-altitude patients suggests that chronic exposure to low oxygen levels accelerates lung function deterioration. This is consistent with previous studies demonstrating that hypoxic environments contribute to pulmonary hypertension, increased airway resistance, and higher exacerbation rates in COPD patients [11].

These findings emphasize the need for adaptive rehabilitation strategies for patients residing in high-altitude regions. Oxygen therapy, altitude-adjusted pulmonary rehabilitation, and anti-inflammatory treatments could help counteract the detrimental effects of chronic hypoxia on lung function [16].

The study also identifies several barriers to effective rehabilitation, particularly for patients in high-altitude regions. Limited access to pulmonary rehabilitation centers, lack of trained specialists, and logistical difficulties in reaching urban healthcare facilities pose significant challenges for these patients.

Additionally, many COPD and post-COVID patients at high altitudes require long-term oxygen therapy due to persistent hypoxia. However, availability of oxygen concentrators and home-based care programs remains inadequate in many regions [7].

Telemedicine and home-based rehabilitation programs could be a viable solution for improving patient care in remote high-altitude locations. Implementing mobile health monitoring systems, virtual respiratory therapy sessions, and community-based health interventions could help bridge the gap in healthcare access [6].

Implementation of telemedicine presents both opportunities and challenges for COPD and post-COVID rehabilitation in Kyrgyzstan. While telerehabilitation programs have demonstrated effectiveness in improving respiratory outcomes, dyspnea control, and quality of life in post-COVID patients [17], several barriers must be addressed for successful implementation in the Kyrgyz context. Infrastructure limitations, including inconsistent internet access in rural and high-altitude regions, pose significant challenges to establishing reliable telemedicine services [18]. Additionally, low levels of digital literacy among both healthcare providers and patients may hinder adoption of remote monitoring technologies [19]. Financial constraints within the healthcare system and unclear regulatory frameworks for telemedicine practice further complicate implementation efforts. Addressing these challenges requires coordinated investment in telecommunications infrastructure, development of training programs for medical staff, establishment of clear telemedicine protocols, and creation of sustainable financing mechanisms. Despite these obstacles, telemedicine remains

a promising solution for expanding access to specialized respiratory care in underserved regions of Kyrgyzstan.

The findings of this study have important clinical implications for the management of COPD and post-COVID syndrome, particularly in high-altitude regions. Based on these results, several key strategies should be considered:

- Early identification of high-risk patients through biomarker analysis (IL-6, TNF- $\alpha$ , and CRP levels) to predict lung function decline and guide individualized treatment plans.
- Integration of anti-inflammatory therapies into COPD and post-COVID management protocols to reduce disease progression and improve respiratory outcomes.
- Expansion of pulmonary rehabilitation services, with an emphasis on home-based programs and telemedicine solutions for high-altitude residents.
- Further research into hypoxia-related inflammation and its impact on long-term lung function decline, with a focus on developing altitude-specific treatment guidelines.

Future studies should also investigate the role of genetic adaptations to high-altitude living and their influence on COPD and post-COVID recovery. Understanding how chronic hypoxia interacts with immune dysregulation could pave the way for personalized treatment approaches for patients in these environments [4].

## Conclusion.

This study highlights the significant impact of post-COVID syndrome and COPD on lung function decline, systemic inflammation, and rehabilitation challenges, particularly in high-altitude environments. The findings confirm that patients with both conditions experience more severe respiratory impairment, increased inflammatory markers, and greater functional limitations compared to those with either condition alone. The presence of chronic inflammation, as evidenced by elevated IL-6 and TNF- $\alpha$  levels, is strongly correlated with reduced pulmonary function, emphasizing the need for targeted anti-inflammatory interventions in disease management.

Post-COVID syndrome appears to accelerate the progression of COPD, leading to worsened airflow limitation, increased breathlessness, and a higher burden of fatigue. These effects are further exacerbated by chronic hypoxia in high-altitude environments, where reduced oxygen saturation contributes to heightened systemic inflammation and increased respiratory distress. The study demonstrates that COPD and post-COVID patients residing at high altitudes require specialized rehabilitation strategies that address both oxygenation and immune modulation.

Descriptive statistical comparisons across all study groups demonstrated consistent differences in inflammatory markers, pulmonary function, and functional outcomes, with patients suffering from both COPD and post-COVID syndrome showing the most severe clinical impairment compared to single-disease and control groups.

The challenges associated with rehabilitation in high-altitude regions, including limited access to specialized care, a lack of rehabilitation facilities, and a greater reliance on oxygen therapy, highlight the need for improved healthcare infrastructure. Expanding pulmonary rehabilitation services, integrating telemedicine for remote monitoring, and enhancing home-based

oxygen therapy availability are critical steps toward improving patient outcomes.

Future research should focus on understanding the long-term consequences of post-COVID syndrome in COPD patients, particularly in relation to immune dysregulation and lung function decline. Additionally, investigating genetic and physiological adaptations to high-altitude living may provide insights into personalized treatment approaches for patients residing in such environments.

In conclusion, addressing the complex interplay between systemic inflammation, pulmonary impairment, and high-altitude hypoxia is essential for optimizing the management of COPD and post-COVID patients. Implementing multidisciplinary rehabilitation programs, improving healthcare accessibility, and advancing research into hypoxia-driven immune responses will be key to improving the quality of life and long-term health outcomes for this vulnerable population.

## REFERENCES

1. Barnes PJ, Shapiro SD, Pauwels RA. Chronic obstructive pulmonary disease: molecular and cellular mechanisms. *Eur Respir J*. 2003;22:672-88.
2. Global Initiative for Chronic Obstructive Lung Disease (GOLD). Global strategy for the diagnosis, management, and prevention of COPD (2023 Report). [https://goldcopd.org/wp-content/uploads/2023/03/GOLD-2023-ver-1.3-17Feb2023\\_WMV.pdf](https://goldcopd.org/wp-content/uploads/2023/03/GOLD-2023-ver-1.3-17Feb2023_WMV.pdf)
3. Nalbandian A, Sehgal K, Gupta A, et al. Post-acute COVID-19 syndrome. *Nat Med*. 2021;27:601-15.
4. Beall CM, Decker MJ, Brittenham GM, et al. An Ethiopian pattern of human adaptation to high-altitude hypoxia. *Proc Natl Acad Sci U S A*. 2002;99:17215-8.
5. Attaway A, Hatipoğlu U. Management of patients with COPD during the COVID-19 pandemic. *Cleve Clin J Med*. 2020.
6. World Health Organization (WHO). 2021 Annual Report WHO's response to COVID-19. Geneva: World Health Organization; 2022.
7. Mazzeo RS. Physiological responses to exercise at altitude: an update. *Sports Med*. 2008;38:1-8.
8. Stephenson T, Allin B, Nugawela MD, et al. Long COVID (post-COVID-19 condition) in children: a modified Delphi process. *Arch Dis Child*. 2022;107:674-680.
9. Singh SJ, Baldwin MM, Daynes E, et al. Respiratory sequelae of COVID-19: pulmonary and extrapulmonary origins, and approaches to clinical care and rehabilitation. *Lancet Respir Med*. 2023;11:709-25.
10. Mo X, Jian W, Su Z, et al. Abnormal pulmonary function in COVID-19 patients at time of hospital discharge. *Eur Respir J*. 2020;55:2001217.
11. Chen Y, Gaber T. Hypoxia/HIF modulates immune responses. *Biomedicines*. 2021;9:260.
12. Huang C, Huang L, Wang Y, et al. 6-month consequences of COVID-19 in patients discharged from hospital: a cohort study. *Lancet*. 2021;397:220-32.
13. Góngora-Bendezú JA, Martínez-López MV, Aguinaga-Fernandez AD, et al. Post-COVID spirometric abnormalities in workers with intermittent high-altitude exposure: a cross-sectional study in Peru. *medRxiv preprint*. 2025;1-27.
14. Zubieta-Calleja G. Redefining chronic mountain sickness: insights from high-altitude research and clinical experience. *Med Rev*. 2024;5:44-65.
15. Kubincová A, Takáč P, Demjanovič Kendrová L, et al. Predictors of quality-of-life improvement at different minimum clinically important difference values in patients with chronic obstructive pulmonary disease after climatic rehabilitation treatment. *Life*. 2023;13:1763.
16. West JB, Schoene R, Luks A, et al. High-altitude medicine and physiology. Boca Raton: CRC Press; 2016.
17. de la Plaza San Frutos M, Abuín Porras V, Blanco Morales M, et al. Telemedicine in pulmonary rehabilitation - benefits of a telerehabilitation program in post-COVID-19 patients: a controlled quasi-experimental study. *Ther Adv Respir Dis*. 2023;17:17534666231167354.
18. Salomakhina NS. Prospects of telemedicine development in Kyrgyzstan. *Econ Manag Educ*. 2018;4:86-90.
19. Dozaliev AA, Alymkulov AT, Atykanov AO. Telemedicine in obstetrics and gynecology in the Kyrgyz Republic (literature review). *Bull Sci Pract*. 2024;10:170-6.