

# **GEORGIAN MEDICAL NEWS**

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**ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ**

Медицинские новости Грузии  
საქართველოს სამედიცინო სიახლენი

## GEORGIAN MEDICAL NEWS

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

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

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

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

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

### WEBSITE

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

## К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

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

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

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

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

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

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

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

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

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

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

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

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

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

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

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

## REQUIREMENTS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## ავტორთა საქურაღებოლ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დაიცვათ შემდეგი წესები:

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

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

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

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

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

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

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

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

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

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

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

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

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

Hua-ting Bi, Wen-Wen Hao. CORRELATION BETWEEN PREOPERATIVE MACULAR THICKNESS AND POSTOPERATIVE VISUAL PROGNOSIS IN PATIENTS WITH DIABETIC CATARACT.....	6-9
Melik-Andreasyan G.G, Tkhruni F.N, Karapetyan K.J, Atoyan S.A, Aleksanyan N.J, Kotsinyan N. Yu, Israyelyan A.L. COMPARATIVE SUSCEPTIBILITY PROFILES OF CLINICAL AND REFERENCE BACTERIAL STRAINS ACROSS MULTIPLE ANTIBIOTIC CLASSES.....	10-16
Khrantsov D.M, Chernyshov O.V, Stoyanov O.M, Gryb V.A, Vorokhta Y.M. COGNITIVE RESERVE IN PATIENTS AFTER CORONAVIRUS INFECTION.....	17-22
Egzon Daku, Leon B. Hajdari, Bese R. Morina. OPTIMIZING SPINAL ANESTHESIA IN URGENT CESAREAN DELIVERY: THE TAYLOR APPROACH IN A PARTURIENT WITH CORRECTED SEVERE SCOLIOSIS AND PULMONARY COMPLICATIONS: A CASE REPORT.....	23-28
Ana Maisuradze, Ketevan Kiguradze-Gogilashvili, Flavien Fettak, Ketevan Oghiashvili, Vaja Maisuradze. CORRELATION BETWEEN RADIATION SAFETY TRAINING AND COMPLIANCE WITH RADIATION PROTECTION PRACTICES: A CROSS-SECTIONAL STUDY.....	29-32
Sarmad S. Salih Al Qassar, Omar Hussein Alluazy, Ahmed Khalaf Ali. A NOVEL NON-INVASIVE MODULATION OF ORTHODONTIC RELAPSE: INSIGHTS FROM A RABBIT MODEL.....	33-44
Fitim Alidema, Lirim Mustafa, Egzona Papraniku, Arieta Hasani Alidema, Mirlinda Havolli. BIOCHEMICAL ABNORMALITIES OF HEPATIC AND RENAL FUNCTION IN HOSPITALIZED PATIENTS RECEIVING PHARMACOLOGICAL THERAPY: A THREE-YEAR RETROSPECTIVE ANALYSIS.....	45-49
Sion Jo. DOUBLE LUMEN TECHNIQUE (DLT) - ENDOTRACHEAL TUBE GUIDED LEVIN TUBE INSERTION TECHNIQUE.....	50-53
Ellen Safadi, Aparna Baburaj, Sara Musa Abdalla Elamin, Marwan Ismail. ASSOCIATION OF DEMOGRAPHIC AND SOCIOECONOMIC VARIABLES WITH PATIENTS' COMPREHENSION AND CONTENTMENT REGARDING INFORMED CONSENT IN A UNIVERSITY HOSPITAL SETTING: A CROSS-SECTIONAL STUDY.....	54-59
Ostemirkyzy Darika, Kapsalyamova Elmira, Daryono Hadi Tjahjono, Ustenova Gulbaram, Eva Susanty Simaremare. ISOLATION AND IDENTIFICATION OF $\beta$ -SITOSTEROL FROM <i>ZYGOPHYLLUM FABAGO</i> L. HERB USING SUBCRITICAL CO <sub>2</sub> EXTRACTION.....	60-66
Oleg Batiuk, Marharyta Shkabarina, Andrii Manko, Svitlana Cherneta, Iryna Bychuk. THE DYNAMICS OF PERCEPTIONS AND EVALUATION OF THE COMPONENTS OF THE IMAGE OF AN IDEAL TEACHER DURING THE COVID-19 PANDEMIC.....	67-75
Ghaith Wadhah Hamdoon, Aws Hazem Al-Numan, Nawar Yahya Ahmed, Rikan Sulaiman Jumaah, Mazin Mahmoud Fawzi, Banan Burhan Mohammed. UMBILICAL STUMP CARE IN NEWBORNS: IS BREAST MILK AS EFFECTIVE AS CONVENTIONAL METHODS.....	76-80
Sana Khamassi, Emna Bornaz, Nourhène Tayari, Amel Gamoudi, Kamilia Ounaissa, Haifa Abdesselem, Ichraf Ben Ammar, Bahija Riahi, Dorra Bousnina, Henda Jamoussi, Chiraz Amrouche. OVERWEIGHT AMONG TUNISIAN SCHOOL-AGED CHILDREN: PREVALENCE AND ASSOCIATED FACTORS.....	81-86
Tsisana Giorgadze, Tinatin Gognadze, Lasha Dolidze. CERTAIN PROPERTIES OF $\beta$ -GLUCOSIDASE FROM <i>YUCCA GLORIOSA</i> FLOWERS.....	87-92
Issenova Saule, Rakhimzhanova Adel, Shukirgaliyeva Marzhana. RISK MANAGEMENT AND HEALTH SUPPORT FOR PREGNANT WOMEN USING INOSITOLS.....	93-100
Lirim Isufi, Diellza Kelmendi, Adelina Ahmeti Pronaj. GENDER DIFFERENCES IN EMOTIONAL REGULATION AMONG ADOLESCENTS WITH ELEVATED ADHD SYMPTOMS: A SCHOOL-BASED STUDY.....	101-105
Ketevan Omiadze, Alikya Chipurupalli, Tea Abzhandadze. CHRONIC URTICARIA RELATED TO <i>HELICOBACTER PYLORI</i> INFECTION – A CASE REPORT.....	106-109
Dinara Aliyeva, Ildar Fakhradiyev, Marat Shoranov. IDEOLOGICAL FAULT LINES IN PHARMACEUTICAL POLICY OF KAZAKHSTAN: A Q-METHODOLOGICAL APPROACH.....	110-119
Ahmed Abdalla Jarelnape. ARTIFICIAL INTELLIGENCE UTILIZATION AND ITS ASSOCIATION WITH NURSING PRACTICE IN CARDIOLOGY AND INTENSIVE CARE UNITS: A CROSS-SECTIONAL STUDY.....	120-124
Jiaqi Liu, Yan Pan, Zuliang Yan, Hong Jiang, Hanglin Li, Ying Yu. GLOBAL, REGIONAL, AND NATIONAL BURDEN OF CHRONIC KIDNEY DISEASE DUE TO TYPE 2 DIABETES MELLITUS, 1990-2021, WITH FORECASTS TO 2035: A FORECASTING STUDY FOR THE GLOBAL BURDEN OF DISEASE STUDY 202.....	125-135

Ahmed Dallal Bashi, Noor Abdulmonim, Noor Salem, Saleh Nayf, Teba Ammar, Yosif Ismaeel. THE MOST COMMONLY PRESCRIBED MEDICATIONS BY PEDIATRICIANS IN MOSUL CITY .....	136-142
Lukina Veronika V, Katibgadzhiev Magomed A, Solovyov Andrey A, Kovalenko Polina S, Kuzmich Vitaliy V, Eremeeva Mariia V, Gaevskaya Rinata R, Kuznetsova Anna A, Aleksandrova Iuliia S, Bulia Mariam Z, Sadrutdinov Tatam D, Saitova Atikat S. COMPARATIVE EFFECTIVENESS OF CONSERVATIVE METHODS FOR ACCELERATING EPITHELIALIZATION IN ACUTE ANAL FISSURE.....	143-147
Yerzhan Sharapatov, Maida Tusupbekova, Yermek Turgunov, Yuriy Pak, Yersaiyn Zhiyenbayev, Kuandyk Beisenov. COMPARATIVE EXPERIMENTAL STUDY OF MORPHOLOGICAL CHANGES IN THE KIDNEY IN ACUTE OBSTRUCTIVE PYELONEPHRITIS MODEL: INFLUENCE OF INFECTION ROUTE.....	148-155
Aymar Kassa Boukat, Massine El Hamoummi, Yassine Sarboute, Beouiss Mohamed, Andemey Leyoubou Emilie, Edderai Meryem, El Hassane Kabiri. POST-CT-GUIDED BIOPSY PNEUMOTHORAX, ACCORDING TO THE COAXIAL TECHNIQUE WITH AN 18-GAUGE NEEDLE: EPIDEMIOLOGICAL, DIAGNOSTIC AND THERAPEUTIC ASPECTS.....	156-161
Azamat K. Kairgali, Raisa A. Aringazina, Murat K. Jakanov, Abdolreza Haghpanah, Marat N. Sarkulov. THE EFFECT OF TRIVALENT CHROMIUM ON METABOLIC SYNDROME: A NARRATIVE REVIEW.....	162-169
Mohammed K.M Madi, Hannan Awad, Marwan Ismail, Maxmudjon Butaboyev, Jamoliddin Bobokalonzoda, Gaybiev Akmaljon Axmadjonovich, Elryah I Ali, Husham O. Elzein, Rasha Babiker, Amin SI Banaga, Salah Eldin Omar Hussein, Ayman H. Alfeel, Ahmed L. Osman, Asaad Babker. RETICULOCYTE SUBPOPULATION ANALYSIS AND ITS CORRELATION WITH IRON DEFICIENCY ANEMIA: A RETROSPECTIVE STUDY IN A PREDOMINANTLY FEMALE POPULATION.....	170-176
Zena S. Tawffiq, Inas H. Ahmed, Luma M. Al-Obaidy. PHYTOCHEMICAL SCREENING AND LIPID LOWERING EFFECTS OF <i>TERMINALIA CHEBULA</i> FRUIT EXTRACTS IN ALBINO WISTAR RATS.....	177-181
Azamat Shamsiev, Abdiqodir Shakhriev, Botir Yuldashev, Leyla Khakimova, Fariza Khalimova, Sagirayev Nodir Zhumakulovich. CLINICAL EFFECTIVENESS OF TRADITIONAL TREATMENT METHODS FOR GRADE III CHEMICAL ESOPHAGEAL BURNS IN CHILDREN.....	182-186
Plaurat Krasniqi, Leon B. Hajdari, Fatos Sada, Egzon Daku. POSTOPERATIVE MORPHINE USE IN ABDOMINAL SURGERY: CLINICAL INSIGHTS FROM A ONE-YEAR SINGLE-CENTER RETROSPECTIVESTUDY.....	187-193
Bashayr Z. Alamri, Reem F. Alnemari, Abduljawad S. Alharbi. UNDERSTANDING FACTORS CONTRIBUTING TO PATIENTS' NON-ADHERENCE TO A LIFESTYLE MODIFICATION PLAN: A CROSS-SECTIONAL STUDY AMONG VISITORS OF LIFESTYLE CLINICS IN KING ABDUL-AZIZ MEDICAL CITY, JEDDAH.....	194-201

## GENDER DIFFERENCES IN EMOTIONAL REGULATION AMONG ADOLESCENTS WITH ELEVATED ADHD SYMPTOMS: A SCHOOL-BASED STUDY

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### Abstract.

**Background:** Executive function deficits are consistently associated with attention-deficit/hyperactivity disorder (ADHD), yet the expression of specific executive domains may differ across genders. Emotional regulation difficulties have been increasingly recognized as an important component of ADHD, particularly among adolescent girls, although evidence from large community-based samples remains limited.

**Objective:** This study examined gender differences across executive function domains in adolescents, with particular emphasis on emotional regulation among those with elevated ADHD symptoms.

**Methods:** A school-based cross-sectional study was conducted with 1,260 adolescents aged 11–18 years. Executive functioning was assessed using the Behavior Rating Inventory of Executive Function – Self Report (BRIEF-SR), and ADHD symptoms were measured with the Youth Self Report (YSR). Participants scoring in the clinical range on the YSR Attention Problems scale were classified as the high ADHD symptom group. A subsample underwent neurocognitive testing using the Stroop Color–Word Test and the Go/No-Go task. Group comparisons, correlational analyses, and interaction models were used to examine executive function domains and the influence of gender.

**Results:** ADHD symptoms were strongly associated with global executive dysfunction ( $r = 0.703, p < 0.001$ ). Adolescents in the high ADHD symptom group showed substantially greater impairment across behavioral, emotional, and cognitive regulation domains compared with peers below the clinical threshold. A gender difference was observed specifically in the emotional regulation domain, with females reporting higher levels of impairment than males, while overall ADHD symptom scores did not differ significantly by gender. Neurocognitive testing in the subsample indicated longer reaction times in the incongruent condition of the Stroop task among adolescents with elevated ADHD symptoms.

**Conclusions:** Emotional dysregulation appears to represent a particularly salient executive difficulty among female adolescents with elevated ADHD symptoms. These findings support the inclusion of emotional regulation measures in routine assessment and highlight the potential value of gender-sensitive approaches in the identification and intervention of adolescents with ADHD-related difficulties.

**Key words.** ADHD symptoms, executive functions, emotional regulation, gender differences, adolescents.

### Introduction.

Attention-deficit/hyperactivity disorder (ADHD) is a prevalent neurodevelopmental condition characterized by persistent patterns of inattention, hyperactivity, and impulsivity that interfere with functioning across academic, social, and family domains. Epidemiological studies estimate that ADHD affects approximately 5–7% of school-aged children and adolescents worldwide, making it one of the most common psychiatric disorders in this age group [1,2]. Although ADHD has traditionally been conceptualized as a behavioral disorder, contemporary models increasingly emphasize deficits in cognitive and emotional self-regulation as central features of its underlying neuropsychological profile.

Executive functions (EF) refer to a set of higher-order cognitive processes that enable goal-directed behavior, including inhibitory control, working memory, cognitive flexibility, planning, and organization. These functions are essential for adaptive functioning across developmental contexts. A large body of research has consistently demonstrated that individuals with ADHD exhibit impairments in multiple executive domains, particularly in behavioral inhibition and working memory [3,4]. Barkley's theoretical model proposes that ADHD is fundamentally a disorder of behavioral inhibition, which leads to secondary impairments in other executive processes, including internalized speech, self-regulation of affect, and reconstitution of behavior [4]. Within this framework, emotional regulation is not viewed as a peripheral or comorbid feature, but rather as an integral component of executive functioning.

In recent years, emotional dysregulation has received increasing attention as a clinically relevant aspect of ADHD. Children and adolescents with ADHD frequently display heightened emotional reactivity, low frustration tolerance, and difficulties modulating affective responses in everyday situations [5]. Emotional dysregulation in ADHD has been associated with poorer social relationships, increased risk of comorbid psychiatric conditions, and greater overall functional impairment [6]. These findings have contributed to a broader understanding of ADHD as a disorder involving both cognitive and emotional self-regulation.

Gender differences in ADHD have also been widely documented. Boys are diagnosed more frequently and tend to exhibit more overt hyperactive and disruptive behaviors, whereas girls are more likely to present with inattentive symptoms, internalizing problems, and emotional instability [7,8]. Because these symptoms are often less disruptive in

structured environments such as classrooms, ADHD in girls may be underrecognized or diagnosed later in development. Emerging evidence suggests that emotional dysregulation may represent a particularly salient feature of ADHD in females, potentially reflecting gender-specific patterns of executive dysfunction [5,9].

Despite growing interest in gender-related differences in ADHD, many studies have relied on small clinical samples or have focused primarily on behavioral symptom profiles rather than specific executive function domains. Moreover, relatively few studies have examined emotional regulation within large community-based adolescent samples. Adolescence is a critical developmental period marked by significant neurobiological and emotional changes, during which executive functions and emotional regulation processes continue to mature. Understanding how executive domains, particularly emotional regulation, differ across genders during this period may have important implications for early identification and intervention.

The present study aimed to examine gender differences across executive function domains in a large school-based sample of adolescents, with particular emphasis on emotional regulation among those with elevated ADHD symptoms. Based on existing theoretical models and empirical findings, it was hypothesized that emotional regulation difficulties would be more pronounced in females compared to males within the high ADHD symptom group, even in the absence of overall gender differences in ADHD symptom severity.

## Materials and Methods.

**Study design:** This study was conducted as a **school-based cross-sectional investigation** examining executive function domains and their association with ADHD symptoms in adolescents. The design consisted of a screening phase using standardized self-report instruments, followed by an experimental phase involving neurocognitive testing in a subsample of participants. All procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki.

**Participants:** The study sample consisted of **1,260 adolescents aged 11–18 years**, recruited from primary and secondary schools through school-based screening procedures. Of the total sample, **46.8% (n = 590) were male** and **53.2% (n = 670) were female**. The mean age of participants was **14.23 years (SD = 2.24)**.

Participants were recruited from **general education classrooms**. Students attending regular classes were invited to participate. Adolescents with severe intellectual disability or those unable to complete the self-report instruments were excluded.

Written informed consent was obtained from parents or legal guardians, and assent was obtained from the adolescents prior to participation.

**Operational definition of the ADHD symptom group:** The ADHD symptom group was operationally defined using the **Attention Problems scale of the Youth Self Report (YSR)**. The YSR is a standardized, norm-referenced instrument that provides T-scores based on age- and gender-adjusted norms. Participants scoring in the **clinical range (T-score  $\geq$  70)** on the

Attention Problems scale were classified as the **high ADHD symptom group**. Participants scoring below this threshold were classified as the **comparison group**. This classification was based on screening criteria and does not represent a formal clinical diagnosis. Accordingly, the terminology “high ADHD symptom group” is used throughout the study to reflect the symptom-based classification.

## Instruments.

**Executive function assessment:** Executive functioning was assessed using the Behavior Rating Inventory of Executive Function – Self Report (BRIEF-SR). This standardized instrument evaluates executive functioning in everyday contexts among adolescents. The BRIEF-SR yields a Global Executive Composite (GEC) score and three principal indices:

- **Behavior Regulation Index (BRI)**
- **Emotional Regulation Index (ERI)**
- **Cognitive Regulation Index (CRI)**

These indices reflect major domains of executive functioning, including inhibition, emotional control, working memory, planning, and organization. Scores were interpreted according to standardized normative guidelines, with clinical-range scores defined according to the instrument manual.

## ADHD symptom and internalizing symptom assessment:

ADHD symptoms and associated emotional and behavioral problems were assessed using the **Youth Self Report (YSR)**. The YSR is a widely used standardized self-report instrument for adolescents aged 11–18 years.

For the purposes of this study, the following scales were used:

- **Attention Problems scale** – used to define the high ADHD symptom group.
- **Internalizing Problems composite** – used as a covariate to control for anxiety and depressive symptoms in analyses of emotional regulation.

## Neurocognitive assessment:

In the experimental phase, a **subsample of 88 adolescents** was selected from both the high ADHD symptom group and the comparison group to undergo neurocognitive testing.

Neurocognitive functioning was evaluated using:

1. **Stroop Color–Word Test:**
  - o Assesses cognitive interference and inhibitory control
  - o Reaction times were recorded for congruent and incongruent conditions
2. **Go/No-Go task:**
  - o Assesses response inhibition and attentional control
  - o Measures included reaction time and error rates

Testing was conducted individually in a quiet room within the school environment to minimize distractions and ensure standardized administration.

## Procedure:

The study was conducted in two phases: **Screening phase:** Participants completed the BRIEF-SR and YSR questionnaires in a classroom setting under standardized administration conditions. Instructions were provided by trained research personnel.

**Experimental phase:** A subsample of participants was invited to complete the neurocognitive testing battery, including the

Stroop Color–Word Test and the Go/No-Go task. Testing was conducted individually in a controlled environment within the school.

**Medication status:** The study was conducted as a school-based screening investigation. Systematic information regarding current or past pharmacological treatment for ADHD was not collected as part of the screening protocol. Consequently, medication status was not included as an exclusion criterion or covariate in the analyses. This limitation is addressed in the Discussion section.

**Statistical analysis:** Statistical analyses were performed using SPSS software (version 23 for Windows). A significance level of  $p < 0.05$  was used for all statistical tests. The analyses were conducted in several steps:

1. **Reliability analysis**

o Internal consistency of the BRIEF-SR and YSR scales was assessed using Cronbach’s alpha coefficients.

2. **Descriptive statistics**

o Means, standard deviations, and frequency distributions were calculated for demographic and clinical variables.

3. **Group comparisons**

o Differences between the high ADHD symptom group and the comparison group were examined using appropriate statistical tests for continuous and categorical variables.

4. **Correlation analysis**

o Pearson correlation coefficients were calculated to examine associations between ADHD symptom severity and global executive dysfunction.

5. **Gender and interaction analyses**

o To determine whether gender differences in emotional regulation were specific to the high ADHD symptom group, interaction models were conducted.

o Executive function scores were analyzed using models including:

§ ADHD symptom group

§ gender

§ ADHD  $\times$  gender interaction term

6. **Covariate-adjusted models**

o Analyses of emotional regulation included the **YSR Internalizing Problems score** as a covariate to control for anxiety and depressive symptoms.

7. **Neurocognitive analyses**

o Reaction times and error rates from the Stroop and Go/No-Go tasks were compared between groups.

o Interaction effects between gender and ADHD symptom group were examined where appropriate.

Where available, results are reported with corresponding test statistics,  $p$ -values, and effect size estimates.

**Results.**

**Sample characteristics:**

The study included 1,260 adolescents aged 11–18 years, with a mean age of 14.23 years ( $SD = 2.24$ ). Females comprised 53.2% of the sample ( $n = 670$ ), while males represented 46.8% ( $n = 590$ ).

Based on the clinical cutoff of the YSR Attention Problems scale ( $T$ -score  $\geq 70$ ), participants were classified into a high ADHD symptom group and a comparison group. The prevalence of adolescents in the clinical range for ADHD symptoms was

7.5% of the total sample.

**Association between ADHD symptoms and executive dysfunction:**

A strong positive correlation was observed between ADHD symptom severity and the Global Executive Composite (GEC) score of the BRIEF-SR:

- $r = 0.703$
- $p < 0.001$

This finding indicates a robust association between ADHD symptoms and global executive dysfunction.

Executive function impairments: high ADHD symptom group vs comparison group.

Adolescents in the high ADHD symptom group demonstrated greater impairment across all major executive function domains compared with the comparison group.

1. **Behavior Regulation Index (BRI):**

High ADHD symptom group: 67.3% in the clinical range  
Comparison group: 10.1%

2. **Emotional Regulation Index (ERI):**

High ADHD symptom group: 69.5% in the clinical range  
Comparison group: 10.2%

3. **Cognitive Regulation Index (CRI):**

High ADHD symptom group: 70.5% in the clinical range  
Comparison group: 11.0%.

**Gender differences across executive function domains:**

Gender analyses revealed a significant difference only in the emotional regulation domain. Female adolescents in the high ADHD symptom group reported higher emotional regulation impairment compared to males.

No significant gender differences were observed in:

- Behavior Regulation Index (BRI)
- Cognitive Regulation Index (CRI)
- overall ADHD symptom scores

**Gender  $\times$  ADHD symptom group interaction:** Interaction analyses indicated a significant interaction between gender and ADHD symptom group for the Emotional Regulation Index, suggesting that emotional dysregulation was more pronounced among females within the high ADHD symptom group. No significant interaction effects were observed for the Behavior Regulation or Cognitive Regulation indices.

**Neurocognitive performance:** A subsample of adolescents participated in the neurocognitive testing phase. Participants in the high ADHD symptom group demonstrated longer reaction times in the incongruent condition of the Stroop task compared with the comparison group.

A significant interaction effect between gender and ADHD symptom group was observed in the Stroop task:

- $F(1,88) = 6.835$
- $p = 0.011$

Females in the high ADHD symptom group showed higher mean reaction times compared with other groups.

In the Go/No-Go task, significant differences were observed between groups in response inhibition performance, with a moderate interaction effect:

- $F(1) = 4.76$
- $p = 0.032$
- $\eta^2 = 0.053$

**Table 1.** Proportion of participants in the clinical range across executive domains.

Executive domain	High ADHD symptom group (%)	Comparison group (%)	P - Value
Behavior Regulation (BRI)	67.30%	10.10%	<0.001
EMOTIONAL REGULATION (ERI)	69.50%	10.20%	<0.001
Cognitive Regulation (CRI)	70.50%	11.00%	<0.001

**Table 2.** Gender differences across executive domains within the high ADHD symptom group.

Executive domain	Male adolescents	Female adolescents	p-value
Behavior Regulation (BRI)	No significant difference	No significant difference	>0.05
Emotional Regulation (ERI)	Lower impairment	Higher impairment	<0.05
Cognitive Regulation (CRI)	No significant difference	No significant difference	>0.05
ADHD symptom scores	No significant difference	No significant difference	>0.05

**Table 3.** Neurocognitive performance in the subsample.

Measure	High ADHD symptom group	Comparison group	Statistic	p-value
Stroop incongruent RT	Longer reaction times	Shorter reaction times	F(1,88) = 6.835	0.011
Go/No-Go inhibition	Reduced inhibition	Better inhibition	F(1) = 4.76, $\eta^2 = 0.053$	0.032

## Discussion.

The present study examined gender differences across executive function domains in a large school-based sample of adolescents, with particular emphasis on emotional regulation among those with elevated ADHD symptoms. The results demonstrated a strong association between ADHD symptom severity and global executive dysfunction. Adolescents in the high ADHD symptom group showed substantially greater impairment across behavioral, emotional, and cognitive regulation domains compared with their peers. Importantly, a gender difference emerged specifically in the emotional regulation domain, with females reporting greater impairment than males, while overall ADHD symptom scores did not differ significantly between genders.

These findings support theoretical models that conceptualize ADHD as a disorder of self-regulation rather than solely of attention or motor control. Barkley’s inhibition model proposes that deficits in behavioral inhibition lead to downstream impairments in executive functions, including emotional self-regulation. The strong correlation observed between ADHD symptoms and the Global Executive Composite in this study is consistent with previous research demonstrating that executive dysfunction represents a central neuropsychological feature of ADHD.

One of the most relevant findings was the gender-specific difference in emotional regulation. Female adolescents in the high ADHD symptom group reported significantly higher levels of emotional dysregulation compared to males, despite similar overall ADHD symptom severity. This suggests that emotional regulation difficulties may represent a more prominent aspect of executive dysfunction among females with elevated ADHD symptoms. Such findings are consistent with clinical observations and prior research indicating that girls with ADHD are more likely to present with internalizing symptoms, emotional instability, and less overt hyperactive behavior. Because these symptoms are often less disruptive in structured environments, they may be underrecognized or attributed to

emotional or personality factors rather than ADHD-related executive dysfunction.

The absence of significant gender differences in overall ADHD symptom scores warrants consideration. Epidemiological studies typically report higher ADHD symptom levels and diagnostic rates among males. However, the present findings are based on self-report measures in a community sample, which may influence the observed pattern. Adolescent boys are known to underreport emotional and attentional difficulties, while girls may be more willing to acknowledge internal distress. Additionally, the use of a school-based sample rather than a clinically referred population may reduce the magnitude of gender differences typically observed in diagnostic studies. These factors may partly explain the lack of gender differences in overall ADHD symptom severity in the present study.

The interaction analyses further supported the specificity of the emotional regulation finding. The gender difference was observed primarily within the high ADHD symptom group, rather than reflecting a general gender difference in emotional reporting across the entire sample. Moreover, the inclusion of internalizing symptoms as covariates in the analyses aimed to control for potential confounding effects of anxiety and depression, which are more prevalent among adolescent girls. The persistence of the gender difference in emotional regulation after accounting for internalizing symptoms suggests that the observed effect is not solely attributable to general emotional distress.

The neurocognitive findings provided additional support for the presence of executive dysfunction in adolescents with elevated ADHD symptoms. Participants in the high ADHD symptom group demonstrated longer reaction times in the incongruent condition of the Stroop task, reflecting reduced inhibitory control. Furthermore, the observed interaction between gender and ADHD symptom group in the neurocognitive tasks indicated that females with elevated ADHD symptoms exhibited greater performance deficits in specific inhibitory conditions. These

results are consistent with the broader pattern of emotional and cognitive regulation difficulties observed in the self-report measures.

### **Clinical implications.**

The findings of this study have several clinical implications. First, they highlight the importance of assessing executive functions, particularly emotional regulation, in adolescents presenting with ADHD symptoms. Traditional diagnostic frameworks have focused primarily on behavioral symptoms such as inattention and hyperactivity, which may not fully capture the functional impairments experienced by many adolescents, especially females.

Second, the results suggest that gender-sensitive approaches to assessment and intervention may be beneficial. Emotional dysregulation may represent a key target for clinical interventions among female adolescents with elevated ADHD symptoms. Interventions that incorporate emotional regulation training, cognitive-behavioral strategies, and family-based approaches may be particularly relevant for this population.

Finally, these findings underscore the importance of screening for ADHD-related executive difficulties in school-based settings. Early identification of emotional regulation problems may help prevent the development of secondary complications, such as anxiety, depression, and social difficulties.

### **Limitations.**

Several limitations should be considered when interpreting the results. First, the study relied primarily on self-report measures for the assessment of executive functioning and ADHD symptoms. Self-report data may be influenced by subjective perception, reporting biases, and gender-related differences in emotional expression.

Second, the cross-sectional design does not allow conclusions about causality or developmental trajectories. Longitudinal studies are needed to determine whether emotional regulation difficulties represent a stable feature of ADHD across development or a gender-specific developmental pathway.

Third, the neurocognitive assessment was conducted in a subsample rather than the entire cohort, which may limit the generalizability of those findings.

Fourth, medication status was not systematically assessed as part of the screening protocol. Pharmacological treatment may influence executive function and neurocognitive performance, and future studies should include medication status as a controlled variable.

### **Conclusion.**

The present study demonstrated a strong association between ADHD symptoms and executive dysfunction in a large school-based sample of adolescents. Adolescents with elevated ADHD symptoms showed substantially greater impairment across behavioral, emotional, and cognitive regulation domains compared with their peers. A significant gender difference was observed specifically in the emotional regulation domain, with females reporting greater impairment despite similar overall ADHD symptom levels. These findings suggest that emotional dysregulation may represent a particularly salient executive difficulty among female adolescents with elevated ADHD

symptoms. The results support the importance of incorporating emotional regulation measures into routine assessments and highlight the potential value of gender-sensitive approaches in the identification and intervention of adolescents with ADHD-related difficulties.

### **Conflict of Interest.**

The authors declare no conflict of interest.

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**All authors have read and approved the final version of the manuscript.**

### **Ethical Approval.**

The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the relevant institutional ethics committee prior to data collection. Written informed consent was obtained from parents or legal guardians, and assent was obtained from all participating adolescents.

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