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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии
საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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

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

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

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

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

WEBSITE

www.geomednews.com

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. 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.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 საყურადღებო!

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, შემავსებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

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

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

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

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

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

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

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

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

Nana Shavlakadze, Irine Phkhakadze, Ana Silagadze, Dali Kobuladze, Alina Pakhuridze. CHRONIC URTICARIA AND LEAD EXPOSURE: EVALUATION OF IMMUNOLOGICAL MARKERS.....	6-16
Jangirashvili T, Kikoria G, Tevdorashvili N, Kapanadze L, Odikadze N. PSYCHOLOGICAL WELL-BEING AMONG MEDICAL STUDENTS AT FIVE UNIVERSITIES IN TBILISI, GEORGIA: A CROSS-SECTIONAL STUDY OF PERCEIVED STRESS, ANXIETY, AND SLEEP QUALITY.....	17-23
Yueyue Lu, Yigao Wu. ADVANCES IN RESEARCH OF PSYCHOTHERAPY FOR SOCIAL ANXIETY DISORDER.....	24-31
Saburov Alisher, Kemelbekov Kanatzhan, Arybzhanov Dauranbek, Abdurakhmanov Babur, Huseinov Zafar, Saburova Saidakhon, Tuktibayeva Saule, Yernazarov Adlet, Alipbekova Sandugash. ROLE OF NEOADJUVANT THERAPY FOR PATIENTS WITH GASTRIC CANCER: MULTIDISCIPLINARY HOSPITAL WITH ONCOLOGY CENTER.....	32-37
David Tchkonია, Nino Gabashvili, Teona Mskhaladze, Tamari Kevlishvili, Mikolay Chkonia. EFFICACY OF ENDOBRONCHIAL VALVE PLACEMENT IN THE MANAGEMENT OF PULMONARY HEMORRHAGE: A COMPARATIVE STUDY.....	38-42
Baglan Kemelbekov, Ainur Amanzholykyz, Samat Saparbayev, Manarbek Askarov, Edgaras Stankevicius. IMPACT OF STEM CELL THERAPY ADDED TO GUIDELINE-DIRECTED MEDICAL THERAPY ON QUALITY OF LIFE IN PATIENTS WITH ISCHEMIC CARDIOMYOPATHY.....	43-50
Abramishvili T, Papava K, Mamisashvili M, Tkeshelashvili M, Tsinamdzgvrishvili B. CARDIAC STRAIN IN WOMEN WITH A DOCUMENTED HISTORY OF OVERT OR SUBCLINICAL HYPOTHYROIDISM: AN EXPLORATORY SPECKLE-TRACKING ECHOCARDIOGRAPHY STUDY.....	51-56
TEREZA Y. AZATYAN. FORMATION AND DISTRIBUTION PATTERNS OF FUNCTIONAL INTERHEMISPHERIC BRAIN ASYMMETRY IN CHILDREN WITH INTELLECTUAL DISABILITIES.....	57-63
Fai Twrki Althoini, Ebtehal Solaiman Almogbel. CARDIOMETABOLIC RISK PROFILES IN ADULTS WITH DIABETES: ASSOCIATIONS WITH GLYCEMIC CONTROL, DIABETES TYPE, AND DEMOGRAPHIC CHARACTERISTICS.....	64-77
Datumyan G.S, Shaboyan K.R, Muradyan A.A, Shaboyan E.K, Galstyan A.S, Badalyan A, Sargsyan M.V. IMPACT OF THE COVID-19 PANDEMIC ON THE SEVERITY AND OUTCOMES OF GUNSHOT INJURIES.....	78-84
Zhanar Kozhakhmetova, Nazym Yelemessova, Syzdykova Dinara, Abdullina Sayagul, Nagima Issatayeva, Assiya Turgambayeva, Gulnara Kamalbekova, Diana Zhumagaleyeva, Akmaral Mussakhanova. CRITICAL VALUES OF HEMOSTASIS PARAMETERS IN AN ONCOLOGY CENTER: A RETROSPECTIVE REGISTRY-BASED STUDY.....	85-92
Gradil G.I, Torianyk I.I, Yurko K.V, Shiyan D.M, Merkulova N.F, Mohylenets O.I, Tkachenko V.G, Karmazina I.S, Lantukh A.P, Hryhorov Y.B, Gargin V.V. ASSOCIATION OF PULMONARY AND CUTANEOUS CHANGES IN COVID-19-RELATED CONDITIONS.....	93-98
Alaa MA. Albayaty, Alaa M. Sadiq, Ali SJ. Al Qaissi. ASSOCIATION BETWEEN INFLAMMATORY MARKERS, LIVER ENZYMES, LIPID PROFILE, AND VITAMIN D STATUS IN ADULTS WITH OBESITY: A CROSS-SECTIONAL STUDY.....	99-104
Kenzhebaeva B, Baimuratova M, Kalmakhanov S, Budakoğlu I.I, Laktionova M, Abdulkalikova D. IMPACT OF CLINICAL, ORGANIZATIONAL, AND PSYCHOSOCIAL FACTORS ON THE QUALITY OF LIFE OF PATIENTS WITH DERMATOVENEREOLGICAL DISEASES.....	105-114
Obidov F. Kh, Shamsiev E. A, Samatov F. F, Naimov Dilshod Kayim ugli, Khalimova F. T, Marwan Ismail. BIOMARKER-ORIENTED REHABILITATION IN CHRONIC CEREBRAL ISCHEMIA.....	115-122
Raghad Alkhalify, Lina Almutairi, Fatimah Alghofaili, Wasan Alhawaish, Thekra Alhumidi. COMPARATIVE IN-VITRO QUALITY EVALUATION OF COMMERCIALY AVAILABLE DICLOFENAC SODIUM TABLETS.....	123-131
Ali S. Jumaah, Ali A. Younis, Shamil H. Othman. EFFECTS OF CURCUMIN ON CLINICAL OUTCOMES AND INFLAMMATORY BIOMARKERS IN KNEE OSTEOARTHRITIS: A RANDOMIZED TRIAL.....	132-138
Ashot Markosyan, Diana Alaverdieva, Mark Danghyan, Ani Mkrtchyan, Lusine Balayan, Khachik Hakobyan, Arpine Geolchanyan, Tigran Soghomonyan, Volodya Mirzoyan. SYNTHESIS AND SOME BIOLOGICAL PROPERTIES OF DERIVATIVES OF 2,3-DISUBSTITUTED 5,5-DIMETHYL-BENZO[h]QUINAZOLIN-4(1H)-ONES.....	139-143

J. Gobadze, M. Nagervadze, T. Gogitidze, N. Bejanidze, N. Zarnadze, K. Dolidze. IMPACT OF GESTATIONAL DIABETES MELLITUS ON NEONATAL BIRTH WEIGHT, LENGTH, AND GESTATIONAL AGE: A RETROSPECTIVE CASE-CONTROL STUDY	144-151
Liudmyla Bashkistrova, Iryna Romanova, Vitalii Yatsynovych, Oleksandr Zlobin, Artem Lanskoi. EVIDENCE-BASED PHARMACOTHERAPY FOR ANXIETY DISORDERS COMORBID WITH PTSD: A SYSTEMATIC REVIEW	152-163
Madina Makhmudova, Tolegen Kerimbekov, Zhaina Berikbayeva, Dinara Turebekova, Lyudmila Akhmaltdinova, Yefim Alisseiko, Olga Avdienko, Madina Rashova. IN VITRO INVESTIGATION OF THE POTENTIAL OF C60 FULLERENES AS ADJUVANTS OF NONSPECIFIC IMMUNITY	164-168
Tchernev G, Tchernev KG Jr, Kordeva S. DERMATOLOGIC SURGERY ROUNDS: THE LIMBERG FLAP AND V-TO-T CLOSURE FOR CUTANEOUS/ MUCOCUTANEOUS DEFECTS FOLLOWING SKIN CANCER EXCISION IN HIGH-RISK FACIAL REGIONS	169-174
Nino Nadiradze, Zurab Ckhaidze. SELF-RATED HEALTH IN THE POPULATION OF MEDICAL WORKERS IN GEORGIA	175-180
Argjend Shala, Nexhmedin Shala, Fisnik Jashari, Blert Jashari, Rushit Jashari. SPORADIC CREUTZFELDT-JAKOB DISEASE: CLINICAL FEATURES, DIAGNOSIS AND THERAPEUTIC HORIZONS	181-189
Omar S. Salman, Adeeb A. Al-Zubaidy. ACEBROPHYLLINE REPROGRAMS INFLAMMATORY AND REDOX SIGNALLING IN EXPERIMENTAL ULCERATIVE COLITIS: A DOSE-DEPENDENT STUDY	190-199
Eib K. Eibov, Solikhabonu Khavaskhonova, Kamshat S. Taubay, Karlygash Zh. Sadykova. CALCULATED WHOLE BLOOD VISCOSITY IS SPECIFICALLY ASSOCIATED WITH ABDOMINAL OBESITY, BUT NOT WITH OTHER COMPONENTS OF METABOLIC SYNDROME: A CROSS-SECTIONAL STUDY IN A CENTRAL ASIAN ADULT COHORT	200-208
Shqiponje Gashi, Erza Voca Mulaj, Naser Rugova, Suzana Dvojakovska, Filip Koneski. MANAGEMENT OF PERIOPERATIVE BLEEDING IN PATIENTS WITH PLATELET HYPOAGGREGABILITY DURING DENTOALVEOLAR SURGERY: CLINICAL OUTCOMES AND THERAPEUTIC APPROACHES	209-214
Alina Articulo, Rigor Rey Cuevas, Hani Al-Najjar, Rahaf Alkhuraif, Rasha Aburmeishan, Abdulaziz Almatrody. EXPLORING THE SATISFACTION OF NEWLY HIRED NURSES USING AN EVIDENCE-BASED, PERSONALIZED ONBOARDING PROGRAM: A CROSS-SECTIONAL ANALYSIS	215-222
Nagima Issatayeva, Samal Duisekova, Meruert Saberbekova, Roza Tumanova, Larisa Guruleva, Sholpan Mukanova. APPLICATION OF THE FAILURE MODE AND EFFECTS ANALYSIS METHOD IN HEALTHCARE: A CASE STUDY OF A UNIVERSITY MEDICAL CENTER IN KAZAKHSTAN	223-237
Hisham R. Ezzat, Ibrahim M. Faisal. CARDIOPROTECTIVE EFFECTS OF SILYMARIN AND VITAMIN E AGAINST DOXORUBICIN-INDUCED CARDIOTOXICITY IN RATS: EVIDENCE FROM OXIDATIVE STRESS MARKERS AND HISTOPATHOLOGICAL ANALYSIS	238-245
Shishniashvili D.S, Bedinashvili Z.J, Tsomaia K.B, Svanadze L.M, Chkhikvishvili N.M, Durglishvili G.A. FIRST-VOID URINE VERSUS URETHRAL SWAB FOR MOLECULAR DETECTION OF SEXUALLY TRANSMITTED INFECTIONS IN MEN WITH MULTIPLE SEXUAL PARTNERS	246-252
Chekhovska G.S, Pustova N.O, Syzon O.O, Chaplyk-Chyzho I.O, Dashko M.O, Vozniak I.Ya, Volbyn S.V, Ivaniushko-Nazarko N.V, Zhemela O.D, Gargin V.V. NAIL PLATE DAMAGE INDEX IN DERMATOSCOPIC EXAMINATION OF PATIENTS WITH ONYCHOMYCOSIS	253-258
Meng-Yun Zhou, Shi-qi Yu, Shao-jie Zhu, Xiang Kong, Xin-Ming Yao. A NOVEL KCNJ5 GENE MUTATION ASSOCIATED WITH FAMILIAL ALDOSTERONISM TYPE III WITHOUT HYPERTENSION	259-265
Koba Kamashidze, Tina Beruchashvili, Irina Nakashidze, Sarfraz Ahmad, Tamar Peshkova. BRIDGING THE COVERAGE-PARTICIPATION GAP: BEHAVIORAL DETERMINANTS OF CERVICAL CANCER SCREENING AMONG WOMEN IN ADJARA, GEORGIA	266-273
T.N. Kosayeva, A.T. Amiraslanov, H.K. Muradov, A.Y. Gaziyeu, B.E. Abbasov. PD-L1 EXPRESSION AND SERUM CA125: CLINICOPATHOLOGICAL CORRELATIONS IN HIGH-GRADE SEROUS OVARIAN CARCINOMA	274-280
Ruziyeva Amira Asrorovna, Khamidov Obid Abdurakhmanovich, Murodqosimov Saidolim, Doniyorov Bakhridin Baxrom ugli, Khalimova F.T, Marwan Ismail. ACE I/D AND NOS3 G894T POLYMORPHISMS AND CARDIOVASCULAR ADAPTATION PROFILES IN ADOLESCENT FOOTBALL PLAYERS	281-288

Mukhriddin Umbarov Ochilovich, Shamsutdinova Maksuda Ilyasovna, Abdullayev Ravshanbek Babajonovich, Rokhila Bakhriiddinovna Mengliyeva. ASSOCIATIONS OF CYTOKINE PROFILE AND EXOCRINE PANCREATIC FUNCTION WITH A SYMPTOM-BASED DEHYDRATION CATEGORY AND SEASON OF PRESENTATION IN CHRONIC PANCREATITIS: A RETROSPECTIVE STUDY.....	289-297
Saeed H. Hussein, Hiba M. Ahmed, Ahmed A. Ahmed. DETECTION OF HEPATITIS B AND C VIRAL INFECTION AMONG CHILDREN WITH ACUTE LEUKAEMIA.....	298-302
Davit Kobuladze, Ahishtan Febrian Nishanthan, Nino Kedelidze, Rusudan Vadatchkoria, Magda Davitashvili, Lamara Zuroshvili, Darejan Margalitashvili, Nani Gvarishvili, Nazi Turmanidze, Tamar Peshkova, Naman Chauhan, Teona Gogitidze, Nameera Parveen Shaikh, Aleena Parveen Shaikh, Abeshana Febrian Nishanthan, Irina Nakashidze. SELECTED LABORATORY PARAMETERS IN PEDIATRIC PATIENTS WITH COVID-19 STRATIFIED BY WHITE BLOOD CELL AND PLATELET PROFILES.....	303-309
Rawan Waleed, Abrar Fadlalla, Jana Abdullah, Marwan Ismail, Mohammed Ibrahim Saeed, Ahmad Luay Osman Hashim, Abdelgadir Elamin Eltom. IMPACT OF HELICOBACTER PYLORI INFECTION ON VITAMIN B12 DEFICIENCY LEVELS: A RETROSPECTIVE STUDY.....	310-315
T.A. Asgarova, K.M. Rahimli, G.A. Valiyeva, Sh.I. Hasanova, F.E. Guliyeva, Kh.R. Mammadova. SOME HEREDITARY DISEASES PREVALENT IN THE REPUBLIC OF AZERBAIJAN.....	316-319
Sahadete Shala, Ferdita Haxhiu Derguti. PSOAS MUSCLE ABSCESS FOLLOWING CESAREAN SECTION: A CASE REPORT.....	320-322
N. Kajaia, L. Gabunia, M. Mantskava, S. Kalmakhelidze, G. Ormotsadze, S. Turabelidze-Robaqidze, T. Sanikidze. PRO-INFLAMMATORY INTERLEUKINS AND OXIDATIVE IMBALANCE IN L-NAME-INDUCED HYPERTENSION: COMPARATIVE EFFECTS OF β -BLOCKERS.....	323-330
Hussein Fadhil Abdulameer, Raed Aziz Badeia. COMPARATIVE EVALUATION OF TWO HERBAL MOUTHWASHES AND CHLORHEXIDINE ON CALPROTECTIN IN GINGIVITIS PATIENTS: A DOUBLE-BLIND RANDOMIZED CONTROLLED TRIAL.....	331-340
J. Gobadze, M. Nagervadze, T. Gogitidze, N. Bejanidze, T. Koiava. SOME BIOLOGICAL CHARACTERISTICS ASSOCIATED WITH GESTATIONAL DIABETES.....	341-348
Yurevych N. O, Sazonova O. N, Kachailo I.A, Hnidyk Yu. V, Pokotylo P. B, Podolyuk M.V, Blyshak N. B, Mykhalevych M. M, Zherebkin V. V, Kosynskyi O. V, Aliksieieva V. V. THREE-DIMENSIONAL CT-BASED MORPHOMETRIC ASSESSMENT OF THE MAXILLARY SINUS.....	349-355
Simbarashe Magaisa. PERCEPTIONS AND PRACTICES OF HEALTHCARE PROVIDERS IN MATERNAL MORTALITY AND STILLBIRTH PREVENTION AND MANAGEMENT: INSIGHTS FROM LEJWELEPUTSWA DISTRICT.....	356-363
Akezhan Rustemuly Astrakhanov, Ainur Amanzholkyzy, Samat Sagatovich Saparbayev, Meirambek Sagnaevich Kurmangazin, Aigerim Iskakova, Gulzhanat Nurlanova. THE ROLE OF CELL THERAPY IN THE COMPREHENSIVE TREATMENT OF CHRONIC HEPATITIS C-RELATED LIVER CIRRHOSIS.....	364-370
Miranda Shervashidze, Khatia Dolidze, Tamar Bakhtadze, Tamar Shervashidze. PREVENTING EXERCISE-RELATED SUDDEN CARDIAC DEATH THROUGH SYSTEMATIC PREPARTICIPATION CARDIOVASCULAR SCREENING: A TWO-YEAR REGIONAL COHORT STUDY OF PEDIATRIC ATHLETES IN ADJARA, GEORGIA.....	371-380
Waseem Hashim Alkhaffaf, Muhammad A. Alkataan. COMPARATIVE EFFICACY OF 200 UNITS VERSUS 155 UNITS OF ONABOTULINUMTOXIN A FOR CHRONIC MIGRAINE.....	381-388
K. Tovar Calderón, J. Orozco Pilco, C. Calderón Cabezas, K. Caiza Cuello. ETHNIC DISPARITIES IN BIRTH WEIGHT AND PRENATAL CARE UTILIZATION IN ECUADOR, 2024.....	389-394
Gaukhar Issakova, Suriya Yessentayeva, Daniyar Amangaliyev, Askhat Bralov, Assiya M. Issayeva, Yestay Abzalbek, Marat Akhetov. INDICATIONS FOR REMOVAL OF A PORT SYSTEM IN A PATIENT WITH SUSPECTED SEPTICEMIA IN THE ABSENCE OF OTHER LOCAL SOURCES OF INFECTION.....	395-398
Mohammed A. Hayawi, Duaa M. Al-Nafoly. PREDOMINANCE OF FOLLICULAR ADENOMA AND PAPILLARY CARCINOMA IN THYROID NEOPLASMS.....	399-403
Nino Buadze, Nata Kazakhashvili. POPULATION KNOWLEDGE, RISK PERCEPTION, GOVERNANCE AND PUBLIC HEALTH DETERMINANTS OF COVID-19 IN GEORGIA: A NATIONAL CROSS-SECTIONAL STUDY.....	404-422

Alaa H. Alfarhan, Bahir S. Allawi, Mohammed A. Aljodah, Ahmed Jawad. MINIMALLY INVASIVE FAT TRANSPOSITION IN LOWER BLEPHAROPLASTY	423-427
Ospanova Meruyert, Ospanova Saniya, Yernazarov Adilet, Amanbaev Rauan, Rakhmankulov Umarali. LOW-FREQUENCY ULTRASOUND AND OZONE/NO TECHNOLOGIES IN THE COMBINED TREATMENT OF EXUDATIVE HEMISINUSITIS USING THE YAMIK-3 SINUS CATHETER.....	428-432
Sodikjon Mashraf Ugli Makhmatkulov, Ibragimova Malika Shavkatovna, Khasanov Alisher Yurevich, Mavlyanova Zilola Farkhadovna, Khalimova F.T, Marwan Ismail. COMBINED BOTULINUM TOXIN THERAPY AND PERCUTANEOUS TIBIAL NERVE STIMULATION IN THE REHABILITATION OF WOMEN WITH URGENCY URINARY INCONTINENCE ASSOCIATED WITH DIABETES MELLITUS.....	433-444
Nellia Veretova, Alfiya Samigullina, Aigul Baialieva, Ruslan Abdyldaev, Begimai Muratbekova. PSYCHONEUROLOGICAL THERAPY FOR POST-COVID SYNDROME: A COMPREHENSIVE REVIEW OF METHODS AND CLINICAL EFFECTIVENESS.....	445-451
Azhar Giniyat, Natalya Slivkina, Viktor Tkachev, Gulbana Khussainova, Ayan Baigaliyev, Sara Kubekova, Aizat Seidakhmetova, Zilola Mavlyanova, Mirbanu Aikhodzheyeva, Raikhan Burumbaeva, Larissa Pavlovets, Raikhan Tleulinova, Raushan Baigenzheyeva, Mereke Alaidarova, Joseph Almazan, Aizhan Altynbekova, Bakyt Zhangabulova, Zinugul Baissova, Manzura Kankina, Parida Pirmanova, Magira Shaizadinova, Aliya Utenova, Zhansaya Raiymkul. DEVELOPMENT AND EVALUATION OF A NURSE-LED SELF-DIRECTED PEDIATRIC REHABILITATION MODEL: COMPARATIVE ANALYSIS OF INTERNATIONAL PRACTICES.....	452-465
Florina Sahiti, Argjira Veseli, Marija Peeva Petreska, Shera Kosumi, Nora Berisha, Enis Veseli, Kaltrina Veseli. BIOMARKERS OF BONE REMODELING AND INFLAMMATION IN CHRONIC PERIAPICAL LESIONS: A NARRATIVE REVIEW	466-473

PSYCHONEUROLOGICAL THERAPY FOR POST-COVID SYNDROME: A COMPREHENSIVE REVIEW OF METHODS AND CLINICAL EFFECTIVENESS

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Abstract.

Background: Post-COVID syndrome has emerged as a major global health issue characterized by long-lasting psychoneurological symptoms, including cognitive impairment, anxiety, depression, sleep disturbances, and fatigue. These symptoms can persist regardless of the severity of the initial SARS-CoV-2 infection and often result in long-term functional limitations. The purpose of this review was to summarize current evidence on psychoneurological therapeutic approaches used to manage post-COVID syndrome and evaluate their clinical effectiveness.

Methods: A structured literature review was conducted using PubMed, Scopus, MEDLINE, and Google Scholar. Eligible studies included randomized controlled trials, observational studies, and clinical reports published up to 2024 that examined pharmacological, psychotherapeutic, physical, complementary, or neuromodulation-based treatments for adults with persistent psychoneurological symptoms after COVID-19. The review followed standard ethical practices for narrative reviews; no new human or animal data were collected, and therefore ethical approval or CTRI registration was not required. Findings were synthesized narratively by therapy category.

Results: The review identified consistent evidence supporting the efficacy of multiple therapeutic modalities. Pharmacological agents including SSRIs, SNRIs, anxiolytics, and nootropics reduced anxiety, depression, and cognitive dysfunction. Psychotherapeutic methods such as cognitive behavioral therapy, psychodynamic therapy, and mindfulness-based interventions improved emotional regulation and coping. Physical rehabilitation, aerobic exercise, and breathing practices enhanced endurance and reduced fatigue. Complementary approaches (e.g., acupuncture, massage) provided additional symptom relief. Neuromodulation techniques, including transcranial magnetic stimulation and electroconvulsive therapy, demonstrated benefits in treatment-resistant cases.

Conclusion: Psychoneurological therapy for post-COVID syndrome requires a multimodal approach that integrates pharmacological, psychological, physical, and neuromodulatory interventions. Current evidence suggests that individualized, combined strategies are most effective for improving cognitive, emotional, and functional outcomes. Further research is needed to optimize treatment protocols and evaluate long-term effectiveness.

Key words. Nonsteroidal anti-inflammatory drugs, cognitive behavioral therapy, social rehabilitation, cognitive function, psycho-emotional state.

Introduction.

The coronavirus that emerged in 2019 (COVID-19) led to a significant rise in global morbidity and mortality. Among the many who recovered from COVID-19, the phenomenon of

post-COVID syndrome, or long COVID, attracted the attention of researchers. The medical community noticed early in the pandemic that many patients experienced persistent symptoms for months after recovery. These manifestations affect a wide range of bodily systems, including physical, cognitive, psycho-emotional, and neurological domains, making post-COVID syndrome a major healthcare challenge [1].

This review explores current perspectives on post-COVID syndrome, including its epidemiology, pathogenesis, and clinical presentation in adults. It also analyzes key therapeutic approaches and their effectiveness. Shortness of breath, chronic cough, and fatigue are most common during the first six months after infection, but cognitive impairments and psychological symptoms may last much longer. Although various hypotheses about the mechanisms behind these symptoms have been proposed, they remain unconfirmed [2].

Post-COVID syndrome has gained particular relevance due to the growing number of recovered patients. According to the World Health Organization (WHO), by the end of 2023, over 500 million people worldwide had contracted COVID-19, with a significant portion developing long-term effects. Research shows that psychoneurological symptoms can occur not only in patients with severe COVID-19 but also in those with mild or asymptomatic cases, suggesting that anyone infected could be affected [3].

The most complex manifestations of post-COVID syndrome are its psychoneurological aspects. These include cognitive disorders, such as impaired memory and concentration, as well as emotional disturbances like depression, anxiety, and post-traumatic stress disorder (PTSD). These symptoms can severely reduce patients' quality of life and lead to prolonged disability, emphasizing the need for effective psychoneurological treatment methods [4].

In recent years, it has become clear that COVID-19 significantly impacts the central and peripheral nervous systems, leading to various neurological and psychiatric complications. Given the global scale of the pandemic and its serious health consequences, studying post-COVID syndrome—particularly its psychoneurological dimensions—is critical for understanding its mechanisms and developing effective treatments [5].

However, despite extensive research, none of the proposed hypotheses has been fully confirmed, highlighting the need for further investigation [6].

Methods.

This article presents a systematic literature review aimed at evaluating the effectiveness of various psychoneurological therapies for post-COVID syndrome. A structured search strategy was developed to identify peer-reviewed publications and clinical studies related to pharmacological, psychotherapeutic, physical, alternative, and neuromodulatory treatment approaches.

The literature search was conducted across multiple electronic databases, including PubMed, Scopus, MEDLINE, and Google Scholar, with additional reference tracking to ensure comprehensiveness. Keywords used for the search included combinations of the following terms: post-COVID syndrome, long COVID, neuropsychiatric symptoms, psychoneurological therapy, antidepressants, cognitive behavioral therapy, physiotherapy, mindfulness, acupuncture, transcranial magnetic stimulation, and social rehabilitation.

Publications up to 2024 were considered for inclusion. Studies focusing on adult populations and reporting data on the therapeutic impact on cognitive, emotional, and neurological outcomes were prioritized. Both randomized controlled trials and observational studies were included. The collected data were synthesized in a narrative format and categorized by therapy type.

The results were analyzed to identify prevailing trends in treatment efficacy, highlight promising multi-modal approaches, and assess the influence of comorbidities on treatment outcomes. Based on the findings, recommendations for future research and clinical practice were formulated.

Epidemiology and Pathogenesis: Prevalence and Mechanisms of Development.

Post-COVID syndrome presents a serious medical and social challenge. Its prevalence varies depending on region, population, and research methodology, but the overall trend indicates that it is widespread among people who have recovered from COVID-19 [7].

According to various studies, post-COVID syndrome develops in a significant number of individuals who have had COVID-19. On average, 10% to 30% of such patients report symptoms that persist for several months after recovery. Research conducted across different countries has shown that even those who experienced mild forms of the infection may face long-term consequences, including psychoneurological disorders. At the same time, patients who suffered more severe illness and required hospitalization or intensive care are more likely to develop post-COVID syndrome, with reported rates as high as 50–60% [7].

As the number of recovered patients grows, the scale of the problem becomes increasingly apparent. Globally, according to estimates by the World Health Organization (WHO), more than 65 million people may have experienced post-COVID syndrome by 2024, significantly impacting healthcare systems and society at large. The prevalence of this syndrome depends on age, gender, comorbidities, and the severity of the COVID-19 infection. Women, particularly between the ages of 30 and 60, are more frequently affected, which may be due to gender differences in immune response as well as psychosocial factors [1,7].

Pathogenesis of post-COVID syndrome:

Understanding the mechanisms of post-COVID syndrome remains a central focus of scientific investigation, as the full pathogenesis is not yet clearly understood. Several hypotheses have been proposed to explain how long-term symptoms develop after SARS-CoV-2 infection:

1. Direct viral damage to the nervous system: SARS-CoV-2 is capable of penetrating the nervous system, causing direct damage to neurons and other cells. The virus may access the central nervous system (CNS) through the olfactory epithelium and olfactory bulbs, which partly explains the frequent loss of smell and taste in COVID-19 patients. However, this is only one aspect. The virus also affects blood vessels, leading to endothelial inflammation, microthrombosis, and ischemic brain damage. These processes may underlie the cognitive and psychoneurological symptoms seen in post-COVID patients [8].

2. Immune dysfunction and autoimmune responses: COVID-19 infection can disrupt normal immune function, triggering autoimmune reactions where the immune system begins attacking the body's own tissues, including the nervous system. Elevated levels of cytokines and other inflammatory mediators in severe cases contribute to neuroinflammation and long-term neural damage. Furthermore, the immune system may continue to attack residual viral antigens, resulting in chronic inflammation and worsening of the patient's condition [8].

3. Mitochondrial dysfunction and oxidative stress: SARS-CoV-2 may induce mitochondrial dysfunction, disrupting cellular energy metabolism and increasing oxidative stress [8]. These processes likely play a key role in the fatigue, weakness, and cognitive impairments frequently reported by post-COVID patients. As mitochondria are critical energy providers—especially for nerve cells—their dysfunction can result in a wide range of psychoneurological symptoms [8].

4. Vascular disturbances and hypoxia: COVID-19 is often associated with microcirculatory dysfunction and hypoxia, which can have long-term effects on the nervous system [8]. The virus may cause endothelial dysfunction, leading to damage in small blood vessels and impaired cerebral blood flow. Hypoxia and ischemia can result in cognitive disorders, headaches, and other neurological symptoms. Moreover, hypoxia can intensify inflammatory processes, exacerbating nerve tissue damage and contributing to post-COVID syndrome [9].

5. Dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis: COVID-19 may impair the regulation of the HPA axis, causing imbalances in stress hormones such as cortisol. This dysregulation may lead to chronic fatigue, depression, and anxiety disorders, all commonly seen in post-COVID patients. Sleep disturbances, including insomnia, may also result from HPA axis dysfunction, further worsening patients' overall health and hindering recovery [10].

6. Psychosocial factors: The COVID-19 pandemic has had a profound effect on mental health, leading to stress, anxiety, depression, and post-traumatic stress disorder. These psychosocial stressors can amplify symptoms of post-COVID syndrome, particularly in individuals predisposed to psychoneurological conditions [8]. Social isolation, economic hardship, and uncertainty about the future may also contribute to the development of neuropsychological disorders in affected individuals [11].

Clinical Manifestations: Neurological and Psychoneurological Symptoms.

Post-COVID syndrome (PCS) is characterized by persistent symptoms that continue beyond the acute phase of COVID-19.

Among the most common—and often underestimated—clinical manifestations of PCS are neurological and psychoneurological symptoms. These manifestations vary in intensity and can significantly impair patients' quality of life.

Neurological Symptoms of Post-COVID Syndrome:

Cognitive Impairment (“Brain Fog”):

One of the most prevalent and disabling symptoms of post-COVID syndrome is cognitive impairment, often described by patients as “brain fog.” This phenomenon encompasses a broad range of cognitive dysfunctions, including difficulties with concentration, memory decline, slowed thinking, and problems with decision-making [9]. Patients frequently report an inability to focus on daily tasks, poor retention of new information, forgetfulness, and an overall sense of cognitive fatigue. The underlying mechanisms of these impairments are still under active investigation. It is suggested that they may result from a combination of factors, such as inflammation of neural cells, hypoxia due to microcirculatory disorders, and autoimmune responses. Psychological factors, including stress and depression triggered by the pandemic and its consequences, also play a significant role [12].

Headache:

Headache is one of the most common symptoms during both the acute phase of COVID-19 and in the post-COVID period. The nature of the pain can range from mild to severe and from intermittent to constant. In some cases, it resembles migraine, accompanied by symptoms such as photophobia and nausea [12]. Headaches associated with PCS are likely caused by multiple factors, including the direct viral impact on neural tissues, inflammation, hypoxia due to impaired cerebral blood flow, and secondary influences such as stress and chronic psychoneurological disorders.

Sleep Disturbances:

Sleep disorders, including insomnia and hypersomnia, are frequently observed in individuals recovering from COVID-19. Insomnia may present as difficulty falling asleep, frequent awakenings during the night, or early morning awakenings with an inability to return to sleep. In contrast, hypersomnia is characterized by excessive daytime sleepiness regardless of nighttime sleep duration [12]. The mechanisms underlying sleep disturbances in PCS include dysregulation of the hypothalamic-pituitary-adrenal axis, disruption of circadian rhythms due to altered daily routines during illness, as well as the impact of anxiety and depressive disorders [12].

Paresthesia and Other Sensory Disturbances:

Paresthesia—sensations of tingling, numbness, or burning in the limbs—is another common consequence of COVID-19 reported by many patients. These sensations may be constant or intermittent, localized or spread throughout the body. Other sensory disturbances include hyperesthesia (increased sensitivity) and hypoesthesia (decreased sensitivity) [12]. Paresthesia in post-COVID syndrome (PCS) may be linked to peripheral nervous system dysfunction caused by inflammation, direct viral damage to nerve fibers, or autoimmune responses. Additionally, prolonged stress and anxiety can intensify these sensory symptoms [12].

Muscle Weakness and Myalgia;

Muscle weakness and myalgia (muscle pain) are frequent PCS symptoms, especially in patients who experienced severe forms of COVID-19. Muscle weakness can manifest as fatigue during minimal physical exertion or inability to perform basic daily activities such as walking or climbing stairs [12]. The causes may include direct viral damage to muscle tissue, impaired nerve impulse transmission due to inflammation and peripheral nerve damage, and mitochondrial dysfunction or oxidative stress, which disrupt energy metabolism in muscle cells [12].

Autonomic Nervous System Disorders:

Autonomic disturbances such as orthostatic hypotension, tachycardia, impaired thermoregulation, and abnormal sweating are often reported by PCS patients. These symptoms can severely affect quality of life and require a multidisciplinary treatment approach. It is believed that autonomic dysfunction in PCS is related to inflammation, direct viral damage to autonomic centers, or dysregulation of the central nervous system. Psychological factors such as anxiety and stress may also contribute [12].

Olfactory and Gustatory Disorders:

Loss of smell (anosmia) and taste (ageusia) are among the earliest and most recognizable COVID-19 symptoms, often persisting for months in PCS patients after recovery. These disturbances are likely related to viral damage to olfactory nerves and receptors, as well as disrupted signal transmission to the central nervous system. In some cases, the recovery of smell and taste functions takes a long time, highlighting the need for extended rehabilitation [12].

Psychoneurological Symptoms of Post-COVID Syndrome:

Anxiety Disorders:

Anxiety disorders—including generalized anxiety disorder, panic attacks, and social phobia—are among the most frequent psychoneurological manifestations of PCS. Patients report constant worry, intrusive fears, and significant interference with daily functioning. The development of anxiety in PCS is likely due to a combination of biological and psychological factors. Neurotransmitter imbalances (such as serotonin and dopamine), inflammation, and pandemic-related stress all contribute to anxiety symptoms. Psychological components, including fear of reinfection and uncertainty about the future, also play a key role [12].

Depressive Disorders:

Depressive disorders, including major depressive disorder and dysthymia, are also common. The biological mechanisms involved may include inflammation, impaired neuroplasticity, and hypothalamic-pituitary-adrenal (HPA) axis dysfunction. Psychosocial factors—such as social isolation, financial stress, and emotional strain from the pandemic—significantly contribute to the development of depressive symptoms [12].

Post-Traumatic Stress Disorder (PTSD):

PTSD is a serious psychoneurological complication that can develop in PCS patients, particularly those who experienced severe COVID-19 or were admitted to intensive care.

Symptoms of PTSD include flashbacks, nightmares, avoidance of reminders of the illness, and heightened arousal. Its onset is linked to the traumatic experience of illness and invasive medical procedures. The clinical course of PTSD varies depending on the individual's psychoneurological regulation, and biological factors such as impaired stress regulation and neurotransmitter dysfunction also contribute [12].

Cognitive and Emotional Dysfunction:

In addition to anxiety and depression, PCS patients may experience cognitive and emotional dysfunctions, including impaired concentration, memory loss, irritability, and emotional instability. These nonspecific symptoms can significantly complicate social interactions and work performance. The development of such dysfunctions involves both biological and psychological mechanisms. Inflammation, impaired neuroplasticity, and the prolonged stress of illness are considered key contributing factors [12].

Methods of Psychoneurological Therapy.

Pharmacological Therapy:

Medication remains a key approach in managing psychoneurological disorders associated with post-COVID syndrome (PCS). The most commonly used medications include antidepressants, antipsychotics, anxiolytics, and nootropics.

Antidepressants, particularly SSRIs (such as fluoxetine, sertraline, escitalopram), are effective in reducing anxiety and depression, while also improving cognitive function. They have a favorable safety profile and are suitable for long-term use [13].

In a randomized clinical trial (2021), SSRIs significantly reduced symptoms of depression and anxiety in 150 PCS patients: 60% showed improvement on the Hamilton scale after 12 weeks of therapy [13]. Similarly, venlafaxine (an SNRI) was found in a 2022 study to improve cognitive function and reduce anxiety in 80 patients compared to a placebo group [13].

Anxiolytics and Antipsychotics:

Anxiolytics such as benzodiazepines (lorazepam, diazepam) are prescribed to reduce anxiety in PCS but are typically used short-term due to the risk of dependence. A safer alternative is buspirone. Diazepam showed temporary anxiety reduction but requires strict monitoring [14].

Antipsychotics are effective in managing psychotic and affective disorders. A 2021 study showed that risperidone reduced delusions and hallucinations in 75% of PCS patients [15], while quetiapine stabilized mood in 70% of patients with bipolar disorders [15].

Nootropics:

Nootropics are used to restore cognitive function. Piracetam enhances brain metabolism and was shown in a 2022 study to improve memory and attention [16]. Citicoline aids in neuronal repair and has neuroprotective properties [16].

Anti-Inflammatory Therapy:

Corticosteroids (e.g., dexamethasone) help reduce inflammation in PCS but must be used cautiously with prolonged treatment [17]. NSAIDs (e.g., ibuprofen, naproxen) are effective for relieving pain and inflammation but are contraindicated in certain chronic conditions [17].

Psychotherapeutic Methods.

Cognitive Behavioral Therapy (CBT):

CBT is one of the most researched and widely used psychotherapeutic approaches. It helps patients recognize and alter negative thought patterns and behaviors that may exacerbate anxiety, depression, and other psychoneurological symptoms. In the context of post-COVID syndrome, CBT is applied not only to emotional disorders but also to cognitive impairments such as memory and concentration decline. CBT is also effective in managing post-traumatic stress disorder (PTSD), which may develop in patients who experienced severe COVID-19. A randomized trial conducted in 2021 found that CBT significantly reduced symptoms of depression and anxiety in PCS patients, with 65% showing marked improvement on the Hamilton Depression Scale after 8 weeks of therapy [18]. In another study from 2022, CBT also proved effective in treating PTSD related to PCS. A 60% reduction in post-traumatic symptoms and improvement in quality of life were observed among participants [18].

Psychodynamic Therapy:

Psychodynamic therapy focuses on the deep psychological processes that may underlie psychoneurological symptoms. This approach is rooted in psychoanalytic theory and aims to identify and resolve internal conflicts that may manifest as depression, anxiety, or other mental disorders.

Research indicates that psychodynamic therapy can be particularly beneficial for patients experiencing intense emotional distress who find it difficult to express their emotions within more structured frameworks like CBT. This method creates space for the acknowledgment and processing of complex emotions, facilitating psychological recovery. A 2021 study found that patients undergoing psychodynamic therapy showed improvements in emotional well-being and reductions in anxiety and depression symptoms [19].

Mindfulness-Based Therapy:

Mindfulness therapy, or mindfulness-based intervention, is grounded in meditation practices and the cultivation of present-moment awareness. This approach has proven effective in reducing stress, anxiety, and depression, making it a valuable tool for managing post-COVID syndrome. Mindfulness helps patients focus on the present rather than ruminate on the past or worry about the future. This is particularly important for PCS patients who may experience heightened anxiety due to fear of reinfection or chronic health consequences. Mindfulness practices help decrease the intensity of these worries and improve emotional well-being [20].

Physical and Alternative Therapeutic Methods.

Physiotherapy and Rehabilitation:

Physiotherapy plays a vital role in the recovery of PCS patients, especially those with physical and cognitive impairments. Its primary goals are to enhance overall physical fitness, reduce fatigue, and restore lost functional abilities. A 2021 study among PCS patients showed that regular physical exercises and physiotherapy improved endurance and reduced chronic fatigue in 80% of participants. In a 2022 clinical trial, patients who

underwent cognitive rehabilitation demonstrated significant improvements in memory, concentration, and other cognitive functions compared to a control group [21].

Breathing Exercises:

Breathing exercises are a key component of physiotherapy for PCS patients. These techniques aim to improve lung function, increase lung capacity, and reduce shortness of breath—a common lingering symptom of long COVID. Practices such as diaphragmatic breathing and controlled breathing exercises enhance tissue oxygenation and help reduce stress levels.

Aerobic Exercise:

Aerobic exercise—including walking, swimming, and cycling—can enhance cardiovascular endurance and reduce fatigue. Studies show that moderate aerobic activity helps patients restore physical fitness and improve mood, which is especially important for those experiencing depressive and anxiety symptoms. Incorporating aerobic routines into rehabilitation plans supports both physiological recovery and emotional well-being.

Massage and Manual Therapy:

Massage and manual therapy are commonly used to relieve muscle pain and tension, frequently reported by individuals with post-COVID syndrome. These techniques promote better blood and lymphatic circulation, contributing to overall bodily recovery. Additionally, massage can reduce stress levels and improve general well-being, making it a valuable element of comprehensive rehabilitation programs [21].

Alternative Therapeutic Methods:

Alternative therapies are becoming increasingly popular among patients with post-COVID syndrome, especially when conventional treatments fall short. Although many of these approaches still require further scientific validation, they can serve as beneficial adjuncts to standard care.

Acupuncture:

Acupuncture, an ancient Chinese practice that involves inserting fine needles into specific body points, is used to relieve pain and reduce stress. Research suggests that acupuncture can help lower anxiety and depression levels, improve sleep, and reduce chronic fatigue. While data on its effectiveness specifically for PCS remain limited, some patients report significant improvement following treatment. In a 2022 study, acupuncture demonstrated effectiveness in alleviating chronic pain and improving general well-being in PCS patients, with 65% of participants reporting substantial improvement [22]. Another study from 2021 found that herbal medicine—including ginseng and chamomile extracts—helped enhance emotional well-being and reduce anxiety symptoms in PCS patients [22].

Social Rehabilitation:

Social rehabilitation assists patients in adapting to lifestyle changes caused by post-COVID syndrome. It includes support in restoring social activity, professional functioning, and communication skills. Support groups play a critical role in this process by providing a platform for patients to share experiences and receive emotional encouragement. A 2021 study showed that participation in social rehabilitation programs helped

75% of PCS patients regain social and occupational abilities, significantly improving their quality of life [23].

Neuromodulation Methods.

Neuromodulation methods represent advanced approaches in the treatment of psychoneurological disorders and may be particularly beneficial for patients with post-COVID syndrome (PCS). These methods include transcranial magnetic stimulation (TMS), electroconvulsive therapy (ECT), and neurofeedback. They aim to modify neural activity and enhance both cognitive and emotional functioning.

Transcranial Magnetic Stimulation (TMS):

TMS is a non-invasive neuromodulation technique that uses magnetic fields to stimulate specific areas of the brain. It is widely used in the treatment of depression and other psychoneurological disorders and is currently being explored for its effectiveness in PCS.

Numerous studies support the efficacy of TMS for PCS, reporting improvements in overall patient condition, reductions in depression and anxiety symptoms, and enhancements in cognitive functioning. TMS is considered a safe treatment with minimal side effects, such as mild headaches or localized discomfort at the stimulation site [24].

Electroconvulsive Therapy (ECT):

ECT is an effective treatment for severe psychoneurological disorders, including treatment-resistant depression. It involves applying controlled electrical currents to induce a brief seizure, which helps restore neurochemical balance and relieve symptoms.

In PCS, ECT is used when patients experience persistent and severe depressive symptoms that do not respond to antidepressants or psychotherapy. It may also be effective for treating certain anxiety disorders and psychotic episodes. Research indicates that ECT can significantly reduce depression severity and improve overall health status. However, it requires close monitoring due to possible side effects such as short-term memory loss and cognitive disturbances. Despite these risks, ECT remains a safe and effective intervention when conducted under proper medical supervision [25].

Rehabilitation Programs.

Rehabilitation programs play a vital role in the recovery of PCS patients. They aim to comprehensively improve physical, cognitive, and emotional well-being. This section highlights multidisciplinary treatment strategies, the impact of physical exercise, and the role of nutrition in recovery [26].

Physical Activity and Exercise.

Physical activity is a crucial part of post-COVID rehabilitation. It helps enhance physical health, reduce fatigue, and support psychoneurological recovery.

Aerobic Exercise: Activities like walking, swimming, and cycling improve cardiovascular function, increase energy levels, and reduce stress. These exercises also build endurance and physical capacity, which are essential for patients dealing with chronic fatigue and weakness.

Strength Training: Strength-based exercises help rebuild physical activity tolerance and maintain muscle and joint health.

These can include weight training, bodyweight exercises, and resistance band workouts.

Flexibility and Stretching: Flexibility routines such as yoga and Pilates enhance mobility and relieve muscle tension. These exercises support general well-being and help lower stress levels.

Studies show that regular physical activity improves psychoneurological health, reduces depression and anxiety symptoms, and boosts cognitive performance. It is essential to tailor exercise programs to individual capabilities to prevent overexertion or adverse effects [26].

Balanced nutrition, combined with physical activity and other rehabilitation components, can significantly improve the general condition of PCS patients and support more effective recovery [26].

The Impact of Comorbid Conditions on Treatment Choice and Effectiveness.

The presence of comorbidities significantly influences both the selection and effectiveness of therapy in patients with post-COVID syndrome. Chronic illnesses such as diabetes or cardiovascular disease can complicate treatment plans and necessitate adjustments to standard therapeutic protocols. For instance, certain antidepressants may interact with medications used to manage chronic conditions, requiring careful consideration and monitoring during prescription.

Patients with pre-existing psychiatric disorders demand a more comprehensive approach and more frequent observation. In cases involving conditions like bipolar disorder or schizophrenia, treatment must be customized, often involving a combination of pharmacological and psychotherapeutic interventions tailored to the specific clinical profile.

Individual treatment responses vary widely, influenced by genetic predispositions, stress levels, and the presence of other health conditions. As a result, therapy must be personalized and dynamic, with regular assessments of efficacy and ongoing adjustments based on patient progress and tolerance.

Conclusion.

A comprehensive review of literature on psychoneurological therapy for post-COVID syndrome highlights several key aspects. First, the diversity of symptoms—ranging from depression and anxiety to cognitive impairment—demands a multifaceted treatment strategy. Pharmacological interventions, particularly antidepressants and anxiolytics, remain central despite the need for careful dosage personalization and monitoring for side effects.

Second, neuromodulation methods such as transcranial magnetic stimulation (TMS) and electroconvulsive therapy (ECT) have shown considerable promise, especially in severe cases unresponsive to medication. Neurofeedback presents a novel approach to managing cognitive and emotional dysfunctions, although more empirical evidence is needed to fully confirm its effectiveness.

Physical activity and integrated rehabilitation programs are also critical components in the recovery of functional and cognitive capacities. Regular exercise and multidisciplinary approaches have consistently led to improvements in patient outcomes and quality of life.

The effectiveness of therapy for post-COVID syndrome is supported by a wide range of studies encompassing pharmacological treatments, psychotherapy, rehabilitation, and complementary approaches. This section summarized major research findings demonstrating how various treatment methods contribute to restoring psychoneurological health in affected individuals.

Post-COVID syndrome is a complex and multifactorial condition requiring a holistic and flexible treatment framework. While existing data support the efficacy of numerous therapeutic strategies, each comes with its limitations and demands further research. Promising directions for future studies include the development of individualized treatment plans, investigation of long-term outcomes, integration of multimodal therapies, and deeper exploration of the psychoneurological mechanisms underlying PCS. These efforts are essential for improving patient care and ensuring more effective management of post-COVID syndrome.

Authors Contributions.

Conceptualization and project administration: NV and AS. Methodology and literature analysis: AB and RA. Data curation and validation: BM. Writing – original draft preparation: NV, AS, and AB. Writing – review and editing: RA and BM. All authors have read and approved the final version of the manuscript.

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