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Publication ethics

The Journal is committed to practice the publication ethics and takes all possible measures against any publication malpractices.

The editorial and publication processes of the journal are shaped in accordance with the guidelines of the International Council of Medical Journal Editors (ICMJE), The World Association of Medical Editors (WAME), The Council of Science Editors (CSE), The Committee on Publication Ethics (COPE), The European Association of Science Editors (EASE), and National Information Standards Organization (NISO). The journal conforms to the Principles of Transparency and Best Practice in Scholarly Publishing (https://doaj.org/bestpractice).

In the event of alleged or suspected research misconduct, e.g., plagiarism, citation manipulation, and data falsification/fabrication, the Editorial Board will follow and act in accordance with COPE guidelines.

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ABOUT THE JOURNAL

Scientific Reports in Medicine is a scientific publication of Academician Publishing and published three times a year online.

It is an open access scientific journal, which publishes original contributions in medical disciplines pertaining to human medicine. In this context, the Journal publishes original researches, case reports, and reviews based on clinical and experimental studies in all areas of human medicine. It is a scientific, periodic journal based on the principles of blind peer-review process. The publication language is English. The Journal is published online three times a year on April, August, and December.

Manuscripts submitted for publication in the journal should be prepared in accordance with research and publication ethics. All manuscripts submitted to the Journal are screened in terms of originality.

All manuscripts should be submitted by online system of the Journal.

The Journal aims to;

- Publish original contributions from different scientific disciplines through the advisory board covering a wide range of medical disciplines,
- Offer all its content freely available without charge to the user or his/her institution, to make research freely available to the public, and to support a greater global exchange of knowledge,
- By permitting authors to enter into separate, additional contractual arrangements for the non-exclusive distribution of the journal's published version of the work (e.g., post it to an institutional repository or publish it in a book), to lead productive exchanges, as well as earlier and greater citation of published work.

Subject areas include, (but are not restricted) to the clinical and experimental studies of the following fields:

- First Aid and Emergency Medicine
- Family Medicine
- Public Health and Preventive Medicine
- Internal Diseases
- General Surgery
- Gynecology and Obstetrics
- Ear, Nose and Throat Diseases
- Eye Diseases
- Orthopedics and Traumatology
- Radiology and Radiodiagnostics
- Anesthesia and Intensive Care Medicine
- Adolescent Diseases
- Childhood Diseases
- Multisystem Diseases
- Physical Medicine and Rehabilitation
- Forensic Medicine
- Mental Health and Diseases
- Cardiovascular System Diseases
- Nervous System Diseases
- Neurosurgery
- Respiratory System Diseases
- Infectious Diseases
- Occupational Diseases
- Nuclear Medicine
- Oncological Diseases
- Sports Medicine
- Genetic Diseases
- Medical Pathology

The journal covers all relevant branches in human medicine specialties of the topics mentioned above.

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AUTHOR GUIDELINES

Thank you for your interest in submitting your manuscript to Scientific Reports in Medicine for editing and publication consideration. In order to facilitate preparation and submission of your manuscript, we have prepared this guideline explaining basic points that should be taken into account when preparing the paper.

Scientific Reports in Medicine is a scientific publication of Academician Publishing and published three times a year online.

It is an open access scientific journal, which publishes original contributions in medical disciplines pertaining to human medicine. In this context, the Journal publishes original researches, case reports, and reviews based on clinical and experimental studies in all areas of human medicine. It is a scientific, periodic journal based on the principles of blind peer-review process. The publication language is English. The Journal is published online three times a year on April, August, and December.

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All manuscripts should be submitted by online system of the Journal.

Subject areas include, but are not restricted to the clinical and experimental studies of the following fields: first aid and emergency medicine, family medicine, public health and preventive medicine, internal diseases, general surgery, gynecology and obstetrics, ear, nose and throat diseases, eye diseases, orthopedics and traumatology, radiology and radiodiagnostics, anesthesia and intensive care medicine, adolescent diseases, childhood diseases, multisystem diseases, physical medicine and rehabilitation, forensic medicine, mental health and diseases, cardiovascular system diseases, nervous system diseases, neurosurgery, respiratory system diseases, infectious diseases, occupational diseases, nuclear medicine, oncological diseases, sports medicine, genetic diseases, medical pathology.

The journal covers all relevant branches in human medicine specialties of the topics mentioned above.

Audience

Academicians, specialist physicians and research assistants in surgical and non-surgical medical disciplines and general practitioners.

Manuscript Preparation

All manuscripts which will be published in the journal must be in accordance with research and publication ethics. All authors should have contributed to the article directly either academically or scientifically. Presentations at congresses or in symposia are accepted only if they were not published in whole in congress or symposium booklets and should be mentioned as a footnote.

Manuscripts are received with the explicit understanding that they have not been published in whole or in part elsewhere, that they are not under simultaneous consideration by any other publication. Direct quotations, tables, or illustrations that have appeared in copyrighted material must be accompanied by written permission for their use from the copyright owner and authors. All articles are subject to review by the editors and referees.

Process of Peer Review

The journal utilizes a standard online site (SRINMED), operated by Academician Publishing, for the process of both manuscript submission and manuscript peer review. Upon receiving a manuscript submitted for consideration of publication to the journal, the journal manager and editorial staff review the submission to assure all required components as outlined in this Guide for Authors are included. The manuscript is then assigned to one of the co-editors (either the editor in chief or an associate editor) who directs and oversees the peer-review process. The co-editor then reviews the submission for relevance, content and quality. Those submissions deemed appropriate for consideration of publication are then assigned to at least two peer reviewers. In order for a manuscript to be considered for publication, it must be original and significant, providing a contribution to research and importance to field. In general, there should be no flaws in the specific procedures used in performance of the study, or in the logic used for the interpretation of the data. It is important that the results of the study support its conclusions, and that there are no errors in reference to prior work (or no exclusions of pertinent references). Where appropriate, confirmation of regulatory review (such as institutional review board approval) must be present. The validity of the statistics used (often including a justification of a sample size) to analyze data is necessary, and the data presented in the figures and tables should be reflective of the results presented and adequate to justify the study conclusions. In general, the manuscript length and quality of the writing are important to ensure its quality.

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When the editor has a full complement of reviews completed, the editor reviews the comments and recommendations, and a decision regarding the suitability for publication of the manuscript is made. Acceptance is based on significance, and originality of the material submitted. If the article is accepted for publication, it may be subject to editorial revisions to aid clarity and understanding without changing the data presented.

As part of the submission process, authors are required to check off their submission's compliance with all of the following items, and submissions may be returned to authors that do not adhere to these guidelines.

About the scientific language to be used in writing your manuscript

In line with the recommendation of the international directories we applied to increase the scientific effectiveness of our journal and enrich its content, our Editorial Board has decided that the studies to be published in English. So the manuscripts sent to our journal are subject to English language control and revision.

Our experience from previous articles has shown that most of the articles prepared in English need to be improved in terms of fluent readability and intelligibility, as well as scientific and technical examination. Most of the manuscrpits should undergo a comprehensive review and revision process in terms of language, before they were included in the review stage.

Therefore, we recommend that you receive professional English editing and proofreading services before submitting your manuscript to our journal, although it is not mandatory.

You can contact Academician Publishing to receive Editing and Proofreading services for a fee. You can click here to contact Academician Publishing.

Our journal does not have any commercial partnership with any translation or proofreading service company, and our authors are absolutely free to make their choices as they wish.

By uploading the revised English full text of your manuscript to our Journal system by ensuring that English Editing and Proofreading is carried out by a local or foreign professional, you may minimize the possibility of rejection due to translation errors.

Use of first person

In addition, it is necessary to make the necessary checks and revisions in terms of language of your work and to ensure integrity in terms of language and time use throughout the entire article.

Expressions such as ... "Our study, in our study, we, we did, we found, we aimed, I did, I found, I think ... etc." should be revised as follows;

• In this study, … it was found/determined/… or

• In this study … it was aimed to …

Names made up of single word should not be abbreviated.

Instead of,

• Hypertension (HT) is one of the most …

Throughout the manuscript, you should use;

• Hypertension is one of the most …

Instead of,

• Rituximab (RTX) is an IgG1 kappa chimeric monoclonal

Throughout the manuscript, you should use;

• Rituximab is an …

Numbers should always be used to indicate statistics, age and measurements (including time as in the 3 weeks example). In specifying the others, only the numbers one to nine should be written in letters. (Numbers between 1-10 should be written with letters, except for the date and number of cases)

For example;

• In 2 studies, …

Should be replaced with;

• In two studies …

For example;

• … perivascular lymphotic infiltration in only 10 percent and fibrosis in 7 percent of the patients,

Should be replaced with; … perivascular lymphotic infiltration in only 10% of patients … in 7% of patients …

Prejudiced expressions should be avoided in expressions other than classical textbook knowledge, which has been verified by dozens of studies and has become the industry standard in the literature.

• determined to be high

Should be replaced with;

• … was found to be high.

Or throughout the entire manuscript;

• found to be significantly higher …

If diametrically opposite findings are mentioned among the studies mentioned in the Discussion section, it should be stated as "… a significant relationship was found / observed / reported", rather than "a significant relationship was determined" etc.

• While no significant relationship was determined between blood pressure and disease severity (26,27), a strong relationship was determined in some studies (28,29).

Should be replaced with; While no significant relationship was observed between blood pressure and disease severity (26,27), it was reported that a strong relationship was found in some studies (28,29).

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General Principles

The text of articles reporting original research should be divided into Introduction, Methods, Results [Findings], and Discussion sections. This so-called "IMRAD" structure is not an arbitrary publication format but a reflection of the process of scientific discovery. Articles often need subheadings within these sections to further organize their content. Other types of articles, such as meta-analyses, may require different formats, while case reports, narrative reviews, and editorials may have less structured or unstructured formats.

Electronic formats have created opportunities for adding details or sections, layering information, cross-linking, or extracting portions of articles in electronic versions. Supplementary electronic-only material should be submitted and sent for peer review simultaneously with the primary manuscript.

Sections

Abstract

Original research, systematic reviews, and meta-analyses require structured abstracts. The abstract should provide the context or background for the study and should state the study's purpose, basic procedures (selection of study participants, settings, measurements, analytical methods), main findings (giving specific effect sizes and their statistical and clinical significance, if possible), and principal conclusions. It should emphasize new and important aspects of the study or observations, note important limitations, and not overinterpret findings. Please, do not cite figures, tables or references in the abstract.

Because abstracts are the only substantive portion of the article indexed in many electronic databases, and the only portion many readers read, authors need to ensure that they accurately reflect the content of the article. All the articles submitted to the journal require to include abstract in English. Abstracts of original articles should not exceed 250 words.

Keywords

Three to six words or determinative groups of words should be written below the abstract. Abbreviations should not be used as keywords. Keywords in English should be chosen from MESH (Medical Subject Headings http://www.nlm.nih.gov/mesh) index. Abbreviations cannot be used as keywords, but instead they should be written explicitly. Letters that do not exist in Latin alphabet (e.g. alpha, beta, delta etc.) should be used with their pronunciation.

Examples; carbon monoxide, firearms, sexual abuse, oral mucosa

Introduction

Provide a context or background for the study (that is, the nature of the problem and its significance). State the specific purpose or research objective of, or hypothesis tested by, the study or observation. Cite only directly pertinent references, and do not include data or conclusions from the work being reported.

Methods

The guiding principle of the Methods section should be clarity about how and why a study was done in a particular way. The Methods section should aim to be sufficiently detailed such that others with access to the data would be able to reproduce the results.

The authors should clearly describe the selection of observational or experimental participants (healthy individuals or patients, including controls), autopsied persons, including eligibility and exclusion criteria and a description of the source population.

In general, the section should include only information that was available at the time the plan or protocol for the study was being written; all information obtained during the study belongs in the Results [Findings] section. If an organization was paid or otherwise contracted to help conduct the research (examples include data collection and management), then this should be detailed in the methods.

The Methods section should include a statement indicating that the research was approved or exempted from the need for review by the responsible review committee (institutional or national). If no formal ethics committee is available, a statement indicating that the research was conducted according to the principles of the Declaration of Helsinki should be included.

Identifying information, including names, initials, or autopsy numbers of the patients/deceased should not be exposed in written descriptions or photographs in no ways. Identifying details should be omitted if they are not essential.

Informed consent should be obtained in human studies and it should be stated in the manuscript.

When reporting experiments on human subjects, authors should indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as

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revised in 2000. When reporting experiments on animals, authors should indicate whether the institutional and national guide for the care and use of laboratory animals was followed.

The authors should describe statistical methods with enough detail to enable a knowledgeable reader with access to the original data to judge its appropriateness for the study and to verify the reported results. They should define statistical terms, abbreviations, symbols and should specify the statistical software package(s) and versions used.

Results [Findings]

You should present your results in logical sequence in the text, tables, and figures, giving the main or most important findings first. Please, do not repeat all the data in the tables or figures in the text; emphasize or summarize only the most important observations. Provide data on all primary and secondary outcomes identified in the Methods Section. Extra or supplementary materials and technical details can be placed in an appendix where they will be accessible but will not interrupt the flow of the text, or they can be published solely in the electronic version of the journal.

You should give numeric results not only as derivatives (for example, percentages) but also as the absolute numbers from which the derivatives were calculated, and specify the statistical significance attached to them, if any. You should restrict tables and figures to those needed to explain the argument of the paper and to assess supporting data. Please, use graphs as an alternative to tables with many entries; do not duplicate data in graphs and tables. Avoid nontechnical uses of technical terms in statistics, such as "random" (which implies a randomizing device), "normal," "significant," "correlations," and "sample." Separate reporting of data by demographic variables, such as age and sex, facilitate pooling of data for subgroups across studies and should be routine, unless there are compelling reasons not to stratify reporting, which should be explained.

Discussion

It is useful to begin the discussion by briefly summarizing the main findings and explore possible mechanisms or explanations for these findings. Emphasize the new and important aspects of your study and put your findings in the context of the totality of the relevant evidence. State the limitations of your study and explore the implications of your findings for future research and for clinical practice or policy. Do not repeat in detail data or other information given in other parts of the manuscript, such as in the Introduction or the Results [Findings] section.

Link the conclusions with the goals of the study but avoid unqualified statements and conclusions not adequately supported by the data. In particular, distinguish between clinical and statistical significance, and avoid making statements on economic benefits and costs unless the manuscript includes the appropriate economic data and analyses. Avoid claiming priority or alluding to work that has not been completed. State new hypotheses when warranted but label them clearly.

In-text Citations and References

Authors should provide direct references to original research sources whenever possible. References should not be used by authors, editors, or peer reviewers to promote

self-interests. Although references to review articles can be an efficient way to guide readers to a body of literature, review articles do not always reflect original work accurately. On the other hand, extensive lists of references to original work on a topic can use excessive space. Fewer references to key original papers often serve as well as more exhaustive lists, particularly since references can now be added to the electronic version of published papers, and since electronic literature searching allows readers to retrieve published literature efficiently.

Do not use conference abstracts as references: they can be cited in the text, in parentheses, but not as page footnotes. References to papers accepted but not yet published should be designated as "in press". Information from manuscripts submitted but not accepted should be cited in the text as "unpublished observations" with written permission from the source.

Laws (e.g., penal code), statutes and regulations are not scientific writings. In addition to being published on the official gazette, since it is published on various internet sites, a reference number should not be given to laws, statutes and regulations. If it is to be cited within the text, the law could be cited by specifying the number of the law, the date and number of publications in the official gazette (e.g., A Review of Article 5 of the Turkish Criminal Penal Code No. 5237). They should not be numbered within the text, or in the reference list.

To minimize citation errors, references can be verified using either an electronic bibliographic source, such as PubMed, or print copies from original sources. References should be numbered consecutively in the order in which they are first mentioned in the text. Roman numerals should be avoided. Identify references in text, tables, and legends by Arabic numerals (1, 2, 3 … 9, 0) in parentheses. References cited only in tables or figure legends should be

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numbered in accordance with the sequence established by the first identification in the text of the particular table or figure. The titles of journals should be abbreviated according to the style used for MEDLINE (www.ncbi.nlm.nih.gov/nlmcatalog/journals).

If you refer to a work more than once, use the first number also for the second and following references. References to more than one source in the same phrase may be entered like this: (2-4), i.e., references 2 through 4 in the reference list, and (2-4, 8), i.e. the references 2 through 4, plus reference no 8 in the list of references.

Sample for in-text citation:

In a clinical research in healthy individuals, Ellis (25) has studied the sciatic nerve excursion using ultrasound technique.

Wright and Ellis (10) has investigated the excursion of nerves around the elbow joint.

In another and similar cadaveric study by Wright et al (13), the radial nerve median excursion values were 4.1, 8.8, and 0.2, 0.1 mm with motions of shoulder, elbow, wrist and fingers respectively.

Suicide is a major public health problem and globally the second leading cause of death among young adults (1). Studies focusing on how mental health risk factors impact on youth suicidal behaviors suggest that psychopathological symptoms are associated with suicidal behavior (3,4). Adverse effects of H2S on human health vary from local irritation to immediate death depending on the form, concentration, duration and route of exposure (9, 13-15).

Reference Style

The Vancouver system, also known as Vancouver reference style or the author–number system, is a citation style that uses numbers within the text that refer to numbered entries in the reference list. Vancouver style is used by MEDLINE and PubMed. The names "Vancouver system" or "Vancouver style" have existed since 1978. The latest version of the latter is Citing Medicine, per the References > Style and Format section of the ICMJE Recommendations. In 1978, a committee of editors from various medical journals, the International Committee of Medical Journal Editors (ICMJE), met in Vancouver, BC, Canada to agree to a unified set of requirements for the articles of such journals. This meeting led to the establishment of the Uniform Requirements for Manuscripts Submitted to Biomedical Journals (URMs). Part of the URMs is the reference style, for which the ICMJE selected the long-established author–number principle.

Since the early to mid-2000s, the United States National Library of Medicine (which runs MEDLINE and PubMed) has hosted the ICMJE's "Sample References" pages. Around 2007, the NLM created Citing Medicine, its style guide for citation style, as a new home for the style's details. The ICMJE Recommendations now point to Citing Medicine as the home for the formatting details of Vancouver style.

Scientific Reports in Medicine, since the first day of its publication uses the PubMed/NLM reference style. Thus, references should follow the standards summarized in the NLM's International Committee of Medical Journal Editors (ICMJE) Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals: Samples of Formatted References for Authors of Journal Articles web page and detailed in the NLM's Citing Medicine, 2nd edition.

According to the Vancouver rules, you can only refer to the literature you have read yourself. If you find anything interesting in a text where it is referred to another text, you must read and refer to the original.

Reference List

The reference list should be ordered numerically in the order in which the references appear in the text.

The journal's name may be abbreviated, according to the abbreviation rules for journal titles. Records retrieved from a search for the full journal title in the National Library of Medicine's search page include the abbreviated title.

Authors' names should be given as surname followed by initials. There should be a space between surname and initials. A maximum of two initials are allowed for each author, they should be entered without spaces or punctuation. Different authors should be separated by a space and a comma. A period (.) should follow the last author's name. If six or more authors, list the first six authors followed by et al.

Only capital letter of the first word of the title, proper nouns, proper adjectives, acronyms, and initialisms should be capitalized.

The most reliable method for calculating the impact factor of our journal and number of citations of articles published in our journal or calculating the number of times your own article is cited in a healthy way, is to add DOIs to the references section. In order to give the DOIs to the articles published in Scientific Reports in Medicine, the CrossRef membership application has been completed and all the research articles, case reports, and reviews are being assigned DOIs. For this reason, DOIs need to be added to the References section if available for those references. We

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hope that the Simple Text Query Form will be helpful in referencing articles published in our journal.
With the help of the Simple Text Query Form web page, which has a link in the full-text template, DOI records need to be added to the sources.
https://apps.crossref.org/SimpleTextQuery
Note: Please, do not insert Pubmed ID (PMID) or Pubmed Central ID (PMCID) records to the reference list since they are useless in determining the citation counts.
We place great importance to the addition of DOIs to the references.
Sample for Journal Article without DOI
Dokgöz H, Kar H, Bilgin NG, Toros F. Forensic Approach to Teenage Mothers Concept: 3 Case Reports. Turkiye Klinikleri J Foren Med 2008;5(2):80-4
Kaufman DM, Mann KV, Miujtjens AM, Van der Vleuten CP. A comparison of standard setting procedures for an OSCE in undergraduate medical education. Academic Medicine 2000;75:267–71.Sample for Journal Article with DOI
Koçak U, Alpaslan AH, Yağan M, Özer E. Suicide by Homemade Hydrogen Sulfide in Türkiye a Case Report. Bull Leg Med. 2016;21(3):189-192. https://doi.org/10.17986/blm.2016323754
Article not in English
Kar H, Dokgöz H, Gamsız Bilgin N, Albayrak B, Kaya Tİ. Lazer Epilasyona Bağlı Cilt Lezyonlarının Malpraktis Açısından Değerlendirilmesi. Bull Leg Med. 2016;21(3):153-158. https://doi.org/10.17986/blm.2016323748
Books and Other Monographs
Personal author(s)
Murray PR, Rosenthal KS, Kobayashi GS, Pfaller MA. Medical microbiology. 4th ed. St. Louis: Mosby; 2002.
Editor(s), compiler(s) as author
Gilstrap LC 3rd, Cunningham FG, VanDorsten JP, editors. Operative obstetrics. 2nd ed. New York: McGraw-Hill; 2002.
Author(s) and editor(s)
Breedlove GK, Schorfheide AM. Adolescent pregnancy. 2nd ed. Wieczorek RR, editor. White Plains (NY): March of Dimes Education Services; 2001.
Chapter in a book
Meltzer PS, Kallioniemi A, Trent JM. Chromosome alterations in human solid tumors. In: Vogelstein B, Kinzler KW, editors. The genetic basis of human cancer. New York: McGraw-Hill; 2002. p. 93-113
Emmerson BT. Gout and renal disease. In: Massry SG, Glassock RJ (Editors). Textbook of Nephrology 1. Baskı, Baltimore: Williams and Wilkins; 1989. p. 756–760.
Conference proceedings
Harnden P, Joffe JK, Jones WG, editors. Germ cell tumours V. Proceedings of the 5th Germ Cell Tumour Conference; 2001 Sep 13-15; Leeds, UK. New York: Springer; 2002.
Article published on the Internet ahead of the print version:
Yu WM, Hawley TS, Hawley RG, Qu CK. Immortalization of yolk sac-derived precursor cells. Blood. 2002 Nov 15;100(10):3828-31. Epub 2002 Jul 5.
Part of a homepage/Web site [Edited 28 Dec 2016]
American Medical Association [Internet]. Chicago: The Association; c1995-2016 [cited 2016 Dec 27]. Office of International Medicine; [about 2 screens]. Available from: https://www.ama-assn.org/about/office-international-medicine

Thesis

Skrtic L. Hydrogen sulfide, oil and gas, and people's health [Master's of Science Thesis]. Berkeley, CA: University of California; 2006.
Weisbaum LD. Human sexuality of children and adolescents: a comprehensive training guide for social work professionals [master's thesis]. Long Beach (CA): California State University; 2005. 200 p.
For the reference types not listed here, please visit Samples of Formatted References for Authors of Journal Articles available at Medline Web site (https://www.nlm.nih.gov/bsd/uniform_requirements.html).

Tables

Tables capture information concisely and display it efficiently; they also provide information at any desired level of detail and precision. Including data in tables rather than text frequently makes it possible to reduce the length of the text.
It would be appropriate to place the tables at the end of the main text. Number tables consecutively in the order of their first citation in the text and supply a title for each. Titles in tables should be short but self-explanatory, containing information that allows readers to understand the table's content without having to go back to the text. Be sure that each table is cited in the text. Give each column a short or an abbreviated heading. In the tables, case counts (n) and percentages (%) should be specified in separate columns, not in the same cell.
Authors should place explanatory matter in footnotes, not in the heading. Explain all nonstandard abbreviations in footnotes and use symbols to explain information if needed. Symbols may be as alphabet letters or such symbols as *, p t> T §). Please, identify statistical measures of variations, such as standard deviation and standard error of the mean.

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Illustrations (Figures)

The lexical meaning of figure constitutes a number symbol (numeral, digit), a written or printed character, a diagram or pictorial illustration of textual matter, arithmetical calculation or digits representing an amount when plural. While definition of picture includes a design or representation made by various means (as painting, drawing, or photography), illustration means a picture or diagram that helps make something clear or attractive. Although these terms bear distinctive meanings, they are too often used interchangeably. Thus, we meant them in the same way without distinction.

Digital images

The 300 DPI Story

In the ancient times when digital cameras have not been invented, the photos taken by analogue cameras were used to be printed on photo papers. In order to transfer these photos to the digital environment, they had to be scanned by optical devices called scanners. On the same dates, desktop publishing and printing technology was far beyond the digital photography, and many years had passed since the invention of laser printing technology. Here, several technical terms should be explained to make the concept clearer. DPI is used to describe the resolution number of dots per inch in a digital print and the printing resolution of a hard copy print dot gain, which is the increase in the size of the halftone dots during printing. A dot matrix printer, for example, applies ink via tiny rods striking an ink ribbon, and has a relatively low resolution, typically in the range of 60 to 90 DPI (420 to 280 μm). An inkjet printer sprays ink through tiny nozzles and is typically capable of 300–720 DPI. A laser printer applies toner through a controlled electrostatic charge and may be in the range of 600 to 2,400 DPI. Along with the cheaper memory chips, 1200 dpi printers have been widely available in the consumer market since 2008. Monitors do not have dots but do have pixels. The closely related concept for monitors and images is pixels per inch or PPI. Old CRT type video displays were almost universally rated in dot pitch, which refers to the spacing between the sub-pixel red, green and blue dots which made up the pixels themselves. The DP measurement of a printer often needs to be considerably higher than the pixels per inch (PPI) measurement of a video display in order to produce similar-quality output. This dithered printing process could require a region of four to six dots (measured across each side) in order to faithfully reproduce the color in a single pixel. An image that is 100 pixels wide may need to be 400 to 600 dots in width in the printed output; if a 100×100-pixel image is to be printed in a one-inch square; the printer must be capable of 400 to 600 dots per inch to reproduce the image. The dpi of early model laser printers was 300 to 360, thus scanning images at 300 DPI was a common practice at that time.

In printing, DPI (dots per inch) refers to the output resolution of a printer or imagesetter, and PPI (pixels per inch) refers to the input resolution of a photograph or image. DPI refers to the physical dot density of an image when it is reproduced as a real physical entity, for example printed onto paper. A digitally stored image has no inherent physical dimensions, measured in inches or centimeters. Some digital file formats record a DPI value, or more commonly a PPI (pixels per inch) value, which is to be used when printing the image. This number lets the printer or software know the intended size of the image, or in the case of scanned images, the size of the original scanned object. For example, a bitmap image may measure 1,000 × 1,000 pixels, a resolution of 1 megapixel. If it is labeled as 250 PPI, that is an instruction to the printer to print it at a size of 4 × 4 inches. Changing the PPI to 100 in an image editing program would tell the printer to print it at a size of 10×10 inches. However, changing the PPI value would not change the size of the image in pixels which would still be 1,000 × 1,000. An image may also be resampled to change the number of pixels and therefore the size or resolution of the image, but this is quite different from simply setting a new PPI for the file.

Therefore, an image that is 2048 pixels in width and 1536 pixels in height has a total of 2048×1536 = 3,145,728 pixels or 3.1 megapixels. One could refer to it as 2048 by 1536 or a 3.1-megapixel image. Or, you can think of it as a very low-quality image (72 ppi) if printed at about 28.5 inches wide, or a very good quality (300 ppi) image if printed at about 7 inches wide.

Since the 1980s, the Microsoft Windows operating system has set the default display "DPI" to 96 PPI, while Apple/Macintosh computers have used a default of 72 PPI. The choice of 72 PPI by Macintosh for their displays arose from the convenient fact that the official 72 points per inch mirrored the 72 pixels per inch that appeared on their display screens. (Points are a physical unit of measure in typography, dating from the days of printing presses, where 1 point by the modern definition is 1/72 of the international inch (25.4 mm), which therefore makes 1 point approximately 0.0139 in or 352.8 μm). Thus, the 72 pixels per inch seen on the display had exactly the same physical dimensions as the 72 points per inch later seen on a printout, with 1 pt in printed text equal to 1 px on

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the display screen. As it is, the Macintosh 128K featured a screen measuring 512 pixels in width by 342 pixels in height, and this corresponded to the width of standard office paper (512 px ÷ 72 px/in ≈ 7.1 in, with a 0.7 in margin down each side when assuming 8.5 in × 11 in North American paper size (in Europe, it's 21 cm x 30 cm - called "A4")).

In computing, an image scanner—often abbreviated to just scanner, is a device that optically scans images, printed text, handwriting or an object and converts it to a digital image. Although the history of digital cameras dates back to the 1970s, they have become widely used in the 2000s. While the resolution of the first digital camera invented by Kodak was as low as 100 by 100 pixels (0.01 megapixels), the first commercially available digital camera, Fujix DS-1P had a resolution of 0.4 megapixels. On the other hand, modern scanners are considered the successors of early telephotography and fax input devices. The pantelegraph was an early form of facsimile machine transmitting over normal telegraph lines developed by Giovanni Caselli, used commercially in the 1860s, that was the first such device to enter practical service. The history of the first image scanner developed for use with a computer goes back to 1957. Color scanners typically read RGB (red-green-blue color) data from the array. This data is then processed with some proprietary algorithm to correct for different exposure conditions and sent to the computer via the device's input/output interface. Color depth varies depending on the scanning array characteristics but is usually at least 24 bits. High quality models have 36-48 bits of color depth. Another qualifying parameter for a scanner is its optical resolution, measured in pixels per inch (ppi), sometimes more accurately referred to as samples per inch (spi).

Images in web pages, video, and slide shows can be as low as 72 PPI for a static image or 150 PPI if we are going to focus in on the image. For printing, the DPI needs to be larger, with images scanned in at least 300 DPI. The DPI standard for and images to be printed within journals and books is 300 DPI and for museum exhibits, it's 600 DPI.

The most important factors determining image quality of digital images can be considered as pixel dimensions and color depth. Increasing the dpi value of an image by resampling in Photo Editors (e.g., Adobe Photoshop) has no improving effect on its quality, but it lets us to determine target printing size.

For vector images, there is no equivalent of resampling an image when it is resized, and there is no PPI in the file because it is resolution independent (prints equally well at all sizes). However, there is still a target printing size. Some image formats, such as Photoshop format, can contain both bitmap and vector data in the same file. Adjusting the PPI in a Photoshop file will change the intended printing size of the bitmap portion of the data and also change the intended printing size of the vector data to match. This way the vector and bitmap data maintain a consistent size relationship when the target printing size is changed. Text stored as outline fonts in bitmap image formats is handled in the same way. Other formats, such as PDF, are primarily vector formats which can contain images, potentially at a mixture of resolutions. In these formats the target PPI of the bitmaps is adjusted to match when the target print size of the file is changed. This is the converse of how it works in a primarily bitmap format like Photoshop but has exactly the same result of maintaining the relationship between the vector and bitmap portions of the data.

Long story short, it is not technically possible to talk about DPI value for images that were taken by digital cameras or any type of digital images that were transferred to the computer's storage media. The DPI value stored within exif information of images is just a virtual value just to guide the photo editing software and the graphic artist to determine the target printing size of that image.

Requirements for Digital Media

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Due to the reasons explained above, images should be taken by a digital camera of 5 megapixels or more in JPEG, RAW, or TIFF format, and should be inserted in their original form as JPEG or TIFF files.

Paper-printed images or documents should be scanned at 300 DPI resolution and should be inserted as TIFF or JPEG files.

Each vector graphic software has its own built-in settings and may have been preset at 72 dpi. So, the document should be created enough big to obtain the image in the desired dimensions. The vector graphics should be

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exported to a rasterized image format and inserted such as JPEG or TIFF files.

For X-ray films, CT scans, and other diagnostic images, as well as pictures of pathology specimens or photomicrographs, you should insert high-resolution photographic image files. Since blots are used as primary evidence in many scientific articles, we may require deposition of the original photographs of blots on the journal website.

Letters, numbers, and symbols on figures should therefore be clear and consistent throughout, and large enough to remain legible when the figure is reduced for publication.

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3. Case Reports: Brief descriptions of a previously undocumented disease process, a unique unreported manifestation or treatment of a known disease process, or unique unreported complications of treatment regimens.

The manuscript should contain English abstract, a maximum of 150 words, but a structured abstract is not required. The main text should include titles or related topics to further organize the content. The manuscript could be of up to 2000 words (excluding references and abstract) and could be supported with up to 25 references. Care should be taken to ensure that the number of figures or tables does not exceed 5-6 each.

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3. It is the responsibility of all authors to approve the final version of the article before it is published.
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The sections (i.e., Introduction, Methods, Case, Results [Findings], Discussion, and Conclusion) and their subheadings should be numbered respectively. Paragraphs might be aligned left or justified, but this situation should be consistent throughout the article. Please, use single return after each paragraph. All headings should be typed on a separate line, not run in with the text. There should be no additional spacing before or after lines. Headings and subheadings should be numbered, and their depth should not exceed three levels. The References section should not be numbered. You should not use the "Endnotes" or "Footnotes" feature for your references and remove any Word specific codes. When 'Magic Citations' inserts citations, or formats your manuscript in Microsoft Word, it uses "fields", which you can typically recognize as boxes that turn grey when the insertion point is placed inside one of them. Here is how to remove the fields in a Microsoft Word document:

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The manuscript could be of up to 2000 words (excluding references and abstract) and could be supported with up to 25 references. Care should be taken to ensure that the number of figures or tables does not exceed 5-6 each.

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Research Article

Core decompression can still be an effective treatment in femoral head avascular necrosis

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Abstract

Objective: Core decompression is one of the femoral head sparing surgeries that is used in femoral head avascular necrosis. The efficacy of the treatment is inconsistent in the literature. We aimed to contribute to clarifying the controversies about the index treatment by publishing this retrospective paper.

Methods: Functional and radiological data of 44 hips of 33 patients who were diagnosed with femoral head avascular necrosis and treated with core decompression were extracted from the hospital database. Presumed risk factors were determined as corticosteroid use, trauma, chemotherapy, sickle cell anemia, alcohol, and pregnancy. Twenty hips were treated with core decompression only, 24 hips were treated with core decompression and avascular bone grafting. All surgeries were performed with a standard technique which is described by Arlet and Ficat, and patients complied with standard follow-up protocol. Functional results were assessed with Harris hip score and radiological findings before and after the operations were evaluated by a single author.

Results: The mean follow-up of patients was 89 (17-171) months. Patients had significant improvement in Harris hip score postoperatively regardless of the surgical technique. Sixteen hips (36.3%) underwent total hip arthroplasty (THA) during follow-up and there is no significant difference between treatment groups. Mean interval between the primary surgery and THA was 37.8 months.

Conclusion: Core decompression can still be an effective treatment options at an early-stage avascular necrosis of the femoral head.

Keywords: Avascular necrosis, core decompression, femoral head

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Introduction

Avascular necrosis of the femoral head has been remaining a clinical issue that is difficult to treat and obtain a satisfactory outcome. In literature, it was reported to affect the people between the third and fifth decades of their lives (1). So, it has serious demanding effects on work and leisure activities of highly active groups of population. Untreated cases suffer from early hip degeneration that is irresponsive to salvage procedures and inevitably needs to be treated with hip arthroplasty (2). Besides, treatment options at early periods include various options standing between restriction of activities such as weight bearing combined with nonsteroid anti-inflammatory drugs and salvage procedures such as core decompression with non-vascular grafting or vascular grafting (3). However, the effectiveness of these treatment options is debatable and there is no widely accepted treatment algorithm (4).

Many etiologic factors were blamed for the disease. Excessive alcohol use, corticosteroid use, some metabolic disorders, radiation therapy, and chemotherapeutic agents are presumed as some of the etiological factors but, the mystery of the exact pathophysiological mechanism remains (5). Ficat and Arlet came up with the idea of an increment in the intraosseous pressure which ends up with the deterioration of the perfusion and necrosis of the bone (6). This theory encouraged the orthopedic surgeons to try to diminish the increased intraosseous pressure with invasive approaches including core decompression which is the most famous one.

Core decompression was firstly described by Ficat and Arlet in 1968 (6). They theorized that the removal of the increased pressure may reconstitute the normal blood flow, alleviate the pain of the patients, and stimulate the healing of the necrotic bone. They obtained promising results. Controversial results were reported in following studies but, there is a consensus on the fact that far better results would be obtained if the procedure was applied before the femoral head collapsed (7,8). Different methods of core decompression were defined by different authors, however the success of these methods extended in a distinct perspective according to the affected site of the femoral head, grade and extension of the disease (9,10). In our institute, we used a standard approach of core decompression combined with avascular autografting. In this study, we revealed the functional results and necessity of the secondary arthroplasty following the core decompression.

Material and Methods

Ethical approval was obtained from Cukurova University ethical committee 09.06.2009/6-15. Patients who were diagnosed as avascular necrosis of the femoral head on radiographs and magnetic resonance imaging, **(Figures 1-4)** and had regular follow-ups were included in the study. Data of the patients who met the inclusion criteria between 1996 and 2009 was extracted. There were 44 hips of 33 patients were recorded as treated by core decompression or core decompression with bone grafting. Retrospective review showed that all the patients who had the diagnosis of AVN without collapse in the femoral head were defined as candidates for core decompression regardless of the etiology. Autograft was used as bone substitute to enhance the mechanical strength of the subchondral bone. In the presence of large defects after decompression allograft was also added. All interventions were performed by one experienced hip surgeon.

Figure 1: Radiograph of Ficat grade 2 hip avascular necrosis

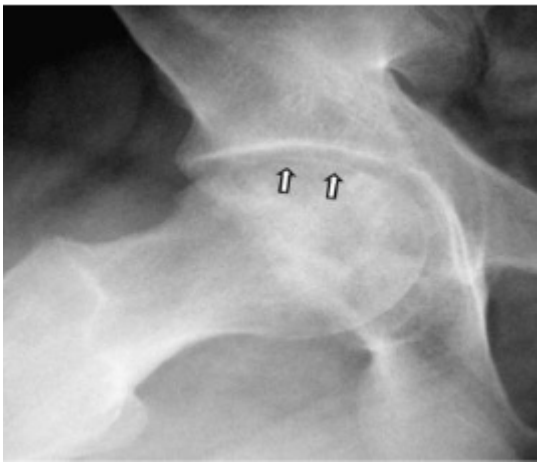

Figure 2: Crescent sign (X-ray)

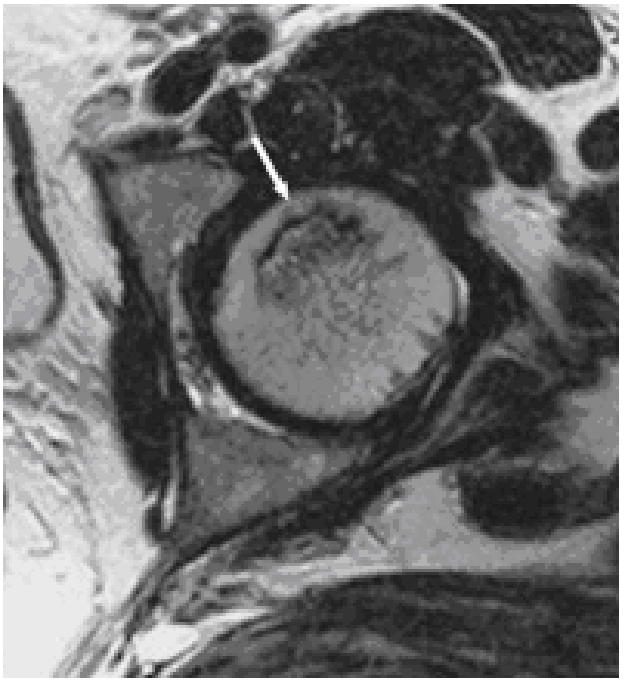

Figure 3: Double line sign (MRI – axial view)

Surgical Technique

Surgery was performed under epidural or general anesthesia. Patients were placed supine on the fracture table. Involved lower extremity was adjusted as 15 degrees of internal rotation to acquire the parallelism of the femoral neck to the ground. Adequate AP and lateral views of the hips were checked. The surgical area was sterilized with Betadine solution. For the surgical prophylaxis, 1 gram of cephazolin was administered intravenously. Five centimeters length skin incision was made to the distal of the tip of trochanter major. Fibers of tensor fascia lata were separated and 3.2 mm guide wire was sent into the previously determined necrosis area with the help of C-arm fluoroscopy **(Figures 5,6)**. Eight millimeters drill was sent through the drill guide and decompression was made **(Figure 7)**. Subsequently, another 5 centimeters incision was made over the iliac crest, 3 centimeters proximal to the anterior superior iliac spine (ASIS). A cortical window was created and spongiosa bone was harvested. Grafts were embedded with spinal rod through dynamic hip screw holder which was placed into the previously performed drill hole **(Figures 8,9)**. The grafted site was controlled with Fluoroscopy lastly. Then the layers were closed appropriately.

Figure 4: Double line sign (MRI - coronal view)

Figure 5: 3.2 mm guide wire is sent to the femoral head through the incision.

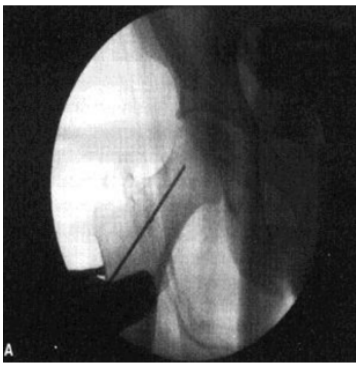

Figure 6: Guide wire position and relation with lesion is checked with C – arm fluoroscopy.

Figure 7: Reaming is performed with 8 mm drill, over the guide wire; and decompression is made.

Figure 8: Non-vascularized bone graft which is harvested from the iliac crest.

Figure 9: Grafts are sent through dynamic hip screw holder which is placed into the previously performed drill hole with spinal rod.

Postoperative Rehabilitation

Patients received prophylactic antibiotic treatment till the day after the surgery. Wound dressings were renewed and patients were discharged from the hospital. Weight bearing was not allowed until the 6th week. Routine follow-up procedure was admonished at 3rd week, 6th week, 3rd, 6th, 9th, and 12th month of the surgery. Radiographs of the hips were obtained in control admission to the outpatient clinic. If the radiographs were failed to demonstrate the condition of the femoral head in a clinically worsening patient, MRI obtained for detailed evaluation. Control examination of the patients includes the routine daily activity level of the patients, crouch use or limping, and Harris Hip scores.

Results

Twenty-two patients were male and 11 patients were female. The mean age of patients was 34.8 (16-57) years and the mean follow-up duration was 89 (17-171) months **(Table 1)**. Presumed risk factors in this study were corticosteroid use in 21 hips, sickle cell anemia in 3, trauma in 3, chemotherapy in 2, and pregnancy in one. No etiologic factor was detected in 14 patients **(Table 2)**. Ficat and Arlet classification was used for the grading of the disease. Twelve hips were grade 1, 27 were grade 2, and 5 were grade 3 **(Table 3)**. Core decompression and grafting were performed in 20 hips, and core decompression without grafting was performed in 24 hips **(Table 4)**. Age, follow-up duration, distribution of the grades of the hips were homogenous between two groups.

Functional results were evaluated according to the Harris hip score system. The preoperative Harris hip score was 57.9±14.6 , and the postoperative score was 92.9±8.7 . Median values of the Harris hip score were significantly higher in the postoperative group (61, 95 respectively) (p=0.0001) **(Table 5,6)**. Forty-one patients showed excellent or good functional results however 3 patients were assessed as bad functional results **(Table 7)**.

Table 1: Gender and side distribution of the patients.			
		Number	**Percentage**
Gender	Female	11	33.3 %
	Male	22	66.7 %
Total patients)		**33**	**%100**
Side	Right	24	54.5 %
	Left	20	45.5 %
Total (hips)		**44**	**%100**

Table 2: Etiologic factors involved in study.		
Etiology	**Number**	**Percentage**
Corticosteroid use	21	47.7 %
Primary	14	31.9 %
Sickle Cell Anemia	3	6.8 %
Trauma	3	6.8 %
Chemoterapy	2	4.5 %
Pregnancy	1	2.3 %

Table 3: Distribution of the hips according to Ficet – Arlet grading system.		
Ficat – Arlet	**Number**	**Percentage**
Grade 1	12	27.3 %
Grade 2	27	61.4 %
Grade 3	5	11.3 %

Table 4: Distribution of patients according to performed surgical methods.		
Method	**Number**	**Percentage**
Core decompression	24	54.4 %
Core decompression + grafting	20	45.5 %

Table 5: Pre-operative Harris Hip Scores	
Pre-operative HHS	**Number (Percentage)**
Excellent	0 (0 %)
Good	0 (0 %)
Moderate	35 (79.5 %)
Poor	9 (20.5 %)

Table 6: Comparison of pre-operative and post-operative Harris Hip Scores			
	Pre-operative HHS	Postoperative HHS	P value
Mean ± SD	57.9 ± 14.6	92.9 ± 8.7	
Median	61.0 (32.0 – 78.0)	95.0 (65.0 – 100.0)	0.0001

Following the operation, 16 hips underwent total hip arthroplasty. The mean time for subsequent THA due to the disease progression and clinical worsening was 37.8 months after the primary surgery **(Table 8)**. Analysis of the grades of these hips before the surgery revealed that one patient was grade 1, 11 patients were grade 2, and 4 patients were grade 3 **(Table 9)**. We found no statistical differences between two treatment groups in terms of total hip arthroplasty necessity. Six of 16 patients were treated with core decompression and bone grafting while 10 patients with core decompression only **(Table 10)**.

Table 7: Post operative Harris Hip Scores	
Post operative HHS	**Number (Percentage)**
Excellent	32 (72.7 %)
Good	9 (20.5 %)
Moderate	0
Poor	3 (6.8 %)

Table 8: Correlation of graft use and hip survival					
	Grafting				
	Yes		**No**		
	Mean ± SD	**Median**	**Mean ± SD**	**Median**	**P value**
Hip survival (months)	28,2 ± 21,7	23,0	43,7 ± 26.1	48.0	0.313
		(6.0 – 56.0)		(7.0 – 79.0)	

Table 9: Follow-up findings			
Grade	**Number (Hips)**	**Additional intervention**	**Percentage among the grade**
1	12	1	8.3 %
2	27	11	40.7 %
3	5	4	80 %

Table 10: Patient distribution according to grades of AVN and graft use			
	Grade 1 (n)	**Grade 2 (n)**	**Grade 3 (n)**
Graft +	4 (33.3 %)	13 (48 %)	3 (%60)
Graft -	8 (66.7 %)	14 (52 %)	2 (40 %)

Discussion

Core decompression is a femoral head sparing technique for treatment of femoral head avascular necrosis. It is still a widely used procedure and is believed to decrease the intraosseous pressure and restore the blood flow into the necrotic area. Despite a standard technique was described by Arlet, many variations and combinations with supportive techniques were also described by different authors later (6,11-16). The efficacy of the treatment is inconsistent in the literature. We aimed to contribute to clarifying the controversies about the index treatment by publishing this retrospective paper. In this study; patients had significant improvement in Harris hip score postoperatively regardless of the surgical technique. This finding shows that; core decompression can still be an effective treatment options at an early-stage avascular necrosis of the femoral head.

Femoral head avascular necrosis is a progressive disease that leads to collapse and early hip degeneration. It was described that untreated disease leads to early hip degeneration in 70% of the cases so, early detection and treatment of the disease is mandatory to prevent the progression to the irreversible stage (17). Multiple etiologic factors were blamed. The common feature of all these factors is their deterioration of the microcirculatory system which leads to apoptosis of osteocytes and necrosis of the subchondral bone. As a result mechanical failure ends up with the collapse of the femoral head and degeneration of the joint. Hyperlipidemia, chronic alcohol use, and corticosteroids create a hypertrophic fat tissue in the intraosseous space and obstructs the blood flow (18). Hemoglobinopathies could cause sickling of the erythrocytes and obstruction of the blood flow (19). Trauma related to the femoral neck may intervene the anastomoses that provide the blood supply of the femoral head and lead to avascular necrosis (20). Nitrogen bubbles due to the acute decompression could obstruct the micro-vessels (21). Besides, in most of the cases no etiologic factors could be detected and this group is defined as idiopathic. In our study, corticosteroid was appeared to be the most prevalent causative factor and followed by the idiopathic cases. This finding is consistent with the literature. Sickle cell anemia, trauma, chemotherapy and pregnancy were the other accepted factors.

There are multiple classification systems used for the evaluation of the AVN. Prognostic value of these classification systems remains controversial. The stage and area of the necrotic lesion were defined as the main prognostic factors (22). We used Ficat and Arlet classification for assessing the stage in this study. ARCO classification is based on both stage and the area that is mainly affected. The size and location of the necrosis was ignored in our study. To the best of our knowledge, core decompression was being performed as the only femoral head sparing surgery in our institute and irrespective of the necrosis size; however, it was not performed, if crescent was appeared on the radiograph **(Figure 4)**. Additionally, bone grafting was added if necrosis affected a large part of the subchondral bone and weight bearing area. In the literature, stage of the disease is highly related to the treatment outcomes. In a metanalysis included 1206 patient that investigated the effectiveness of core decompression, it was reported that 84% of stage 1 patients and 65% of stage 2 patients had successful results. The survival of stage 3 hips was 47%. Results also pointed out the proportionality of the size of the necrosis and outcomes. The patients who were failed with the treatment had a mean affected area of 45% of the femoral head, and 22% in patients with favorable results. Another study also showed that 87% of untreated stage 3 hips underwent total hip arthroplasty while core decompression reduced this rate to 53%. In our study, we also found that the hips that were stage 3 AVN according to the Ficat and Arlet classification had the worst outcomes (20%) and best results were obtained in stage 1 patients (91.3%).

Decompression of the necrotic site is the main objective in treatment. Regardless of the physiologic contributory effect of the procedure, elimination of the mechanical effect of the increased pressure was

reported as the one relieving factor of the patients' complaints. On the other hand, some authors also reported that the dramatically favorable clinical feedback of the patients could be related to the prevention of the weight bearing of the affected extremity. Since, the collapse of the subchondral bone appears to be the irreversible step of the disease, literature highly recommends the filling of the space that is formed subsequent the core decompression. Avascular grafting and vascular fibular grafting techniques are viable options for now. Mont et al. reviewed the results of the study that investigated the efficacy of the core decompression with avascular grafting (23). Satisfactory results were reported in 63.5% of 1206 hips which were treated with core decompression only. Results were better in patients without femoral head collapse. This rate was detected as 22.7 % in the treated non-operatively in the same study. In contrary, Koo et al. performed a randomized trial that study about the prevention of femoral head collapse following the core decompression (24). They observed that patients acquired a symptomatic relief following the surgery however survival of the femoral head was similar to the hips which were treated non-operatively. There are similar studies that showed low success results related to the core decompression. These controversial results made the core decompression and avascular grafting questionable. Obtaining more promising results especially in early stages shaded the efficacy of the avascular grafting since the natural course of the disease remained unknown for a long time. Indifference success rates with grafting and without grafting groups could be attributed to this theory. The avascular grafting was believed to be insufficient for obtaining viable osteoprogenitor cells. For this reason, vascular fibular bone grafting is described as an attractive alternative method for reconstruction of the decompressed site. Vascular fibula is a cortical bone which is superior to cancellous autograft in terms of mechanical strength and gathers osteoprogenitor cells because of its vascular feature. Cao et al published the results of 27 bilateral AVN patients whose hips were treated with core decompression and concomitant contralateral vascular fibular grafting (25). They concluded that in the hips treated with vascular fibular grafting, the analysis with SPECT/CT revealed better vascularity, ARCO staging was improved and second operation necessity in the first 36 months was significantly lower in the hips treated with vascular fibular grafting. AVN is accepted as the mesenchymal cell disease of the femoral head. Some authors theorized the pure mononuclear cell extract or bone marrow could provide healthy osteoprogenitor cell to the necrotic region. Tabatabaee et al. published the results of the randomized controlled study that they enrolled 28 hips which were treated with core decompression and concentrated bone marrow aspirate, or core decompression alone. Hips treated with core decompression and bone marrow injection showed better functional and MRI results. In terms of hip joint survival and functional scores, we found consistent results with the similar studies in literature.

Size of the groups and heterogeneity of etiologic factors are weak part of this study. Besides, follow-up duration was enough to predict the natural course of the hips following the treatment.

Conclusion

Core decompression can be used to prevent femoral head collapse and early necessity of THA.

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Peer-Review

Double blind both externally and Internally Peer Reviewed

Conflict of Interest

The authors declare that they have no conflict of interest regarding content of this article.

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Ethical Declaration

Ethical approval was obtained from Çukurova University Research Ethical Committee with date 09/06/2009 and number 6-15, and Helsinki Declaration rules were followed to conduct this study.

Is Thesis?

This study was prepared by rearrangement of the medical specialty thesis by Mustafa Tekin, entitled as "Femur başı avasküler nekrozlarında kor dekompresyon tedavisinin fonksiyonel sonuçları" in 2011.

Authorship Contributions

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Scientific Reports in Medicine

Research Article

Clinical characteristics and treatment outcomes of growth hormone therapy in pediatric patients: a single-center experience and review of current literature

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Abstract

Objective: Recombinant human growth hormone (rhGH) became available for clinical trials, and growth hormone deficiency has been treated more safely and effectively since 1985. Growth hormone therapy enables patients to attain an adult height consistent with their genetic target height.

The present study was undertaken to evaluate patients' characteristics, their response to therapy, factors influencing outcome, and side effects of treatment.

Method: A retrospective file review was conducted. Out of 149 patients followed up with a GHD diagnosis, 92 patients whose files were accessible and who received treatment for at least 1 year were included in the study. Patients' chronological ages, ages at diagnosis, sex, pretreatment bone ages (BA), pubertal stages, annual growth velocities, auxological data during treatment, and side effects were recorded.

Results: Age at diagnosis, sex, etiologic distributions, and auxological data were found to be similar to the results of Western countries. Height gain was found to be significant in the first year of treatment, and then growth velocity declined gradually. Age at the initiation of GH treatment has been shown to be negatively correlated with the response to therapy, emphasizing the need for early diagnosis and treatment of the condition. No significant adverse effects were observed throughout the 16-year follow-up period.

Conclusion: Early detection of pathological short stature, particularly Growth Hormone Deficiency (GHD), and the initiation of treatment at an early stage, lead to a superior final height outcome. Patients with GHD can be treated both effectively and safely with recombinant growth hormone therapy.

Keywords: Growth hormone, child, growth hormone replacement therapy.

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INTRODUCTION

Growth represents one of the most distinctive features of childhood. Evaluating growth is important as it is a sensitive indicator of a child's health, nutrition, and genetic makeup (1). Short stature is a common problem encountered in clinical practice. The prevalence of short stature associated with Growth Hormone Deficiency (GHD) is estimated to be approximately 1:4000 to 1:10000. In studies conducted in various clinics regarding the etiology of short stature, GHD constitutes 7-23% of cases presenting with short stature (2). GHD should be considered particularly in children with severe short stature (height below 3 SD or the 1st percentile for age and sex, those with significantly low growth velocity (below 5-10th percentile), those whose height is between 2 and 3 SD but whose growth velocity has decreased, children with hypoglycemia, micropenis, a history of Central Nervous System (CNS) tumors and radiation or surgery in its treatment, and the presence of congenital or acquired other pituitary hormone deficiencies (1).GHD may occur as an isolated problem or accompany other pituitary hormone deficiencies (most frequently TSH deficiency, less frequently prolactin, gonadotropin, and ACTH deficiencies) (3). According to data from approximately 100,000 patients from 4 major growth hormone study groups worldwide (National Cooperative Growth Study of Genentech (NCGS), Kabi Farmacia International Growth Study (KIGS), Australasian Pediatric Endocrine Group Database (OZGROW), International Cooperative Growth Study in Japan (ICGS)) between 1997-1999, 40-61% of patients using GH treatment had idiopathic GHD, 13-16% had organic causes (multiple pituitary hormone deficiency), 14-40% had idiopathic short stature, 4-18% had Turner syndrome, 1-6% had chronic kidney failure (CKF), and 1-4% had other causes (4). The 2006 data from KIGS, comprising 55,000 patients, reported idiopathic GHD as 51%, organic GHD as 36%, and other causes as 13% (5). The clinical characteristics of patients with GHD are quite heterogeneous, depending on the etiology, the age of onset of the deficiency, and accompanying other hormone deficiencies and diseases. However, GH treatment can ensure that these patients reach adult height consistent with their target height (6). GH treatment has a history of 70 years, In 1985, biosynthetic GH with a polypeptide structure obtained by recombinant DNA technology was introduced (7,8). Due to its safer and more effective nature, the use of GH has become increasingly widespread. In addition to other diseases that cause growth retardation even without GH deficiency, such as idiopathic short stature, Turner syndrome, chronic kidney failure (CKF), and intrauterine growth retardation, the use of GH in adults with GHD has also become relevant due to its metabolic effects. However, significant differences in practice regarding the diagnosis and treatment of GHD have been observed, leading to the publication of various national and international consensus reports. In our country, a consensus report has also been prepared by the National Pediatric Endocrinology Society for clinical and auxological findings in the diagnosis of GHD, appropriate laboratory tests, GH doses used in treatment, factors affecting treatment, aspects to consider during follow-up, and indications for discontinuing GH treatment (9).Our study aimed to evaluate the demographic, clinical characteristics, adherence and response to treatment, and side effects of patients diagnosed with GHD and treated with GH replacement therapy in our clinic.

METHOD

Ethical permission was obtained from the Akdeniz University, Medical Faculty Research Ethics Committee for this study with date 2007/number 183, Medical records of patients receiving GH treatment at Akdeniz University Faculty of Medicine Pediatric Endocrinology Clinic were retrospectively scanned. Data collected included patients' chronological ages (CA), ages at diagnosis, sex, pretreatment bone ages (BA), height measurements, parental heights, pubertal stages, pretreatment annual growth velocities, bone ages and auxological data during and after treatment, and any arising side effects and dose changes were recorded. Between 1991 and 2007, 149 patients followed up with a GHD

diagnosis were identified, and 92 patients whose files were accessible and who received treatment for at least 1 year were included in the study.

Statistical Method: Results were expressed as mean ± SD. Statistical analyses were performed using SPSS version 14.0 (SPSS Inc., Chicago, IL, USA). One Way ANOVA (parametric) and Kruskal-Wallis (non-parametric) tests were used for comparison of three groups, while Independent samples t-test and Mann-Whitney U test were used to show pairwise differences between 3 groups and/or compare two groups, and Wilcoxon Signed-Rank test was used for paired comparison. $P<0.05$ was considered a significant difference, but due to the changing alpha value in pairwise comparisons, Bonferroni correction was applied, and alpha=0.017 was accepted as significant. Spearman correlation test was used for evaluating correlations.

RESULTS

Of the 92 patients included in the study, 30 were female (33%), 52 were male (56%), and 10 patients (11%) were diagnosed with Turner syndrome. According to the etiologies of GHD, 73% of the patients were evaluated as idiopathic GHD, while 27% were found to have organic GHD. 64 cases (69%) were diagnosed with isolated GHD (IGHD) (89.1% idiopathic, 10.9% organic), while 18 cases (20%) were diagnosed with multiple pituitary hormone deficiency (MPHD) (9.1% idiopathic, 89% organic). Among the 64 cases with IGHD, pituitary hypoplasia was detected in the MRI of only 7 (10.9%), while no pathology was found in the pituitary MRIs of the others. Among the 18 patients with MPHD, pituitary MRI was normal in 2 (11%), while 1 patient had partial empty sella, 3 cases had empty sella, 2 had ectopic neurohypophysis, and 10 cases had pituitary hypoplasia. PIT-1 mutation was detected in two siblings, and pituitary hypoplasia was also present in these patients. Magnetic Resonance Imaging (MRI) findings according to the patients' diagnoses are shown in Figure 1. The mean age at initiation of treatment was 10.4 ± 3.59 years, and the mean duration of treatment was 2.8 ± 1.9 years. Pretreatment auxological data of the patients are summarized in Table 1. While the pretreatment annual growth velocity of all cases was 3.47 ± 1.7 cm, it was found to be 8.88 ± 3.69cm, 5.89 ± 1.99 cm, and 4.75±1.09 cm in the 1st, 2nd, and 3rd years of treatment, respectively, with the fastest growth occurring in the 1st year of treatment. The growth velocities of the patients during treatment are shown in Figure 2. In Turner syndrome patients, the age at initiation of treatment was 9.78 ±3.7 years, the mean duration of treatment was 3.4 ± 2.3 years, and while the pretreatment annual growth velocity was 2.57 ±1.7 cm, the fastest growth after treatment was 7.86 ± 2.39cm, again in the 1st year. The mean duration of treatment for the 10 patients (1 with Turner syndrome) who reached final height was 5.09 ±2.94 years. The pretreatment height SDS of the patient with Turner syndrome reached -2.1 after treatment, from -4.05. The pretreatment height SDS of the other patients reached -1.30 ± 0.86, from -4.35 ±2.1. The characteristics of the patients who reached final height are shown in Table 2. Side effects developed in only 2 of the 92 patients; 1 patient had elevated liver transaminases (5 times the normal limit), and 1 patient had insulin resistance, leading to temporary discontinuation of treatment and subsequent continuation.

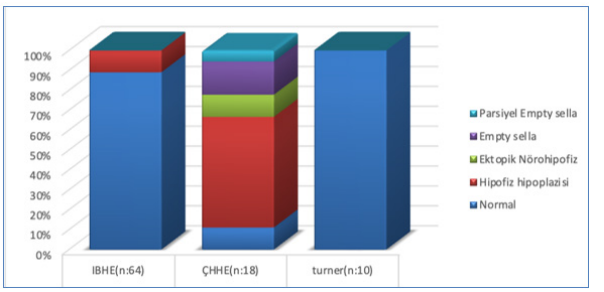

Figure 1. Magnetic Resonance Imaging (MRI) findings according to the patients' diagnose

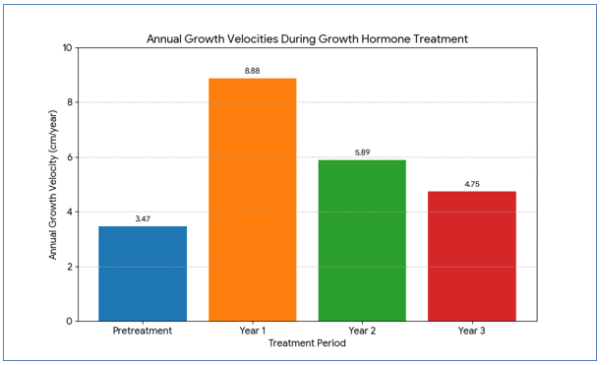

Figure 2. Growth velocities of the patients during treatment

DISCUSSION

In our study, the characteristics of 92 patients who had been receiving regular treatment for at least 1 year with a diagnosis of GHD were evaluated. When patients were evaluated according to sex, the male/female ratio was 1.73. The male/female ratio for patients with GHD was reported to be 1.3 in the USA, 2.1 for idiopathic GHD according to KIGS, and 1.3 for organic causes (10). The higher prevalence observed in males has been attributed to both genetic factors and sociocultural influences. However, the view that social acceptability, rather than genetic predisposition, creates the male sex tendency is dominant (5). Our male/female ratio was found to be higher than in the USA but similar to European countries. According to the etiologies, 73% of the patients were evaluated as idiopathic GHD, while 27% were found to have organic GHD. 64 cases (69%) were diagnosed with isolated GHD (IGHD) (89.1% idiopathic, 10.9% organic), while 18 cases (20%) were diagnosed with multiple pituitary hormone deficiency (MPHD) (11% idiopathic, 89% organic), and 10 cases (11%) were diagnosed with Turner syndrome (3 of whom had mosaic Turner). A multicenter study conducted in our country with data from 70 patients with GHD who reached final height found that 26% of the patients had MPHD (72.2% organic, 27.8% idiopathic), and 74% had IGHD (7.7% organic, 92.3% idiopathic) (11). A study conducted in Canada in 2006 found idiopathic GHD to be 65.6% and organic GHD to be 34.4% (12). In England, idiopathic GHD was reported to constitute 68% of patients treated for GHD (13). Our diagnostic distribution was found to be similar to studies in our country as well as in Canada and England. In our study, pituitary pathology (pituitary hypoplasia) was detected in the MRI of only 7% (10.9%) of cases with IGHD, while pituitary pathology (1 patient partial empty sella, 3 cases empty sella, 2 ectopic neurohypophysis, 10 cases pituitary hypoplasia) was detected in 16% (89%) of the 18 patients with MPHD. Published reports regarding this issue show that pituitary pathology is found in 10-50% of patients with IGHD in MRI, while pituitary pathology is present in 52-93% of patients with MPHD (14-16). Our MRI findings were consistent with these studies. The mean age at diagnosis of our cases was 10.40±3.59 years. The mean age at diagnosis of cases with MPHD (8.38 ± 3.55) was found to be smaller than that of patients with IGHD (10.1± 2.15), although this was not statistically significant (p=0.11). The mean height of our patients at the start of treatment was 119.3 ± 18.53 cm (height SDS -3.42±1.29). When growth velocities were evaluated as a response to treatment, it was found that the mean growth velocity in the first year with GH treatment was 9.88 ±2.66 cm, which was about 2.5 times higher than the pretreatment growth velocity, and then gradually decreased in subsequent years. First-year growth velocity is important because it is a determinant of final height and better treatment outcomes. According to the literature, first-year growth velocity is reported to be between 8-13 cm/year, and growth velocity decreases in subsequent years (17,18). This decrease in growth velocity is independent of the treatment dose and can be shown to be due to the resolution of the GHD condition and adaptation to normal growth velocity, not insufficient treatment (19). In this study, the mean duration of treatment for the 10 patients (8 IGHD, 2 MPHD) who reached final height was found to be 5.09 ± 2.94 years. While their pretreatment mean height was 114.5 ± 22.78 cm, their posttreatment final height was 162 ± 17.99 cm (final height SDS -1.30 ± 0.86), and the Deltaheight SDS was 2.49 ±1.20. The data from the KIGS and NCGS study groups reported a treatment duration of 5-8.1 years, final height SDS of -1.3, and Deltaheight SDS of +1.4-1.7 (20). Our findings are seen to be similar. The key indicator of successful GH therapy is the final height achieved by the patients. Reaching the final height within the target height range is possible with GH replacement therapy (9,21). Factors affecting final height have been evaluated in various studies in the literature. A positive correlation was reported between height at the start of treatment, patients' genetic height potential (target height), duration of treatment, and first-year growth velocities with

final height. The major determinant of final height is stated to be the child's genetic potential, i.e., target height, and that a longer pretreatment height and longer duration of treatment may also provide a taller final height (10,12,22).Starting treatment early, administering treatment for a longer period, and having a high height gain in the first year lead to a better final height (9). The most important proven side effect of GH treatment so far is Creutzfeldt-Jakob disease observed in those treated with GH prepared with human pituitary extract. This side effect has been eliminated with the use of recombinant GH. Numerous review studies have been conducted on potential serious side effects of GH treatment in terms of safety and efficacy, such as malignancy development and recurrence, intracranial hypertension (IH), metabolic side effects, orthopedic problems, stroke, and increased mortality rate (23-27). According to the 2022 KIGS data consisting of approximately 84,000 patients, the most frequently observed side effects in cases receiving GH were non-specific findings such as upper respiratory tract infection, fever, gastroenteritis, headache, and muscle pain, while scoliosis was reported as the second most frequent. It was thought that GH and IGF-1 could increase the risk of malignancy due to their growth-promoting and mitogenic effects. Recurrences have been observed in patients with craniopharyngioma, but a direct causal relationship with treatment could not be demonstrated (24). In patients with intracranial tumors, relapses were reported in 5-10% with an average of 2 years of GH treatment, but the risk was not observed to be increased compared to patients not using GH. It was reported that the incidence of type 1 diabetes was not higher than in the general population, and although the incidence of type 2 diabetes was higher than expected, it was thought to be probably due to previous patient predisposition (24,28). Slipped capital femoral epiphysis, increased intracranial pressure, convulsions, and gynecomastia have been reported. However, the direct relationship of these findings with GH has not been definitively demonstrated (9). In our study, insulin resistance was detected for the first time in only 2 of the 92 patients (treatment was restarted after insulin resistance returned to normal limits after a 1-month break), and no other serious side effect was observed.

CONCLUSION

Early detection of pathological short stature, especially GHD, and the initiation of early treatment, resulting in a longer duration of treatment, lead to a better final height outcome. Recombinant growth hormone therapy is both an effective and safe treatment option for patients with growth hormone deficiency.

Table 1. Pretreatment Auxological Data of the Patients

Data	Total (n=92)	Male	Female	Turner	p
Age(year)	10.43±3.59 (1.5-17.6)	10.61±3.91 (1.5-17)	10,35±3.02 (5-17.6)	9.78±3.7 (4.7-14.9)	0.794
Height (cm)	119.3±18.53 (62-147)	120.76±19.95 (62-147)	118.87±16.96 (90-145)	112.94±15.19 (90.5-134)	0.269
Height SDS	-3.42±1.29	-3.45±1.18	-3.34±1.53	-3.52±1.18	0.973
PH (cm)	157.14±8.68 (140-177)	161.33±6.64 (150-177)	152.8±8.24 (140-169)	151.29±7.63 (142.2-168)	<0.01*
TH (cm)	162.1±7.36 (148-177)	166.42±5.09 (155.3-177)	156±6.2 (148-175.1)	157.8±5.1 (152-166)	<0.01*
BA	7.87±3.55	7.6±3.6	8.3±3.4	7.8±3.73	0.707

*p < .005, SDS = standard deviation score, PH=Predicted Height, TH=Target Height, BA=Bone Age

Table 2. Characteristics of Patients at Final Height								
Male (6)					**Female (4)**			
	Mean	**SDS**	**Median**	**Range**	**Mean**	**SDS**	**Median**	**Range**
Age(years)	9.97	4.02	10.5	1.6-16.6	9	3.92	8.5	5-14
Treatment (years)	5.09	2,94	4	2-11	5.5	2.08	5.5	3-8
Pretreatment Height (cm)	114.5	22.78	120	62-140	117	21.02	117.5	94-139
Pretreatment HSDS	-4.35	2.1	-3.33	-9.67-2.65	-3.52	1.18	-3.33	-5.13-2.29
Final Height (cm)	166.6	17.99	168	157-175	158.5	6.03	158,5	152-165
Final HSDS	-1.3	0,86	-1,81	-2.10 -0.23	-1.17	0.75	-1.15	-2.1-0.3
ΔHSDS	2.49	1.2	2.46	0.92- 3.93	2.22	1.42	1.85	1-4.2
SDS = standard deviation score, PH=Predicted Height, TH=Target Height								

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Peer-Review

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Conflict of Interest

The authors declare that they have no conflict of interest regarding content of this article.

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Ethical Declaration

Ethical permission was obtained from the Akdeniz University, Medical Faculty Research Ethics Committee for this study with date 2007/number 183, and Helsinki Declaration rules were followed to conduct this study.

Authorship Contributions

Concept: ÖU, Design: ÖU, BI, Supervising: BI, Data collection and entry: ÖU, Analysis and interpretation: ÖU, Literature search: ÖU, Writing: ÖU, Critical review: ÖU

Thesis?

This study was prepared by rearrangement of the specialty thesis by Ulaş Özdemir, entitled as "Akdeniz Üniversitesi Tıp Fakültesi Pediatrik Endokrinoloji Bilim Dalında 1991-2007 Yılları Arasında Büyüme Hormonu Replasman Tedavisi Alan Hastaların Değerlendirilmesi".

Is previously presented?

Some part of this study was presented as oral/poster presentation at "Congress of 18th International Eastern Mediterranean Family Medicine Congress 25 – 28 April, 2019 – Adana Divan Hotel, Türkiye"

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Scientific Reports in Medicine

Research Article

Protective effect of Dapagliflozin against Amphotericin B-induced nephrotoxicity in an experimental rat model

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Abstract

Objective: Background: Amphotericin B deoxycholate (AmBD), a potent antifungal agent, is limited by significant nephrotoxicity. SGLT-2 inhibitors, such as dapagliflozin, exhibit renoprotective effects beyond glycemic control. This study aimed to investigate the potential protective effects of dapagliflozin against AmBD-induced nephrotoxicity in an experimental rat model.

Materials and Methods: Thirty-two Wistar albino rats were randomized into four groups (n=8): Control, AmBD (single 50 mg/kg i.p. dose), Dapagliflozin (10 mg/kg/day, gavage), and AmBD + Dapagliflozin. After seven days, serum levels of creatinine, BUN, oxidative stress markers (TOS, MDA, MPO), antioxidant enzymes (CAT, SOD, GPx), and apoptotic mediators (Bax, Bcl-2, Caspase-3) were analyzed. Renal tissues were evaluated for histopathological changes.

Results: AmBD administration induced significant acute kidney injury, characterized by elevated serum BUN and creatinine levels and severe histopathological damage, including tubular necrosis and dilatation. Co-administration of dapagliflozin significantly attenuated these functional and structural injuries, but its effect on systemic oxidative stress and apoptotic markers could not be demonstrated in this model.

Conclusion: Dapagliflozin partially prevented AmBD-induced elevations in BUN and creatinine and significantly ameliorated histopathological damage. However, no significant effect was observed on systemic oxidative stress or apoptotic markers in this model

Keywords: Dapagliflozin, Amphotericin B, nephrotoxicity, oxidative stress, SGLT-2 inhibitor, acute kidney injury.

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INTRODUCTION

Amphotericin B deoxycholate (AmBD) is a broad-spectrum antifungal agent regarded as the gold standard in the treatment of systemic fungal infections. Effective against numerous pathogenic fungi, particularly Aspergillus, Candida, and Cryptococcus species, AmBD is frequently used in the management of severe immunosuppressive conditions and life-threatening clinical scenarios such as febrile neutropenia (1). Despite its high efficacy, nephrotoxicity remains the major adverse effect limiting its therapeutic success (2). This toxicity is mainly characterized by oxidative stress, inflammation, apoptosis, and tubuloglomerular feedback dysfunction, especially in proximal tubular cells (3, 4). In vitro studies have reported transient or permanent impairment of renal function in approximately 80% of patients receiving AmBD therapy (2, 3, 5).

In recent years, sodium–glucose cotransporter-2 (SGLT-2) inhibitors have become widely used in the management of diabetes, not only providing glycemic control but also attracting attention for their notable cardio-renoprotective effects (6-9). SGLT-2 inhibitors such as dapagliflozin exert kidney-protective actions by reducing glomerular hyperfiltration, lowering intraglomerular pressure, and limiting tubulointerstitial injury (10, 11). Moreover, both experimental and clinical studies have demonstrated that these agents modulate oxidative stress, inflammatory, and apoptotic pathways (6, 10, 12-15).

However, data regarding the potential renoprotective effects of SGLT-2 inhibitors against potent nephrotoxic agents such as AmBD remain limited. Elucidating whether dapagliflozin can prevent or mitigate AmBD-induced acute kidney injury (AKI) would address an important clinical and pharmacological gap. The aim of this study was to evaluate the possible renal protective effects of the SGLT-2 inhibitor dapagliflozin against AmBD-induced nephrotoxicity in an experimental rat model, using both biochemical and histopathological assessments.

MATERIAL AND METHODS

2. 1. Experimental Rats

Thirty-two male Wistar albino rats (2 months old; 250–350 g) were obtained from the Experimental Animal Research Unit, Faculty of Medicine, Çukurova University (Adana, Türkiye). Rats were housed under controlled conditions (23 ± 2 °C; 60 ± 5% humidity; 12 h light/dark cycle) with free access to standard pellet chow (Feed Institution Standard Rat Diet) and tap water. After a one-week acclimatization period, animals were randomly divided into four groups (n = 8 per group). All experimental procedures complied with the Guide for the Care and Use of Laboratory Animals (16).

2.2. Experimental Design and Drug Administration

Treatment duration, administration routes, and dosing schedules were determined based on pharmacokinetic data and previous studies on AmBD- and dapagliflozin-induced nephrotoxicity in rats (2, 3). AmBD was administered intraperitoneally(ip) due to its poor oral bioavailability; this route provides consistent systemic exposure and reproducible nephrotoxicity in rodents (17). Dapagliflozin was administered orally by gavage to mimic the clinical route and ensure adequate gastrointestinal absorption (10, 13). Dapagliflozin (Forziga®, AstraZeneca Pharmaceuticals LP, Wilmington, DE, USA) and AmBD (AmBD (Fungizone®, IV formulation, Bristol-Myers Squibb SA, France) were used in the study.

2.3. Experimental Groups

Rats were randomly divided into four groups (n = 8 per group) as follows:

1. Control group: Received isotonic saline (1 mL/kg, ip) once daily for 7 days.
2. Dapagliflozin group: Received dapagliflozin (10 mg/kg, oral gavage) once daily for 7 days.
3. AmBD group: Received a single ip dose of AmBD (50 mg/kg) on day 2 and isotonic saline on the remaining days.

4. AmBD + Dapagliflozin group: Received dapagliflozin (10 mg/kg, oral gavage) once daily for 7 days and a single ip dose of AmBD (50 mg/kg) on day 2.

2.4. Operation Procedures and Measurements

All procedures were conducted in accordance with the Guide for the Care and Use of Laboratory Animals (16). The experimental period lasted seven days. To minimize circadian variations, all treatments were administered between 09:00 and 10:00 a.m. Injections were performed twice daily at 12-hour intervals using insulin syringes inserted into the left lower abdominal quadrant; gentle aspiration was applied before each injection to prevent accidental intravenous administration.

On day 8, rats were anesthetized with ketamine (50 mg/kg, ip) and xylazine (10 mg/kg, i.p.). Blood samples were collected via intracardiac puncture, centrifuged at 3000 rpm for 10 min, and sera were stored at −80 °C until biochemical analysis. Animals were humanely euthanized by cervical dislocation under deep anesthesia, and both kidneys were harvested and fixed in 10% neutral-buffered formalin for histopathological examination.

Serum samples were thawed at room temperature before analysis. Oxidative stress markers—malondialdehyde (MDA), total oxidant status (TOS), and myeloperoxidase (MPO)—and antioxidant parameters—total antioxidant status (TAS), glutathione peroxidase (GPx), catalase (CAT), and superoxide dismutase (SOD)—were quantified. Pro-apoptotic proteins [Bcl-2-associated X protein (Bax) and Caspase-3 (Casp-3)], the anti-apoptotic protein Bcl-2, and renal function indicators (serum urea and creatinine) were also measured. All biochemical, immunohistochemical, and histopathological evaluations were performed by investigators blinded to group allocation to minimize observer bias.

2.5. Ethics Committee

The study was conducted at the Experimental Practice and Research Center of Çukurova University following approval from the Institutional Ethics Committee (Ethics Approval Date/No: July 20, 2023).

2.6. Biochemical Analyses

2.6.1. Determination of Serum Urea and Creatinine Concentrations

Serum urea and creatinine were analyzed colorimetrically with an autoanalyzer (Mindray BS-400, China) using commercial kits (Otto Scientific, Türkiye; Cat. No. OttoBC157 and OttoBC139, respectively). Results were expressed in mg/dL; blood urea nitrogen (BUN) was obtained by dividing urea values by 2.14.

2.6.2. Assessment of MDA and Catalase (CAT) Activities

Serum MDA was measured colorimetrically using a commercial kit (Otto Scientific, Cat. No. Otto1001) following Yoshioka et al (18). CAT activity was determined with a kit (Elabscience, USA; Cat. No. E-BC-K031-S) according to Aebi(19). Data were expressed as nmol/g for MDA and U/L for CAT.

2.6.3. Quantification of Bax, Bcl-2, and Casp-3 Levels

Casp-3 levels were quantified using an ELISA kit (Elabscience, USA; Cat. No. E-EL-R0160) following Engvall and Perlmann (20). Bax and Bcl-2 concentrations were determined with similar ELISA kits (BT-Lab, China; Cat. Nos. E0034Ra and E0037Ra). Absorbance was read at 450 nm using a microplate reader (BIO-TEK EL X 800), and results were expressed as ng/mL.

2.6.4. Determination of SOD, GPx, and MPO Activities

Serum SOD, GPx, and MPO activities were determined colorimetrically using commercial kits (Otto Scientific, Türkiye; Cat. Nos. Otto3047, Otto2085, and Otto3048) on a Mindray BS-400 autoanalyzer (Mindray, China). Analyses followed the methods of Marklund and Marklund, Paglia and Valentine, and Bradley et al. (21, 22). Results were expressed as U/mL for SOD and U/L for GPx and MPO.

2.7. Histopathological Examination of Renal Tissues

Renal tissues were fixed in 10% neutral-buffered formalin, dehydrated in ethanol, cleared with xylene, and embedded in paraffin. Sections (5 μm) were stained with hematoxylin–eosin (H&E) and periodic acid–Schiff (PAS) for morphological evaluation. Histopathological assessments were performed blindly by a pathologist using a light microscope (Olympus BX51, Olympus, Japan). Tubular necrosis, vacuolization, dilatation, atrophy, desquamation, mononuclear cell infiltration, cortical and medullary necrosis, inflammation, and hyaline cast formation were examined. Histopathological alterations were evaluated in a semi-quantitative manner using a scoring system, where the degree of renal damage was graded as (–) no damage, (+) mild, (++) moderate, or (+++) severe, according to the criteria established by Mozaffari(23).

2.8 Statistical Analysis

Statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS) software, version 27.0 (IBM Corp., Armonk, NY, USA). Categorical variables were presented as numbers and percentages, while continuous variables were expressed as mean ± standard deviation (SD). Comparisons of categorical parameters were performed using the chi-square test, and post hoc pairwise group differences were analyzed with the Bonferroni-adjusted test.The Shapiro–Wilk test was applied to determine the normality of data distribution. For variables with normal distribution, one-way analysis of variance (ANOVA) was used, whereas the Kruskal–Wallis test was applied for data that did not follow a normal distribution. A p value of <0.05 was considered statistically significant.

RESULTS

The results for apoptotic mediators, oxidative stress parameters, and renal function tests are summarized in Table 1.

1. Renal Function Indicators

In the AmBD group, serum creatinine and BUN levels showed a significant increase compared to the control group ($p<0.001$). In the Dapagliflozin + AmBD group, these parameters were significantly lower than those in the AmBD group ($p < 0.01$), indicating that dapagliflozin partially prevented AmBD-induced renal dysfunction (Table 2).

2. Markers of Oxidative Stress, Antioxidant Defense, Apoptosis, and Inflammation

There were no statistically significant differences among the four rat groups in plasma levels of oxidative parameters (TOS, MPO, and MDA), antioxidant parameters (GPx, CAT, SOD, and TAS), pro-apoptotic markers (Bax and Casp-3), or the anti-apoptotic marker (Bcl-2) following AmBD administration and its co-administration with Dapagliflozin (Table 2).

3. Histopathological Findings

Renal histopathological evaluation under light microscopy revealed that rats in the AmBD group exhibited markedly more severe renal injury findings, including tubular dilatation ($p<0.001$), tubular vacuolization ($p<0.006$), hyaline cast formation ($p<0.045$), tubular necrosis ($p<0.002$), medullary hemorrhage ($p<0.002$), cortical necrotic areas ($p<0.033$), and tubular desquamation ($p<0.016$), compared with the control, dapagliflozin, and dapagliflozin + AmBD groups. Renal histopathological findings for each group are summarized in Table 2. The results of the kidney histopathological examination are presented in Figures 1-4.

DISCUSSION

Our findings demonstrated that AmBD induced significant histopathological renal damage in the experimental nephrotoxicity model, whereas concomitant administration of dapagliflozin ameliorated these injury findings. Consistent with previous studies (10, 24, 25) suggesting the renoprotective effects of SGLT-2 inhibitors against various nephrotoxic agents, co-treatment with

dapagliflozin also attenuated the AmBD-induced elevation in serum BUN and creatinine levels.

Feldman et al. (2) demonstrated that a single dose of 50 mg/kg ip AmBD was sufficient to induce nephrotoxicity. Similarly, Odabaşı et al. (5) reported that administration of 10 mg/kg ip AmBD for five consecutive days led to marked tubular apoptosis in rats. In our study, a single 50 mg/kg ip AmBD injection resulted in distinct tubular degeneration and interstitial inflammation, accompanied by significant increases in serum creatinine and BUN levels. Co-administration of AmBD with dapagliflozin prevented these increases and attenuated histopathological renal damage, demonstrating a pronounced renoprotective effect of dapagliflozin.

Chang et al. (13) reported that dapagliflozin reduced renal injury in a murine ischemia-reperfusion (IR) model by decreasing serum creatinine and BUN levels. Similarly, Değer et al. (10) demonstrated that dapagliflozin lowered TOS, MDA, and MPO levels while increasing TAS levels in a cyclosporine A-induced renal injury model, indicating enhanced antioxidant defense. These findings support the modulatory effect of dapagliflozin on oxidative stress and its potential renoprotective action through antioxidative mechanisms. In our study, adding dapagliflozin to AmBD treatment did not produce a statistically significant improvement in oxidative or antioxidant parameters compared to AmBD alone, a result that diverges from some literature findings. We propose several potential explanations for this outcome. The primary reason may be the unique pathophysiology of AmBD-induced nephrotoxicity, which is driven by direct tubular damage and vasoconstriction rather than being primarily an oxidative stress-mediated event like in cyclosporine A or ischemia-reperfusion models. Furthermore, our single measurement on day 8 may have missed the earlier, more acute phase of oxidative stress. Consequently, we hypothesize that the renoprotective action of dapagliflozin in this context is likely not through a direct, broad antioxidant effect. Instead, its benefits are more probably linked to alternative mechanisms, such as hemodynamic improvements (e.g., enhanced tubuloglomerular feedback, reduced glomerular pressure) or direct metabolic advantages for tubular cells. This highlights that the protective mechanisms of SGLT2 inhibitors are context-dependent and vary based on the specific type of renal injury. Future research is needed to clarify the precise role of dapagliflozin on oxidative pathways in this particular model.

Table 1. Renal function tests, oxidative stress markers, and apoptosis markers in experimental groups.

Parameters	Control	DAPA	AmBD	AmBD+DAPA	*p*
BUN	31.9±2.71[a]	40.8±16.7[a]	92.3±30.45[b]	37.28±5.36[a]	<0.001
Creatinine	0.75±0.03[a]	0.78±0.39[a]	1.89±0.22[b]	0.87±0.04[a]	<0.001
MDA	7.87±0.87	8.90±1.30	8.40±0.94	7.88±0.66	0.942
TOS	8.08±1.6 [a]	9.3±2.3 [a]	9.6±2.8 [a]	3.1±0.5[b]	0.050
MPO	57.9±3.4	66.5±3.8	62.3±5.5	62.1±2.8	0.069
GPx	501.3±48	543.4±78.9	609.5±14.3	549.9±56.9	0.081
CAT	40.5±3.9[a]	70.6±6.7[b]	43.2±3.1[a]	64.5±5.4[b]	0.001
SOD	282±18.1[a]	261.6±26.3[a]	325.2±15.4[b]	344.8±15.5[b]	0.016
TAS	1.52±0.05	1.52±0.04	1.49±0.09	1.48±0.10	0.847
BAX	8.81±0.37	8.42±0.33	9.75±0.44	8.86±0.26	0.166
Caspas-3	2.37±0.46	5.08±3.1	2.09±0.64	2.90±0.88	0.658
Bcl-2	6.92±0.35	6.89±0.36	7.50±0.39	7.14±0.39	0.353

Data are expressed as mean ± standard deviation. Different superscript letters (a, b) within the same row indicate a statistically significant difference between groups ($p < 0.05$). DAPA: Dapagliflozin, AmBD: Amphotericin B deoxycholate.

Table 2. A comparison of renal histopathology across the studied rat groups

Parameters	Category	Control	DAPA	AmBD	AmBD+DAPA	*p*
Tubular dilatation	Normal	8 (100)	8(100)	3(37.5)	2(25)	<0.001
	Light	-	-	2(25)	6(75)	
	Moderate	-	-	2(25)	-	
	Severe	-	-	1(12.5)	-	
Tubular vacuolization	Normal	8(100)	6(75)	4(50)	-	<0.006
	Light	-	2(25)	1(12.5)	4(50)	
	Moderate	-	-	2(25)	4(50)	
	Severe	-	-	1(12.5)	-	
Hyaline cast	Normal	1(12.5)	-	-	-	<0.045
	Light	7(87.5)	8(100)	5(62.5)	8(100)	
	Moderate	-	-	3(37.5)	-	
	Severe	-	-	-	-	
Tubular necrosis	Normal	8(100)	7(87.5)	4(50)	1(12.5)	
	Light	-	1(12.5)	-	5(62.5)	<0.002
	Moderate	-	-	3(37.5)	2(25)	
	Severe	-	-	1(12.5	-	
	Normal	8(100)	7(87.5)	5(62.5)	7(87.5)	<0.564
Tubular atrophy	Light		1(12.5)	1(12.5)	1(12.5)	
	Moderate	-	-	1(12.5)	-	
	Severe	-	-	1(12.5)	-	
Interstitial edema	Normal	8(100)	8(100)	5(62.5)	4(50)	<0.054
	Light	-	-	2(25)	4(50)	
	Moderate	-	-	1(12.5)	-	
	Severe	-	-	-	-	
Tubular inflammation	Normal	8 (100)	7 (87.5)	5(62.5)	8(100)	<0.077
	Light	-	1(12.5)	3(37.5)	-	
	Moderate	-	-	-	-	
	Severe	-	-	-	-	
Mononuclear cells in the medulla	Normal	8(100)	7(87.5)	4(50)	5(62.5)	<0.088
	Light	-	1(12.5)	2(25)	3(37.5)	
	Moderate	-	-	2(25)	-	
	Severe	-	-		-	
Medullary hemorrhage	Normal	8 (100)	8 (100)	4(50)	4(50)	<0.002
	Light	-	-	1(12.5)	4(50)	
	Moderate	-	-	3(37.5)	-	
	Severe	-	-	-	-	
Necrotic area in cortex	Normal	8(100)	8 (100)	4(50)	8(100)	<0.033
	Light	-	-	3(37.5)	-	
	Moderate	-	-	1(12.5)	-	
	Severe	-	-	-	-	
Tubular desquamation	Normal	8 (100)	8 (100)	4(50)	3(37.5)	<0.016
	Light	-	-	3(37.5)	5(62.5)	
	Moderate	-	-	1(12.5)	-	
	Severe	-	-	-	-	

Values are presented as n (%). DAPA: Dapagliflozin. AmBD: Amphotericin B deoxycholate

When the association between dapagliflozin and apoptosis was examined, Chang et al. (13) demonstrated in an ischemia-reperfusion (IR) mouse model that dapagliflozin attenuated renal injury and improved kidney function. They reported that dapagliflozin reduced renal Bax expression and tubular damage in the hypoxic proximal tubular cells of IR-injured mice. Moreover, the Bax/Bcl-2 ratio, a well-established indicator of apoptotic signaling, was markedly increased in hypoxic proximal tubular cells and was significantly reduced following dapagliflozin treatment. In contrast to reports suggesting anti-apoptotic benefits, our study found no significant impact of dapagliflozin on the measured apoptotic markers. This discrepancy may be explained by several factors. First, our single-timepoint measurement might have missed the transient peak of apoptotic activity, a process known to be highly dynamic (26). Second, the analytical methods may have lacked the sensitivity to detect subtle changes, particularly in distinguishing between active and inactive forms of proteins like casp-3(27). Finally, the dosage or duration of dapagliflozin treatment may have been insufficient to provoke a measurable apoptotic response in our specific model. Thus, while dapagliflozin may have anti-apoptotic potential in other contexts, our findings suggest its influence is limited under these experimental conditions. Future studies using multiple time points and more sensitive assays are needed to fully clarify its role.

Odabaşı et al. (5) observed tubular cell necrosis, cell loss, accumulation of proteinaceous material within the tubular lumen, cellular degeneration, and inflammatory cell infiltration in renal tissues

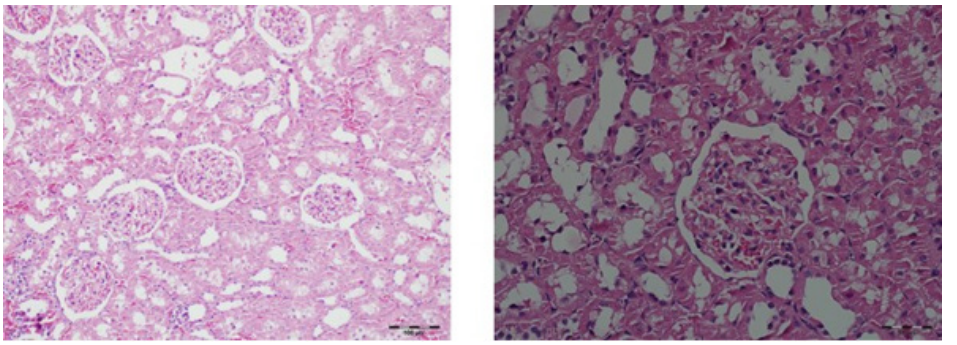

Figure 1. Histological appearance of the kidney tissue from the control group. Glomeruli, proximal, and distal tubules with normal morphology are observed in the cortical and medullary regions (Hematoxylin and Eosin (H&E), ×40).

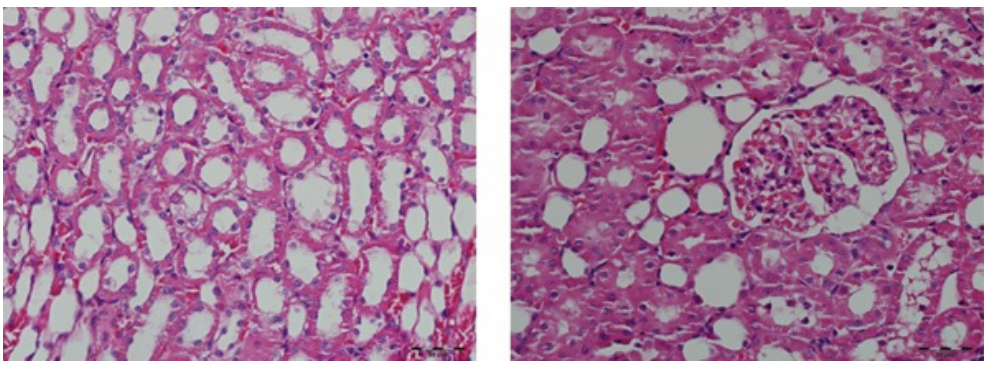

Figure 2. Histology of kidney tissue from the Dapagliflozin-only group. The renal architecture is largely preserved in the cortical and medullary regions, with the exception of mild tubular vacuolization (H&E, ×40).

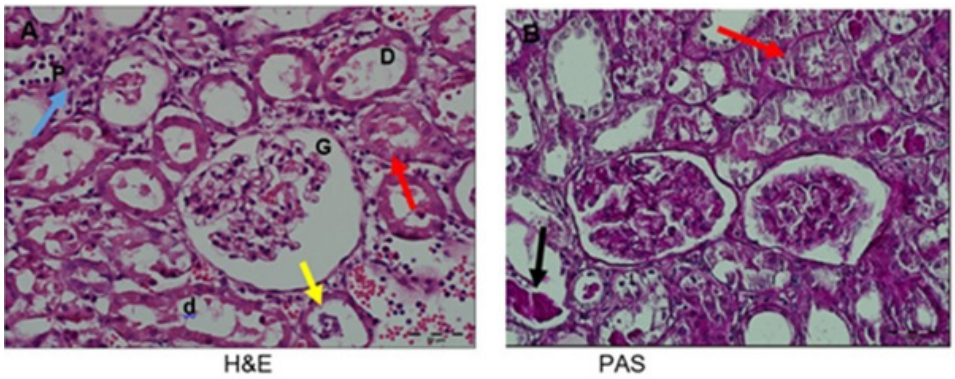

Figure 3. Histopathological findings of severe renal damage observed in the Amphotericin B (AmBD) group.(A) The medullary region displays widespread tubular necrosis (red arrows), tubular dilatation (d), and exfoliation of epithelial cells into the tubular lumen (yellow arrows). Other prominent changes include glomerular damage (G), hyaline material accumulation (black arrows), and dense cellular infiltration (blue arrows) (H&E, ×100). (B) PAS staining shows an irregular reaction in both cortical and medullary regions (PAS, ×100).

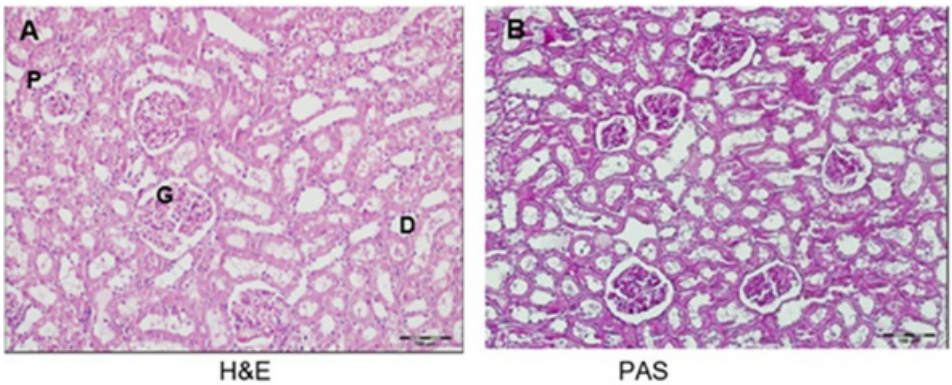

Figure 4. Renal histology of the group co-administered with Dapagliflozin and Amphotericin B (AmBD). (A) A marked attenuation of damage is evident compared to the AmBD group. In the cortical region, glomeruli (G), proximal (P), and distal (D) tubules exhibit a near-normal morphology. While partial tubular necrosis and desquamation persist in the medullary region, the number of dilated tubules is reduced. Mild vacuolization is present in some proximal tubules (H&E, ×40). (B) PAS staining shows a largely regular pattern (PAS, ×40).

of rats treated with AmBD. Similarly, Değer et al. (10) reported that dapagliflozin treatment markedly improved cyclosporine A induced renal histopathological injury. In the study by Chang et al. (13), histological evaluation of IR models demonstrated that dapagliflozin attenuated renal damage characterized by loss of brush border, vacuolization, and desquamation of tubular epithelial cells following IR injury. Consistent with these findings, in our study, renal tissues of rats treated with AmBD showed histopathological alterations such as tubular dilatation, tubular vacuolization, hyaline casts, tubular necrosis, medullary hemorrhage, cortical necrotic areas, and tubular desquamation. The severity of these lesions was significantly higher in the AmBD group compared with the other groups. In contrast, the administration of dapagliflozin with AmBD markedly ameliorated indicators of renal injury, such as tubular dilatation, vacuolization, medullary hemorrhage, and tubular necrosis. These results suggest a protective role for dapagliflozin against AmBD-associated renal injury.

This study has several limitations. First, due to limited data in nephrotoxic rat models, we referenced studies in mice, and species-specific differences in physiology and metabolism warrant caution in interpretation. Second, our study protocol, including the co-administration timing and the

short 8-day duration, may not have captured the optimal therapeutic window for dapagliflozin or its potential long-term effects. Additionally, the absence of blood glucose monitoring is a shortcoming, given that the mechanism of SGLT-2 inhibitors involves glucosuria. Another limitation is that measurements were performed only in serum, which may not fully reflect local renal oxidative stress; different results might have been obtained if tissue-level biomarkers had been assessed. Furthermore, the study did not include urinary biomarkers such as NGAL or KIM-1 in addition to serum markers, which might have provided a more sensitive and earlier indication of kidney injury. Most importantly, these findings are derived from an animal model, and their direct extrapolation to human clinical practice is not warranted.

In conclusion, dapagliflozin was found to attenuate AmBD-induced renal injury. However, further experimental and clinical studies are required to clarify the effects of dapagliflozin on nephrotoxic processes and to determine its potential clinical implications.

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Peer-Review

Double blind both externally and Internally Peer Reviewed

Conflict of Interest

The authors declare that they have no conflict of interest regarding content of this article.

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Ethical Declaration

The study was conducted at the Experimental Practice and Research Center of Çukurova University following approval from the Institutional Ethics Committee (Ethics Approval Date/No: July 20, 2023).

Authorship Contributions

Concept: EA, BK, ST, CA, KEA, GG, TSE BM, Design: EA, BK, ST, CA, KEA, GG, TSE BM, Supervising: EA, BK, ST, CA, KEA, GG, TSE BM, Financing and equipment: EA, BK, ST, CA, KEA, GG, TSE BM, Data collection and entry: EA, BK, ST, CA, KEA, GG, TSE BM, Analysis and interpretation: EA, BK, ST, CA, KEA, GG, TSE BM, Literature search: EA, BK, ST, CA, KEA, GG, TSE BM, Writing: EA, BK, ST, CA, KEA, GG, TSE BM, Critical review: EA, BK, ST, CA, KEA, GG, TSE BM

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Scientific Reports in Medicine

Research Article

Domestic violence and depression among married women: an example of Malatya

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Abstract

Objective: This study aimed to determine the prevalence and types of domestic violence among married women in Malatya, Türkiye, examine associated sociodemographic and partner-related factors, and assess the relationship with depression.

Method: A cross-sectional study was conducted with 398 married women aged 15–49 registered at a Family Health Center between January and April 2019. Data were collected through face-to-face interviews using a questionnaire including sociodemographic data, the Domestic Violence Scale, and the Beck Depression Inventory. As data distribution was not normal, non-parametric tests (including Kruskal-Wallis with Bonferroni post-hoc correction) and Spearman correlation were applied, with $p<0.05$ considered significant.

Results: Most participants were ≥39 years old, unemployed/housewives, and had low education. Higher domestic violence scores were observed among younger, less-educated, and unemployed women, and those with younger, less educated, or unemployed spouses. Partner alcohol use, psychiatric illness, and history of violence were associated with increased violence. Probable depression was present in 13.3% and positively correlated with all violence types, especially verbal and total violence ($r=0.433$ and $r=0.452$, $p<0.001$).

Conclusion: Domestic violence is common among young, less-educated, and socioeconomically disadvantaged women. Partner-related factors and exposure to multiple violence types increase depression risk. Findings support comprehensive prevention strategies addressing both visible and psychological violence and integrating routine mental health screening in primary care settings to facilitate early identification and intervention. This implies a clear recommendation for both clinical practice—proactive screening by healthcare providers—and public health policy aimed at protecting vulnerable women.

Keywords: Domestic Violence, Depression, Partner Risk Factors

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INTRODUCTION

Domestic violence is one of the most prevalent social problems experienced by women worldwide and is recognized as a serious public health concern. The World Health Organization defines violence against women as a violation of human rights and a form of gender-based discrimination (1). Despite its widespread nature, violence against women has historically been systematically overlooked in both research and policy (2).

This issue is pervasive globally, with approximately one-third of women experiencing violence, and prevalence rates in Türkiye are similarly high (1,3,4). When psychological, emotional, economic, and sexual forms of violence are included, it becomes evident that a substantial proportion of women are exposed to multiple forms of abuse (5,6).

The effects of violence on women's health are multidimensional. In addition to physical injuries, mental health consequences are frequently observed. Among these, depression is particularly common, with significantly higher rates among women exposed to violence (7). Depression is a prevalent mental disorder characterized by sadness, hopelessness, loss of energy, and functional impairment, and occurs approximately twice as often in women as in men (7,8).

Socioeconomic and cultural factors play a major role in the emergence of domestic violence (1,6,9). Higher education, financial well-being, social support, and better access to healthcare services are important protective factors that reduce the risk of violence (1,6,10). These same factors are also associated with depression, suggesting a mutually reinforcing relationship between domestic violence and mental health problems (9,11).

Despite the high prevalence of domestic violence and its mental health consequences, there is limited evidence in Türkiye regarding the relationship between domestic violence, sociodemographic factors, and depression among married women, particularly in specific local populations. Existing studies are often restricted to urban areas or focus solely on prevalence without considering family, marital, and prior violence experiences comprehensively. This gap limits the ability to develop targeted interventions for at-risk women. In this context, the present study aimed to determine the prevalence and types of domestic violence among married women in Malatya, Türkiye, to examine the sociodemographic and family-related determinants of such violence, and to investigate the association between domestic violence and depression. Identifying these relationships will contribute to the development of preventive and protective strategies addressing domestic violence and its mental health consequences. Furthermore, locally obtained findings will enrich national and international literature and provide a scientific foundation for interventions in similar populations.

Therefore, the present study makes several unique contributions to the literature. First, it provides one of the first comprehensive analyses of domestic violence in Malatya, an under-represented province in this field of research, offering valuable local data beyond major metropolitan areas. Second, it adopts a holistic approach by simultaneously examining the sociodemographic risk factors of both women and their partners, which is a dimension often overlooked in previous studies. Finally, by assessing multiple forms of violence, it allows for a nuanced understanding of how different types of abuse, including non-physical ones, correlate with depression. In line with this purpose, the study's main hypotheses were as follows:

1. The prevalence of domestic violence is higher among married women with low socioeconomic status (e.g., low education, unemployment).
2. Risk factors related to the partner, such as alcohol use, a history of psychiatric illness, and a personal history of violence, increase the level of violence to which women are exposed.
3. Exposure to all forms of domestic violence is positively correlated with depressive symptoms in women.

METHOD

This study is a cross-sectional study conducted among married women aged 15–49 who were registered at M. Hanifi Bağdatlı Family Health Center, located in the Yeşilyurt district of Malatya province, between January and April 2019. The aim was to determine the prevalence of domestic violence among married women, examine its relationship with sociodemographic factors, and evaluate the association between domestic violence and depression.

The study population consisted of all married women aged 15–49 registered at the Family Health Center. The sample size was calculated based on similar studies and determined using a simple random sampling method. There were 1,392 women in this age group at the center. Using the StatCalc module of EpiInfo version 7.2.3.1, the sample size was estimated as 292 with a 95% confidence level, 5% margin of error, and an assumed prevalence of 40%; however, 398 women participated in the study. Participants were recruited using a convenience sampling method. Specifically, women who visited the Family Health Center for any reason during the study period, met the age criteria, and agreed to participate were included in the study until the target sample size was reached.

Data were collected through face-to-face interviews using a structured questionnaire composed of three sections: sociodemographic information, the Domestic Violence Scale, and the Beck Depression Inventory (BDI). These interviews were conducted by a trained researcher in a private room at the Family Health Center to ensure confidentiality. The Domestic Violence Scale measures lifetime exposure to physical, emotional, verbal, economic, and sexual violence, with a Cronbach's alpha of 0.94 for the full scale and 0.73–0.84 for its subscales. For instance, subscales included items such as, "He tries to choke me by squeezing my throat." (Physical), "He shows me affection." (Emotional), "He swears at me." (Verbal), "He wants me to quit my job."' (Economic), and "He treats me badly if I don't fulfill his sexual demands." (Sexual). During the permission process, six items from the sexual violence subscale were removed at the explicit request of the Malatya Provincial Health Directorate, which cited concerns about the sensitive nature of these questions for the local population. The scale scores range from 44 to 132. The BDI was used to assess depression, with a Cronbach's alpha of 0.80 and a cut-off score of 17 for the Turkish version.

Ethical approval was obtained from the Ethics Committee of İnönü University Institute of Health Sciences (Decision No: 2018/21-2/Date: 20/11/2018), and institutional permissions were obtained from the Malatya Provincial Health Directorate and the Family Health Center. Participants were informed about the study, and verbal and written consent was obtained. Interviews lasted 20–25 minutes on average.

Statistical analysis

Data were analyzed using SPSS 22.0 software. Descriptive statistics (frequency, percentage) were calculated for participants' characteristics. The normality of data distribution was assessed using the Shapiro-Wilk test; since the test confirmed that the data were not normally distributed ($p< 0.05$), scores from scales and subscales were presented as median values. Group comparisons were performed using the Kruskal-Wallis and Mann-Whitney U tests. When the Kruskal-Wallis test resulted in a statistically significant difference, post-hoc pairwise comparisons were conducted using the Mann-Whitney U test with a Bonferroni correction to determine which specific groups differed. The relationship between domestic violence and depression scores was assessed using Spearman correlation, and comparisons between participants with and without depression were made using the Mann-Whitney U test. A p-value of <0.05 was considered statistically significant.

RESULTS

The majority of participants were aged ≥39 years (43.7%, n=174), followed by 30–38 years (32.7%,

n=130). Most were unemployed or housewives (64.1%, n=255), and 38.7% (n=156) had a primary school education or lower. Regarding spouses' characteristics, 39.9% (n=159) were aged ≥44 years, 47.2% (n=188) were employed as workers, and 31.7% (n=126) had completed high school. Household income was predominantly between the minimum wage and 1.5 times the minimum wage (33.9%, n=135), with 22.9% (n=91) earning ≤ minimum wage. Most families were nuclear (78.9%, n=314), and 51.5% (n=205) of participants were in arranged marriages. A minority were related to their spouse prior to marriage (24.9%, n=99). Reproductively, 47.5% (n=189) had 1–2 children, and 35.2% (n=140) had married between 19–22 years. Partner-related risk factors included occasional alcohol consumption (18.8%, n=75) and psychiatric illness (7.8%, n=31). Histories of exposure to violence were reported by 12.1% of participants (n=48) and 11.1% of their spouses (n=44). Probable depression, assessed using the Beck Depression Inventory, was present in 13.3% of participants (n=53) (Table 1).

Younger women (≤20 years) had significantly higher median physical (p=0.001), emotional (p=0.033), verbal (p=0.03), and total violence scores (p=0.013) compared to older groups. Unemployed or housewife participants had higher physical (p=0.013), verbal (p=0.001), economic (p=0.001), and total violence scores (p=0.001) than employed, officer, or retired participants. Specifically, post-hoc analysis with a Bonferroni correction revealed that unemployed/housewife participants had significantly higher scores than both officer and retired participants ($p<0.05$ for all relevant subscales). Women with primary school or lower education had significantly higher scores across all violence subdimensions compared to more educated participants (physical: p=0.002; verbal, economic, sexual, total: p=0.001); specifically, post-hoc tests revealed that women with primary school or lower education had significantly higher scores than both high school and university graduates ($p<0.01$ for all significant subscales). Spouses' age, occupation, and education also affected violence scores: women with younger, unemployed, or less-educated spouses exhibited higher verbal, economic, and total violence scores (all p=0.001) (Table 2).

Table 1. Sociodemographic and Family Characteristics of the Participants

	Categories	n	%
Age	≤20 years	16	4.0
	21–29 years	78	19.6
	30–38 years	130	32.7
	≥39 years	174	43.7
Occupation	Unemployed, Housewife	255	64.1
	Worker	39	9.8
	Civil servant	96	24.1
	Retired	8	2.0
Education	Primary school or below	156	38.7
	Middle school graduate	68	17.1
	High school graduate	79	19.8
	College or university graduate	97	24.4
Spouse's age	≤22 years	10	2.5
	23–29 years	48	12.1
	30–36 years	71	17.8
	37–43 years	110	27.7
	≥44 years	159	39.9

Table 1 (Continued). Sociodemographic and Family Characteristics of the Participants			
	Categories	**n**	**%**
Spouse's occupation	Unemployed	23	5.8
	Worker	188	47.2
	Civil servant	136	34.2
	Retired	51	12.8
Spouse's education	Primary school or below	78	19.6
	Middle school graduate	73	18.3
	High school graduate	126	31.7
	College or university graduate	121	30.4
Household income	≤ Minimum wage	91	22.9
	Minimum wage – 1.5 × Minimum wage	135	33.9
	1.5 × Minimum wage – 2 × Minimum wage	43	10.8
	2 × Minimum wage – 2.5 × Minimum wage	37	9.3
	≥ 2.5 × Minimum wage	92	23.1
Number of children	None	39	9.8
	1-2	189	47.5
	3-4	139	34.9
	5 or more	31	7.8
Family type	Nuclear family	314	78.9
	Extended family	84	21.1
Marital type	Marriage by mutual agreement	193	48.5
	Arranged marriage	205	51.5
Relationship with spouse	Yes	99	24.9
	No	299	75.1
Age at marriage	≤18 years	127	31.9
	19–22 years	140	35.2
	23–26 years	85	21.6
	≥27 years	45	11.3
Partner's alcohol consumption status	Never	304	76.4
	On special occasions	75	18.8
	Very frequent	19	4.8
Partner's psychiatric illness status	Yes	31	7.8
	No	367	92.2
Participant's history of exposure to violence	Yes	48	12.1
	No	350	87.9
Partner's history of exposure to violence	Yes	44	11.1
	No	354	88.9
Presence of probable depression*	Yes	53	13.3
	No	345	86.7
* Presence of probable depression was assessed based on the cut-off score of the Beck Depression Inventory.			

Table 2. Violence Scores According to Participants' and Spouses' Sociodemographic Characteristics								
Variable	Groups	Physical Median (min–max)	Emotional Median (min–max)	Verbal Median (min–max)	Economic Median (min–max)	Sexual Median (min–max)	Total Median (min–max)	p-value **
Participants' age	≤20	12 (10–19)	17.5 (15–23)	14.5 (10–22)	17 (10–24)	6 (4–8)	68 (54–96)	0.001* (physical), 0.033* (emotional), 0.030* (verbal), 0.013* (total)
	21–29	10 (9–26)	16 (10–24)	12 (10–28)	14 (10–26)	6 (4–10)	58 (48–104)	
	30–38	10 (10–18)	16 (10–25)	13 (10–24)	14 (10–27)	6 (4–11)	60 (49–99)	
	≥39	10 (9–20)	16 (10–23)	13 (10–28)	14 (10–23)	6 (4–10)	59 (48–91)	
Participants' occupation	Unemployed / housewife	10 (9–19)	16 (10–25)	13 (10–28)	15 (10–23)	6 (4–10)	60 (48–99)	0.013* (physical), 0.001* (verbal, economic, total)
	Worker	11 (10–26)	17 (10–23)	14 (10–28)	17 (10–27)	6 (4–10)	64 (50–104)	
	Officer	10 (10–21)	15 (12–24)	11 (10–25)	13 (10–26)	5 (4–11)	55 (48–102)	
	Retired	10 (10–16)	15 (14–21)	12.5 (10–15)	12 (10–17)	5 (4–10)	55 (49–79)	
Participants' education level	Primary school or below	10 (9–26)	16 (10–25)	14 (10–28)	16 (10–26)	6 (4–10)	62 (48–104)	0.002* (physical), 0.001* (verbal, economic, sexual, total)
	Middle school	10 (9–21)	16 (13–23)	13 (10–22)	14 (10–27)	6 (4–10)	61 (48–90)	
	High school	10 (9–20)	16 (10–22)	13 (10–23)	14 (10–23)	6 (4–11)	58 (49–91)	
	University or above	10 (10–18)	15 (12–24)	11 (10–22)	13 (10–23)	5 (4–10)	55 (48–92)	
Spouse's age	≤22	12 (10–19)	16.5 (14–23)	14.5 (10–22)	17 (10–24)	6 (6–8)	67.5 (53–96)	0.001* (physical), 0.081 (emotional), 0.711 (verbal), 0.228 (economic), 0.157 (sexual), 0.089 (total)
	23–29	10 (9–26)	16.5 (10–24)	13 (10–28)	15 (10–26)	6 (4–10)	61 (51–104)	
	30–36	10 (9–21)	16 (12–25)	12 (10–24)	14 (10–23)	6 (4–11)	58 (48–99)	
	37–43	10 (10–20)	16 (10–23)	13 (10–24)	14 (10–23)	6 (4–10)	58.5 (48–91)	
	≥44	10 (9–18)	16 (11–23)	14 (10–28)	14 (10–27)	6 (4–10)	60 (48–91)	
Spouse's occupation	Unemployed	10 (10–20)	17 (10–23)	15 (10–24)	16 (10–24)	6 (5–11)	64 (53–96)	0.608 (physical), 0.226 (emotional), 0.001* (verbal, economic, total), 0.012* (sexual)
	Worker	10 (9–19)	16 (10–25)	13 (10–28)	15 (10–23)	6 (4–10)	60 (48–99)	
	Officer	10 (10–26)	16 (12–24)	12 (10–28)	13 (10–27)	5 (4–10)	56 (48–104)	
	Retired	10 (9–17)	16 (11–22)	14 (10–23)	15 (10–23)	6 (4–10)	63 (49–88)	

Table 2 (Continued). Violence Scores According to Participants' and Spouses' Sociodemographic Characteristics								
Variable	Groups	Physical Median (min–max)	Emotional Median (min–max)	Verbal Median (min–max)	Economic Median (min–max)	Sexual Median (min–max)	Total Median (min–max)	p-value **
Spouse's education level	Primary school or below	10 (9–18)	16 (10–23)	14 (10–28)	16 (10–22)	6 (4–10)	62 (48–91)	0.558 (physical), 0.449 (emotional), 0.001* (verbal, economic, total), 0.123 (sexual)
	Middle school	10 (10–19)	16 (12–25)	14 (10–24)	15 (10–24)	6 (4–10)	62 (48–99)	
	High school	10 (9–20)	16 (10–23)	13 (10–23)	14 (10–23)	6 (4–11)	58.5 (49–91)	
	University and above	10 (10–26)	16 (12–24)	12 (10–28)	13 (10–27)	5 (4–10)	55 (48–104)	
* Statistically significant differences (p<0.05).								
** p values were calculated using the Kruskal–Wallis test for variables with more than two groups and the Mann–Whitney U test for variables with two groups, as the data were not normally distributed.								

Women whose spouses consumed alcohol frequently (n=19, 4.8%) had higher median scores in physical, emotional, verbal, economic, sexual, and total violence than women whose spouses never or occasionally consumed alcohol (physical: p=0.001; emotional: p=0.005; verbal: p=0.001; economic: p=0.003; sexual: p=0.041; total: p=0.001). Similarly, women with spouses who had a psychiatric disorder (n=31, 7.8%) reported higher median violence scores across all types (physical: p=0.006; emotional: p=0.001; verbal: p=0.004; economic: p=0.001; sexual: p=0.016). Personal or spousal history of violence was associated with significantly higher scores in all violence subdimensions (p=0.001 for both) (Table 3).

Median depression scores differed by age (≤20 years: 0.5, range 0–47; ≥39 years: 6.5, range 0–41; p=0.038) and education (primary school or lower: 6, range 0–47; p=0.038). Participants' occupation was not significantly associated with depression scores (p=0.975). Spouse-related factors including occupation, alcohol consumption, and history of violence were significantly linked to depression: unemployed spouses (median 2, range 0–47, p=0.003), occasional alcohol use (median 8, range 0–47), frequent alcohol use (median 11, range 0–28, p=0.008), and personal/spousal violence histories (median 11.5, ranges 0–40 and 0–41; p=0.001) (Table 4).

All forms of violence were positively associated with depression scores. The total violence score showed the highest correlation (r=0.452, p=0.001), while among the subtypes, verbal violence exhibited the strongest correlation with depression (r=0.433, p=0.001), followed by emotional, economic, sexual, and physical violence (r=0.407, 0.371, 0.258, and 0.194, respectively; all p=0.001) (Table 5). Participants with probable depression (n=53, 13.3%) had significantly higher median scores across all violence types compared to those without probable depression (physical: 12 vs. 10, emotional: 19 vs. 16, verbal: 17 vs. 13, economic: 17 vs. 14, sexual: 7 vs. 6, total: 73 vs. 58; all p=0.001) (Table 6).

DISCUSSION

This study demonstrates that domestic violence is a significant public health issue among married women in Malatya, strongly associated with both socioeconomic disadvantages and adverse mental health outcomes. Our findings align with the study's main hypotheses and provide nuanced insights into the interplay of individual, partner-related, and contextual factors.

Table 3. Violence Scores According to Spouse-Related Characteristics and History of Violence Exposure

Variable	Groups	Physical Median (min–max)	Emotional Median (min–max)	Verbal Median (min–max)	Economic Median (min–max)	Sexual Median (min–max)	Total Median (min–max)	p-value **
Spouse's alcohol consumption	Never (n=304, 76.4%)	10 (9–20)	16 (10–24)	13 (10–24)	14 (10–27)	6 (4–11)	58 (48–92)	0.001* (physical), 0.005* (emotional), 0.001* (verbal), 0.003* (economic), 0.041* (sexual), 0.001* (total)
	Occasionally (n=75, 18.8%)	10 (9–19)	17 (12–25)	13 (10–25)	14 (10–26)	6 (4–10)	61 (48–102)	
	Frequent (n=19, 4.8%)	12 (10–26)	18 (10–23)	16 (10–28)	17 (12–22)	6 (4–10)	68 (53–104)	
Spouse's psychiatric disorder	Yes (n=31, 7.8%)	10 (10–26)	19 (10–25)	15 (10–28)	17 (10–23)	6 (4–10)	69 (55-106)	0.006* (physical), 0.001* (emotional), 0.004* (verbal), 0.001* (economic), 0.016* (sexual)
	No (n=367, 92.2%)	10 (9–20)	16 (10–24)	13 (10–28)	14 (10–27)	6 (4–11)	58 (46-93)	
History of violence exposure (participant)	Yes (n=48, 12.1%)	11 (9–26)	19 (10–25)	16 (10–28)	17.5 (12–27)	6 (4–10)	70 (57-105)	0.001* (all types)
	No (n=350, 87.9%)	10 (9–21)	16 (10–24)	13 (10–25)	14 (10–26)	6 (4–11)	57 (45-92)	
History of violence exposure (spouse)	Yes (n=44, 11.1%)	12 (10–26)	20 (14–25)	17.5 (10–28)	17.5 (10–27)	6 (4–10)	74 (57-108)	0.001* (all types)
	No (n=354, 88.9%)	10 (9–20)	16 (10–23)	13 (10–24)	14 (10–24)	6 (4–11)	57 (46-95)	

* Statistically significant differences ($p<0.05$).

** p values were calculated using the Kruskal–Wallis test for variables with more than two groups and the Mann–Whitney U test for variables with two groups, as the data were not normally distributed.

Table 4. Median Depression Scores of Participants According to Sociodemographic Characteristics and History of Violence Exposure

Variable	Category	n (%)	Median Depression Score (min–max)	p-value**
Age of women	≤20	16 (4.0)	0.5 (0–47)	0.038*
	21–29	78 (19.6)	2.5 (0–36)	
	30–38	130 (32.7)	5 (0–43)	
	≥39	174 (43.7)	6.5 (0–41)	
Age of men (spouses)	≤22	10 (2.5)	0 (0–47)	0.721
	23–29	48 (12.1)	2.5 (0–36)	
	30–36	71 (17.8)	6 (0–43)	
	37–43	110 (27.7)	3 (0–30)	
	≥44	159 (39.9)	7 (0–41)	

Table 4 (Continued). Median Depression Scores of Participants According to Sociodemographic Characteristics and History of Violence Exposure				
Variable	Category	n (%)	Median Depression Score (min–max)	p-value**
Occupation of women	Unemployed/housewife	255 (64.1)	5 (0–43)	0.975
	Worker	39 (9.8)	1 (0–47)	
	Civil servant	96 (24.1)	5.5 (0–39)	
	Retired	8 (2.0)	3 (0–31)	
Occupation of men (spouses)	Unemployed	23 (5.8)	2 (0–47)	0.003*
	Worker	188 (47.2)	4 (0–41)	
	Civil servant	136 (34.2)	4 (0–43)	
	Retired	51 (12.8)	10 (0–40)	
Education level of women	Primary school and below	156 (38.7)	6 (0–47)	0.038*
	Middle school	68 (17.1)	2 (0–40)	
	High school	79 (19.8)	3 (0–24)	
	College/university	97 (24.4)	5 (0–39)	
Education level of men (spouses)	Primary school and below	78 (19.6)	7 (0–41)	0.411
	Middle school	73 (18.3)	5 (0–47)	
	High school	126 (31.7)	5 (0–43)	
	College/university	121 (30.4)	4 (0–39)	
Alcohol use of spouse	Never	304 (76.4)	4 (0–43)	0.008*
	On special occasions	75 (18.8)	8 (0–47)	
	Very frequently	19 (4.8)	11 (0–28)	
Psychiatric illness of spouse	Yes	31 (7.8)	5 (0–41)	0.105
	No	367 (92.2)	5 (0–47)	
Participant's history of exposure to violence	Yes	48 (12.1)	11.5 (0–40)	0.001*
	No	350 (87.9)	4 (0–47)	
Spouse's history of exposure to violence	Yes	44 (11.1)	11.5 (0–41)	0.001*
	No	354 (88.9)	4 (0–47)	

* Statistically significant differences ($p<0.05$).
** p values were calculated using the Kruskal–Wallis test for variables with more than two groups and the Mann–Whitney U test for variables with two groups, as the data were not normally distributed.

Table 5. Correlation Between Depression Scores and Violence Scores		
Type of Violence	Correlation Coefficient (r)	p-value**
Physical violence	0.194	0.001*
Emotional violence	0.407	0.001*
Verbal violence	0.433	0.001*
Economic violence	0.371	0.001*
Sexual violence	0.258	0.001*
Total violence	0.452	0.001*

* Statistically significant differences ($p<0.05$).
** Correlation coefficients were calculated using Spearman's rank correlation test.

Table 6. Violence Scores According to the Presence of Probable Depression			
Type of Violence	Probable Depression Present (n=53, 13.3%) Median (min–max)	Probable Depression Absent (n=345, 86.7%) Median (min–max)	p-value**
Physical violence	12 (10–19)	10 (9–26)	0.001*
Emotional violence	19 (13–25)	16 (10–23)	0.001*
Verbal violence	17 (10–25)	13 (10–28)	0.001*
Economic violence	17 (11–26)	14 (10–27)	0.001*
Sexual violence	7 (4–10)	6 (4–11)	0.001*
Total violence	73 (51–102)	58 (48–104)	0.001*
* Statistically significant differences (p<0.05). ** p-values were calculated using the Mann-Whitney U test.			

The Role of Sociodemographic Factors

The present study demonstrates that the majority of women had low educational attainment and were unemployed or homemakers. Partner educational level and family economic status were strongly associated with domestic violence, highlighting key socioeconomic determinants of risk. Furthermore, a history of domestic violence and the partner's psychiatric problems emerged as important factors related to women's mental health outcomes. The observed high prevalence of probable depression underscores the clinical and public health significance of these findings. Consistent with previous research, low education and unemployment constitute key socioeconomic risk factors for women, affecting both exposure to violence and mental health outcomes. Conversely, higher education, income, and employment have been consistently identified as protective factors against intimate partner and sexual violence in Türkiye and internationally (2–7,9,11). International meta-analyses similarly confirm that women experiencing partner violence are at significantly increased risk of depression (1,6,12). By demonstrating how these sociodemographic disadvantages limit women's autonomy in a local Turkish context, our study reinforces the urgent need for interventions that promote female education and economic empowerment. Our findings also underscore the importance of considering partners' sociodemographic profiles, a conclusion supported by prior research in Türkiye and Europe. For example, Alkan et al. reported higher risk of verbal and psychological violence among women aged 25–34 compared to those aged 55 and above (15), and the FRA study in the European Union corroborates this pattern (3). Review studies suggest that improvements in education, income, and employment exert protective effects against partner violence (5,7,13). The AİSA 2014 study in Türkiye found higher prevalence of physical and sexual violence among women with lower education levels (4), and systematic reviews similarly identify low education as a key socioeconomic determinant of violence against women (14). Low income and unemployment have also been highlighted as relevant factors in Türkiye (6). These findings reinforce the potential impact of policy interventions aimed at both women and their partners, supporting the development of comprehensive programs addressing multiple levels of risk.

A noteworthy and somewhat unexpected finding of our study was that the youngest women (≤20 years) reported significantly higher median scores for physical, emotional, and total violence compared to older age groups. This observation aligns with a growing body of international literature suggesting that young age is a primary risk factor for intimate partner violence (20). Studies in both high-income and low- and middle-income countries have consistently shown that women in their late teens

and early twenties experience disproportionately high rates of partner abuse (21,22). Several intersecting factors may explain this vulnerability. First, younger women, particularly those in early marriages —a practice still prevalent in certain cultural contexts— often possess less social and economic power, which limits their autonomy and ability to negotiate relationship dynamics or leave an abusive partnership. Second, the early stages of a marriage can be a particularly volatile period where conflicts may be more likely to escalate into violence, especially in the context of financial instability or early parenthood. Finally, it is also possible that this finding reflects a reporting bias; younger generations may be less likely to normalize violence and more willing to identify and report abusive behaviors compared to older cohorts who may have been socialized to accept certain forms of marital conflict. Regardless of the underlying cause, our finding underscores that the early years of marriage represent a critical window for targeted prevention and intervention efforts to protect young women from the long-term consequences of domestic violence.

Partner-Related Characteristics as Key Determinants

Evidence indicates that partners' behavioral and psychiatric characteristics elevate the risk of violence, while past experiences of violence have long-term consequences. Research in Türkiye reports that psychiatric illness is a strong predictor of violence against women (6), and international meta-analyses confirm that psychiatric disorders increase the likelihood of perpetrating partner violence (16). Alcohol use is consistently associated with verbal and psychological violence (15), and EU research shows that partners' heavy alcohol use increases women's risk of psychological violence (3). Longitudinal studies further demonstrate that prior exposure to partner-related physical abuse heightens risk of depression, anxiety, and sleep disturbances over time (17). These findings emphasize the importance of screening for partner behaviors and psychiatric risk factors when designing violence prevention programs.

The elevated depression scores among young and less-educated women appear linked to higher exposure to violence, highlighting the interaction between individual and relational factors in shaping mental health risk. Prior research similarly associates young age and low education with depression and lower life satisfaction (9), and other studies confirm the influence of partner characteristics on depression (6,15). Longitudinal evidence indicates that exposure to partner violence constitutes a risk factor for subsequent depression and suicide attempts (17). Studies in China also report that low household income increases risk of depression and anxiety, while employment status shows no significant association, consistent with our findings (11). Taken together, these results suggest that interventions addressing depression should integrate both individual and relational considerations, implying, from a clinical perspective, that healthcare providers should screen for domestic violence when a woman with risk factors such as a lower educational background presents with depressive symptoms.

The Link Between Violence Types and Depression

A key finding of this study is that all forms of violence, not just physical, were strongly associated with depression. The particularly strong correlation observed with verbal violence suggests that psychological abuse may have uniquely damaging and long-term mental health consequences, possibly due to its persistent and insidious nature. This aligns with research indicating that emotional abuse can be as, or even more, damaging than physical violence (6,7,9,17-19). Therefore, our findings strongly advocate for a multidimensional understanding of violence in clinical and public health settings, emphasizing that interventions must target less visible forms of abuse to effectively address women's mental health.

Public Health and Policy Implications

Taken together, the findings of this study have significant implications for public health policy and clinical practice in Türkiye and similar settings. The strong association between socioeconomic vulnerability and violence underscores the need for structural interventions that promote women's economic and educational empowerment. For healthcare systems, our results strongly advocate for the integration of routine screening for both depression and domestic violence into primary care. Clinicians should be trained to recognize the signs of not only physical but also psychological and economic abuse, particularly when a woman presents with depressive symptoms. Addressing partner-related risk factors also suggests that a more holistic, and where appropriate, family-centered approach may be necessary for effective prevention.

Limitations of the study

Several limitations should be acknowledged. First, the cross-sectional design limits causal inference between partner violence and depression. Second, data were self-reported, which may introduce recall or social desirability bias. Third, six items from the sexual violence subscale of the Domestic Violence Scale were removed during the permission process, potentially limiting assessment of sexual violence. Fourth, the study was conducted at a single Family Health Center, restricting generalizability to other regions or populations. Fifth, potential factors such as partner personality traits, social support networks, or community-level variables were not included. Finally, probable depression was assessed with screening tools rather than clinical diagnosis. Despite these limitations, the study provides important evidence on the multidimensional nature of partner violence and its relationship with women's mental health, highlighting areas for clinical practice and policy interventions.

CONCLUSION

In conclusion, this study confirms that domestic violence is a significant public health issue among married women in Malatya, driven by a combination of socioeconomic disadvantages and partner-related risk factors. Our findings point to the profound psychological impact of violence, particularly non-physical forms, and underscore the urgent need for comprehensive, multi-level prevention strategies. Based on our results, we propose the following key policy and practice recommendations:

1. Integration of Routine Screening in Primary Care: Family Health Centers should be empowered and equipped to implement mandatory, confidential screening for domestic violence for all women of reproductive age. This should be integrated as a standard component of primary care, similar to other routine health assessments.
2. Increasing Recognition of Psychological Violence: Public health campaigns and professional training for healthcare providers must focus on increasing the visibility and recognition of psychological, verbal, and economic violence as serious forms of abuse with severe mental health consequences.
3. Development of Partner-Focused Services: Given the strong link between partner characteristics (e.g., alcohol use, psychiatric history) and violence, developing accessible psychiatric screening and counseling services for partners should be considered a crucial component of a holistic violence prevention strategy.

Implementing these recommendations can facilitate early identification, provide timely support for vulnerable women, and address the root causes of domestic violence.

While this study provides a scientific foundation for evidence-based policies, future research should build upon its limitations to further clarify the dynamics of domestic violence. Employing longitudinal designs would be crucial to track the trajectory of violence and depression over time, helping to establish causality and understand how risk and protective factors evolve, particularly during the early years of marriage. To improve generalizability, future studies should also be conducted as multi-center trials across diverse settings, including both

urban and rural communities in different regions of Türkiye, which would also allow for comparative analyses of cultural and socioeconomic influences. Furthermore, there is a pressing need for intervention research that designs and evaluates the effectiveness of the specific programs recommended in this study, such as primary care-based screening and partner-focused counseling. Such research would be invaluable in translating foundational findings like ours into effective, scalable, and evidence-based public health programs.

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Conflict of Interest

The authors declare that they have no conflict of interest regarding content of this article.

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Ethical Declaration

Ethical permission was obtained from the İnönü University, Institute of Health Science Ethics Committee for this study with date 20/11/2018 and number 2018/21-2, and Helsinki Declaration rules were followed to conduct this study

Thesis?

This study was prepared by rearrangement of the doctoral thesis by Serdar Gülpınar and Gülsen Güneş, entitled as "The Relationship between Domestic Violence and Depression among Married Women Aged 15–49 Registered at M. Hanifi Bağdatlı Family Health Center in Yeşilyurt District of Malatya Province."

Is previously presented?

Some part of this study was presented as an oral presentation at the 6th International and 24th National Public Health Congress held in Antalya, Türkiye, on December 1–4, 2022, entitled as "Domestic Violence, Depressive Symptoms, and Associated Factors among Married Women Aged 15–49 in a District."

Authorship Contributions

Concept: SG, GG, Design: SG, GG, Supervising: SG, GG, Financing and equipment: SG, Data collection and entry: SG, Analysis and interpretation: SG, Literature search: SG, Writing: SG, Critical review: SG, GG

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Research Article

Assessing occupational hazards and safety: a study of healthcare workers' knowledge, attitudes, and practices in Iraq

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Abstract:

Objective: Occupational health and safety are vital in reducing morbidity and mortality from workplace hazards. This study examines healthcare workers' knowledge, attitudes, and practices regarding occupational risks to support targeted interventions and policy development.

Methods: A cross-sectional descriptive study was conducted at Baqubah General Hospital, Diyala Province, Iraq, between 11/20/2023 and 02/20/2024. 400 permanent healthcare worker —including doctors, pharmacists, nurses, technicians, and support staff—were selected through simple random sampling. Data were collected via a structured, face-to-face questionnaire adapted from validated knowledge, attitudes, practices surveys. The questionnaire included 8 knowledge, 5 attitude and 8 practice items, each scored as '1' for correct/positive and '0' for incorrect/negative responses. Median scores were used for evaluation.

Results: Most participants were aged 25–34(62%), with nearly equal gender distribution. About 38% had good knowledge of occupational hazards, higher among males (p=0.028), non-smokers (p=0.026), non-medication users (p=0.042). Only 32% exhibited a positive attitude toward safety, which was significantly associated with male gender (p=0.017) and medication use (p=0.034). Good safety practices were reported by 37%, higher in males (p=0.046), laboratory staff (p=0.006), and non-medication users (p=0.008). No significant associations with age, education or years of service.

Conclusions: The study identified significant gaps in occupational hazard awareness: only one-third had good knowledge, nearly two-thirds had poor knowledge, and less than one-third showed a positive attitude toward occupational health and safety. Healthcare institutions should improve safety by ensuring continuous supply of personal protective equipment and mandatory, targeted training.

Keywords: Occupational Hazards, Knowledge, Attitude, Safety Practices

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Introduction

Health care facilities (HCFs) provide a wide range of services—including counseling, clinical, surgical, and psychiatric care—to both healthy individuals and those who are ill or injured. Globally, they employ over 59 million workers and are considered high-risk workplaces due to healthcare workers' (HCWs) exposure to various harmful agents (1). Hazards refer to the inherent properties of substances, agents, or situations that may cause harm, while risk is the likelihood of such harm occurring. In occupational settings, hazards are work activities that can cause injury or illness, and occupational safety aims to control them to maintain acceptable risk levels, regardless of the profession (2).

The importance of occupational health and safety is highlighted by the substantial morbidity and mortality among exposed workers, with approximately 100,000 fatalities and 400,000 new cases of occupational diseases reported annually (4). The World Health Organization classifies hazards in HCFs as physical, biological, mechanical, ergonomic, chemical, or psychosocial. HCWs face risks such as blood-borne infections (e.g., HIV, HBV, HCV), musculoskeletal disorders, burnout, allergic reactions, chemical spills, radiation, and even patient violence. Contributing factors include negligence, lack of protective equipment, understaffing, heavy workloads, poor adherence to safety protocols, and inadequate training on modern healthcare technologies. In response, the U.S. Centers for Disease Control and Prevention (CDC) established standard precautions (SPs) for managing infectious materials and preventing occupational exposures, which have proven effective in reducing injuries and illnesses among HCWs (5). Moreover, the consequences of occupational hazards extend beyond physical injuries to include significant economic and psychological burdens on workers and their families. In developing countries such as Nigeria, HCWs—including medical doctors, nurses, and nursing assistants—are often ill-prepared to manage these risks, a situation worsened by inadequate facilities and equipment (6). The International Labour Organisation (ILO) maintains that safeguarding workers from occupational hazards is a fundamental component of social justice and a basic human right, a view reinforced by WHO's assertion that safe work is the cornerstone of decent employment. Despite considerable advances in occupational safety over the past century, significant risks persist, particularly in healthcare settings where HCWs—representing roughly 12% of the global workforce—are continuously exposed to both conventional and unique hazards inherent to their roles (7,8).

The present study aims to examine the knowledge, attitudes, and practices related to occupational hazards among HCWs, with the goal of identifying critical factors that can inform targeted interventions and policy improvements in occupational health and safety.

Methods

Study Design and Setting

The study was approved by the Ethics Committee for Non-invasive Clinical Research of Karabük University Medicine Faculty, under no: 2023/1461, date 08.11.2023. This cross-sectional descriptive study evaluated healthcare professionals' knowledge, attitudes, and practices (KAP) regarding occupational hazards at Baquba General Hospital in Diyala Governorate, Iraq. Conducted from November 20, 2023, to February 20, 2024, the study aimed to assess risk perceptions and workplace safety measures among doctors, pharmacists, nurses, medical technicians, and ancillary staff.

Sample Size and Selection Criteria

Based on the G-power analysis, a minimum sample size of 382 was determined to achieve 80% statistical power at a 95% confidence level. To account for non-response, this was increased by 5% (n=400). A simple random sampling method was employed to select participants. Inclusion criteria encompassed all permanent medical personnel at Baquba Hospital, while exclusion criteria excluded temporary/rotating staff, non-clinical personnel, and individuals declining participation.

Data Collection Procedure and Instrument

Data were collected via a structured, self-administered questionnaire adapted from validated KAP surveys in occupational health literature. The tool comprised 34 items across three sections:

1. **Socio-demographics**: Age, gender, education, and years of service.
2. **Occupational Risk Exposure**: Perceptions of workplace hazards, emergency response practices.
3. **Preventive Measures**: Use of protective equipment, health screenings, and awareness of safety protocols.

Pilot testing (n=20) ensured clarity and reliability (Cronbach's α = 0.78). Questionnaires were distributed in person, with a 92% response rate (368/400).

Scores for knowledge (8 items), attitude (5 items), and practice (8 items) were computed. Correct/positive responses were coded as 1 (incorrect/negative: 0). Total scores ranged 0–8 (knowledge/practice) and 0–5 (attitude). Median scores categorized performance:

- Knowledge: scores ≤ Median = "poor," ≥ Median = "good."
- Attitude: scores ≤ Median = "negative," ≥ Median = "positive."
- Practice: scores ≤ Median = "poor," ≥ Median = "good."

Statistical Analysis

Data were analyzed using SPSS v26. Normality was assessed via Shapiro-Wilk test (p>0.05). Descriptive statistics (frequencies, means, SDs) summarized demographics. Categorical variables were analyzed with Pearson's chi-square or Fisher's exact test (for expected counts <5). Associations between KAP scores and demographics were evaluated at α=0.05.

Results

Socio-demographic characteristics of participants

Among the total participants (n=400), the highest percentage (62%) falls within the age group of 25-34, followed by 20% in the 18-24 age group. The ratio between males and females is nearly 1:1, with males constituting 50.2% and females 49.8%. Most participants hold a bachelor's degree (49%) or a diploma (42.5%). Nurses comprise the largest professional group (30.8%), followed by medical technologists (22.8%). The majority have 1-10 years of experience (81.3%). Most participants (76.5%) do not use medications regularly. The majority are non-smokers (76%). The distribution of demographic

Table 1. Socio-demographic characteristics of participants

Characteristics	Frequency (n=400)	Percentage (%)
Gender		
Males	201	50.2
Females	199	49.8
Age groups (years)		
18-24	80	20
25-34	248	62
35-44	53	13.3
45-54	17	4.3
≥ 55	2	0.5
Educational level		
High School	12	3
Diploma	170	42.5
Bachelor's Degree	196	49
Master degree	17	4.3

Table 1. Socio-demographic characteristics of participants		
Characteristics	**Frequency (n=400)**	**Percentage (%)**
PhD degree	5	1.3
Profession		
Physician	10	2.5
Pharmacology	29	7.2
Nurse	123	30.8
Medical technology	91	22.8
Medical assistance	42	10.5
Others	105	26.3
Start working (years)		
18-24	269	67.3
25-29	107	26.8
30-34	19	4.8
35-39	5	1.3
Years of experience		
1-10	325	81.3
11-20	56	14
≥ 21	19	4.8
Using medications regularly		
No	60	15
Yes	34	8.5
Don't use	306	76.5
Smoking status		
No	304	76
Yes	78	19.5
Ex-smoker	18	4.5

characteristics of healthcare workers are seen in table 1.

Knowledge of participants toward occupational hazards and safety

The chi-square analysis revealed significant associations between healthcare workers' knowledge levels and demographic variables Male participants demonstrated notably higher proportions of "good" knowledge scores (57.3%) compared to female participants (42.7% ; $\chi^2 = 4.817$, $p = .028$). Similarly, non-smokers exhibited stronger knowledge outcomes (68.7%) than smokers ($\chi^2 = 7.269, p = .026$), and healthcare workers not using medication scored higher in knowledge (80.7%) compared to those using medication ($\chi^2 = 6.318$, $p = .042$). Conversely, no statistically significant associations were observed between knowledge scores and other demographic factors, including age, education level, or years of service ($p > .05$ for all), (Table 2). Approximately one-third of participants (38%) demonstrate good knowledge scores, while approximately two-thirds (62%) of respondents exhibit poor knowledge scores (Figure 1).

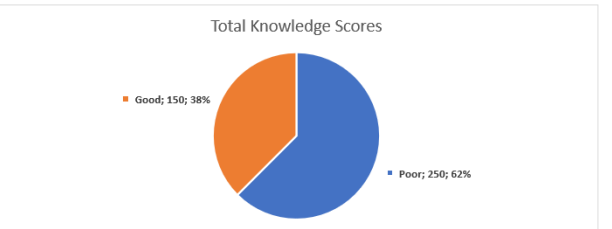

Figure 1. Total knowledge score of the study participants

Attitude of participants towards occupational hazards and safety

Chi-square analysis revealed significant associations between healthcare workers' attitude levels and select demographic variables. Male participants demonstrated a higher proportion of positive attitude scores (58.9%) compared to females (41.1%; $\chi^2 = 5.718$, $p = .017$). Similarly, healthcare workers not using medication exhibited more favorable attitudes (83.7%) than those using medication ($\chi^2 = 6.742$, $p = .034$). No statistically significant associations were observed between attitude scores and other demographic characteristics, including age, education level, years of service, or smoking

Table 2. Knowledge of participants towards occupational hazards

Characteristics		Total Knowledge Scores				X^2	P- value
	Poor		Good				
	n	%	n	%			
Age groups	18-24	49	19.6	31	20.67	1.995	0.737
	25-34	156	62.4	92	61.33		
	35-44	34	13.6	19	12.67		
	45-54	9	3.6	8	5.33		
	≥ 55	2	0.8	0	0		
Gender	Males	115	46	86	57.33	4.817	0.028
	Females	135	54	64	42.67		
Educational level	High School	9	3.6	3	2	4.294	0.368
	Diploma	102	40.8	68	45.33		
	Bachelor's Degree	123	49.2	73	48.67		
	Master degree	11	4.4	6	4		
	PhD degree	5	2	0	0		
Profession	Physician	3	1.2	7	4.67	9.122	0.104
	Pharmacology	23	9.2	6	4		
	Nurse	76	30.4	47	31.33		
	Medical technology	53	21.2	38	25.33		
	Medical assistance	28	11.2	14	9.33		
	Others	67	26.8	38	25.33		
Start working	18-24	174	69.6	95	63.33	7.282	0.063
	25-29	57	22.8	50	33.33		
	30-34	15	6	4	2.67		
	35-39	4	1.6	1	0.67		
Years of experiences	1-10	202	80.8	123	82	1.492	0.474
	11-20	38	15.2	18	12		
	≥ 21	10	4	9	6		
Using medications regularly	No	46	18.4	14	9.33	6.318	0.042
	Yes	19	7.6	15	10		
	Do not use	185	74	121	80.67		
Smoking status	No	201	80.4	103	68.67	7.269	0.026
	Yes	39	15.6	39	26		
	Ex-smoker	10	4	8	5.33		

Table 3. Practice of participants towards occupational hazards and safety

Characteristics		Total practice scores				X^2	P value
	Poor		Good				
	n	%	n	%			
Age groups	18-24	48	19.00	32	21.60	4.284	.369
	25-34	161	63.90	87	58.80		
	35-44	32	12.70	21	14.20		
	45-54	11	4.40	6	4.10		
	≥ 55	0	0.00	2	1.40		
Gender	Males	117	46.40	84	56.80	3.979	.046
	Females	135	53.60	64	43.20		
Educational level	High School	6	2.40	6	4.10	3.106	.540
	Diploma	104	41.30	66	44.60		
	Bachelor's Degree	125	49.60	71	48.00		
	Master degree	13	5.20	4	2.70		
	PhD degree	4	1.60	1	0.70		
Profession	Physician	6	2.40	4	2.70	10.334	.066
	Pharmacology	25	9.90	4	2.70		
	Nurse	74	29.40	49	33.10		
	Medical technology	51	20.20	40	27.00		
	Medical assistance	30	11.90	12	8.10		
	Others	66	26.20	39	26.40		
Start working	18-24	174	69.00	95	64.20	3.172	.366
	25-29	65	25.80	42	28.40		
	30-34	9	3.60	10	6.80		
	35-39	4	1.60	1	0.70		
Years of experiences	1-10	205	81.30	120	81.10	0.253	.881
	11-20	36	14.30	20	13.50		
	≥ 21	11	4.40	8	5.40		
Using medications regularly	No	48	19.00	12	8.10	9.559	.008
	Yes	18	7.10	16	10.80		
	Do not use	186	73.80	120	81.10		
Smoking status	No	200	79.40	104	70.30	4.393	.111
	Yes	43	17.10	35	23.60		
	Ex-smoker	9	3.60	9	6.10		

status ($p > .05$ for all). Approximately one-third of participants (32%) exhibit positive attitude scores, while around two-thirds (68%) of respondents demonstrate negative attitude scores (Figure 2).

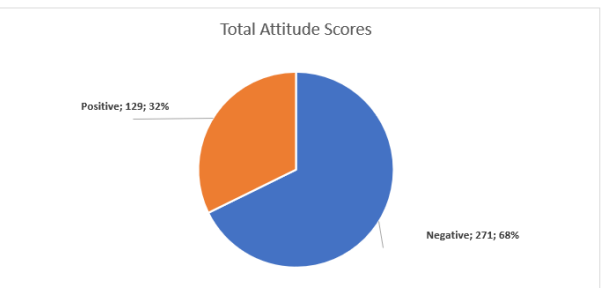

Figure 2. Total attitude score of participants.

Practice of participants towards occupational hazards and safety

Chi-square analysis identified significant associations between healthcare workers' practice levels and specific demographic variables Male participants demonstrated higher proportions of "good" practice scores (56.8%) compared to females (43.2%, n = 173; $\chi^2 = 3.979, p = .046$).. Additionally, healthcare workers not using medication reported better adherence to safety protocols (81.1%) than those using medication (χ^2 = 9.559, p = .008). In contrast, no significant associations were observed between practice scores and age, education level, years of service, or smoking status (p > .05 for all), (Table 3). Approximately one-third of participants (37%) demonstrate good practice scores, while around two-thirds (63%) of respondents exhibit poor practice scores (Figure 3).

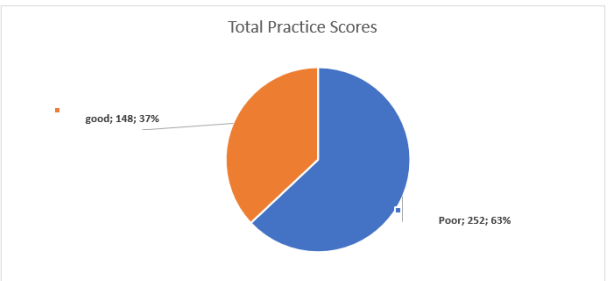

Figure 3. Total practice score of study participants.

Discussion

In this study, predominantly comprised adults aged below 35 years, with balanced gender representation (50% male, 50% female) and a majority holding bachelor's degrees or diplomas. Nurses constituted the largest professional group (30.8%), followed by medical technologists (22.8%), and most participants had 1–10 years of work experience. These findings diverged from a study in Niger assessing occupational risk awareness among healthcare providers, which reported a female predominance (70% vs. 30% male), a higher proportion of participants aged 31–40 years, and similar work experience (<10 years) (9). Conversely, the results aligned with Iraqi research by Faris et al, where nurses at Karbala teaching hospitals exhibited comparable gender disparities (70% female) and age distributions (<40 years), albeit with longer work experience (<14 years) (10).

The present study identified significant associations between healthcare workers' knowledge scores and gender, medication use, and smoking status. Male participants exhibited higher proportions of "good" knowledge scores compared to females (57.3% vs. 42.7%; p = .028). Similarly, non-smokers (68.7% vs. smokers) and healthcare workers not using medication (80.7% vs. medication users) demonstrated superior knowledge (p = .026 and p = .042, respectively). In contrast, no significant associations were observed between knowledge scores and age, educational level, profession, years of experience, or working unit (p > .05 for all). These findings partially align with prior research. For instance, Kumar et al., reported that significant links between education/occupation and knowledge, while in Palestine found no association with gender or age but noted significant ties to education, profession, and experience (3,11). Divergences may stem from contextual factors such as cultural norms, healthcare training quality, or occupational risk exposure. For example, the study conducted by Onowhakpor et al. They found age significantly predicted knowledge among sawmill workers in Nigeria, whereas no such association emerged in our study or in Pakistani textile workers (12,13). Similarly, while gender was insignificant here and in Malaysian laboratory staff, it was pivotal in other settings (10,14). Likewise, Rezaei et al. confirmed that further corroborated the lack of gender and age associations among Iranian hospital staff (15).

This study identified significant associations between healthcare workers' attitude scores and gender as well as medication use. Male participants exhibited a higher proportion of positive attitudes (58.9% vs. 41.1% female; p = .017), and those not using medication demonstrated more favorable attitudes (83.7% vs. medication users; p = .034). No significant associations were observed between attitude scores and age, educational level, profession, or years of experience (p > .05). These findings contrast with studies in other contexts. For example, the study conducted by Nasab et al., they reported significant associations between age, work duration,

and attitude scores among petrochemical workers in Iran, with older workers exhibiting higher scores (16). Conversely, research in Pakistani textile workers (Ahmad et al., 2012) and Malaysian laboratory staff found no age-related associations, aligning with our results (13,14). However, Paul et al. identified gender as a significant predictor of attitude, diverging from our findings (14). Similarly both, Kumar et al., and Aladini et al., reported conflicting associations: the former linked age and profession to attitudes, while the latter found age and profession significant but not gender or education (3,11).

The research identified significant associations between healthcare workers' practice scores and gender, working unit, and medication use, with males (56.8%, p = .046), laboratory staff (35.1%, p = .006), and non-medication users (81.1%, p = .008) demonstrating superior adherence to safety protocols, while no associations emerged with age, education, or experience (p > .05). The findings of present study were inconsistent with the study by Paul et al., while they were similar to the results of both Kumar and Aladini et al who emphasized education/occupation and profession/experience, respectively, as predictors (3,11,14). Discrepancies may stem from cultural-institutional factors (e.g., gender roles in compliance), occupational risks (e.g., laboratory biohazards), and methodological variance (e.g., self-report vs. observational tools). For instance, according to recent study carried out by Almutairi et al., they proposed standardized training in paramedical cohorts may homogenize practices, whereas fragmented systems amplify variability (17). Such variability underscores the need for tailored interventions—gender-neutral training in hierarchical settings, unit-specific protocols for high-risk departments, and investigations into medication use as a proxy for health-related practice barriers. Contextual factors like regional infrastructure and cultural attitudes toward authority must guide strategies to optimize occupational safety practices across diverse healthcare environments.

Based on our findings, it is recommended that the Iraqi Ministry of Health consider integrating occupational safety training into licensure renewal processes. Furthermore, hospital administrations are encouraged to adopt risk-adjusted shift rotations for staff on medication and develop inclusive training strategies to enhance female staff engagement. These measures may facilitate the transition of safety practices from individual initiative to a systemic institutional policy.

While the present study provides valuable insights into occupational hazards among healthcare workers in Iraq, several limitations should be acknowledged. First, the cross-sectional design precludes causal inferences, as it only captures associations at a single point in time. Second, reliance on self-reported data introduces the potential for social desirability bias, particularly in reporting safety practices, which may not reflect actual behaviors. Third, the study was conducted at a single hospital in Diyala Governorate, limiting the generalizability of findings to other regions or healthcare settings with differing resources, protocols, or cultural contexts. These limitations underscore the need for longitudinal, multi-center studies with mixed-method designs to better contextualize occupational hazards in Iraq's healthcare system.

As a result, the study revealed gaps in occupational hazard awareness: over one-third achieved good knowledge scores, yet nearly two-thirds had poor knowledge, and less than one-third demonstrated a positive attitude toward occupational health and safety. Notably, factors such as gender, medication use, and smoking status were significantly associated with knowledge scores, and similar associations were found with attitudes and practices. Based on these findings, it is recommended that healthcare institutions enhance occupational safety by ensuring a continuous supply of personal protective equipment (PPE) and providing mandatory, targeted training for healthcare workers. Regular health check-ups, tailored training programs, and consistent policy enforcement are crucial to improving occupational health outcomes.

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Conflict of Interest

The authors declare that they have no conflict of interest regarding content of this article.

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Ethical Declaration

The study was approved by the Ethics Committee for Non-invasive Clinical Research of Karabük University Medicine Faculty, under no: 2023/1461, date 08.11.2023.

Thesis?

This study was prepared by rearrangement of the master's thesis by Zainab Yousif Murad entitled as "Diyala ilçe sağlık çalışanlarının mesleki tehlikelere ilişkin bilgi, tutum ve uygulamalarının değerlendirilmesi".

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Scientific Reports in Medicine

Case Report

Abernethy syndrome presenting as an incidentally detected intrahepatic portosystemic shunt in an infant

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Abstract

Abernethy syndrome is a rare congenital anomaly in which blood from the splanchnic venous system partially or completely bypasses the liver through a portosystemic shunt and enters the systemic circulation. A subset of patients remains asymptomatic and are diagnosed incidentally, while others may present with complications such as portopulmonary hypertension, hepatopulmonary syndrome, portosystemic encephalopathy, or hepatic tumors. Early identification is important, as clinical outcomes depend on the degree of shunting and the presence of complications. In this report, we describe an asymptomatic infant diagnosed during Doppler ultrasonography, with documented spontaneous closure of the intrahepatic portosystemic shunt during follow-up and discuss the case in light of current literature to highlight the importance of careful monitoring.

Keywords: Abernethy syndrome; portosystemic shunt; intrahepatic shunt; spontaneous closure; portal venous anomaly; congenital shunt; vascular malformation

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Introduction

Abernethy syndrome was first described in the 18th century by the London surgeon John Abernethy (1). It is a rare vascular malformation in which venous blood from the intestine and spleen bypasses the liver and drains directly into the systemic circulation through an abnormal channel (2). Its estimated prevalence is approximately 1 in 30,000 live births. The incidence of persistent congenital portosystemic shunts is roughly 1 in 50,000 (3).

Shunts are classified as intrahepatic when the connection occurs between branches of the portal vein and the hepatic veins or the inferior vena cava, and as extrahepatic when the communication arises directly from the main portal vein before branching or when the portal vein is absent (4). Extrahepatic shunts are often associated with other congenital anomalies (2).

Clinical presentation varies mainly according to the proportion of blood flow diverted through the shunt (5). Findings range from asymptomatic patients diagnosed incidentally during evaluation for elevated transaminases or unrelated imaging, to severely symptomatic patients who may develop multi-organ dysfunction (2,6–8).

Diagnosis is usually made with Doppler ultrasonography of the liver and is commonly complemented with computed tomography (CT) or abdominal magnetic resonance imaging (MRI) (7,9–12).

Management depends on the shunt type and the presence of complications (13). Liver transplantation is the only definitive treatment for type 1 shunts, whereas type 2 and intrahepatic shunts may benefit from percutaneous or surgical closure (2,13–15). Intrahepatic shunts, unlike extrahepatic ones, may close spontaneously during the first year of life (2,6).

In this report, we present an asymptomatic infant diagnosed incidentally through imaging to raise awareness of this rare condition.

Case Presentation

A 46-day-old male infant was referred to our clinic after a portosystemic shunt was incidentally found on portal Doppler ultrasonography. The ultrasound was done because the patient had ongoing feeding difficulties and episodes of hypoglycemia. He was born at 40 weeks of gestation by spontaneous vaginal delivery. His early postnatal period included a 20-day NICU stay due to respiratory distress and hypoglycemia. At five weeks of age, he was hospitalized for five days with poor feeding and intermittent fever, and further evaluation was performed at that time.

During his assessment, the infant appeared well, active, and stable. Physical examination was normal, with no abdominal distention, hepatomegaly, or splenomegaly. Routine laboratory tests, including liver function tests and transaminases, were within normal limits. Ammonia and lactate levels were also normal.

Portal Doppler ultrasonography showed an intrahepatic portosystemic shunt measuring up to 2.5 mm, connecting the anterior segment branch of the right portal vein to the middle hepatic vein (Figure 1A–C). Hepatopedal flow was preserved in the main portal vein. Quantitative measurements such as flow velocity or shunt ratio were not assessed.

The patient was diagnosed with Abernethy syndrome and was followed regularly with clinical and radiological evaluations. Complete spontaneous closure of the shunt was confirmed at 8 months of age. The patient was followed for an additional 6 months after shunt closure and remained asymptomatic, with normal liver function tests and laboratory parameters during subsequent visits.

Figure 1. Color Doppler ultrasonography images (A–C) demonstrating a 2.5-mm intrahepatic portosystemic shunt connecting the anterior segment branch of the right portal vein to the middle hepatic vein.

Discussion

Congenital portosystemic shunts are rare abnormalities, and their association with other syndromes and malformations has become clearer as more cases have been reported (7). In addition to the intrahepatic and extrahepatic classification, Morgan and Superina proposed an additional system for extrahepatic shunts. They defined type 1 shunts as *end-to-side* connections in which all portal venous blood is diverted, and the intrahepatic portal branches are severely hypoplastic or completely absent. Type 2 shunts are *side-to-side* connections, where only part of the portal flow is diverted, and the liver still receives some degree of portal perfusion (16). Type 1 shunts are further classified into type 1A and type 1B. Type 1A involves complete congenital absence of the portal vein, whereas in type 1B, the superior mesenteric vein and splenic vein join to form a portal-like trunk that drains directly into the inferior vena cava (4). Other congenital anomalies are reported more frequently in type 2 extrahepatic shunts (2,4,15). The Morgan and Superina classification is summarized in Table 1.

Table 1. Classification of Congenital Extrahepatic Portosystemic Shunts (Morgan & Superina Classification)

Type	Description	Portal Venous Anatomy	Hepatic Perfusion
Type 1A	Complete diversion through an end-to-side shunt	Congenital absence of portal vein; SMV and splenic vein drain separately	No hepatic portal flow
Type 1B	Complete diversion through an end-to-side shunt	SMV + splenic vein form a portal-like trunk draining into IVC	No hepatic portal flow
Type 2	Partial diversion through a side-to-side shunt	Intrahepatic portal branches intact	Partial hepatic portal flow

Summary of the Morgan and Superina classification of congenital extrahepatic portosystemic shunts (16).

Clinical features vary depending on the underlying physiology and the amount of blood bypassing the liver. Reduced hepatic perfusion may lead to intrauterine growth restriction (17), which is seen in about 50% of children with congenital portosystemic shunts. Neonatal cholestasis is another possible early presentation (2).

Because metabolites and vasoactive substances from the splanchnic circulation bypass the liver, serum galactose and ammonia levels may increase. These changes can lead to portosystemic encephalopathy, hepatopulmonary syndrome, or pulmonary arterial hypertension. According to the literature, hypergalactosemia occurs in nearly 70% of newborns with congenital portosystemic shunts (2). Conversely, about 60% of newborns with persistent hypergalactosemia but no enzyme deficiency are found to have a congenital portosystemic shunt (18).

Pulmonary arterial hypertension is another important complication and may occur at any age and

in all shunt types. It can even be the first presenting symptom. Because pulmonary hypertension may progress to right heart failure and death, patients with a known shunt should be monitored with a careful history, physical examination, and echocardiography (2,15,19). Another complication that may occur especially in the neonatal period is severe and persistent hypoglycemia, likely due to reduced hepatic insulin clearance (20). This patient had a history of hypoglycemia in the neonatal period, which aligns with this mechanism.

For type 1 shunts, liver transplantation is the only definitive treatment (2). For shunts in which the intrahepatic portal system is intact, surgical ligation or percutaneous closure performed by an experienced interventional radiologist are possible management options (15,21). Intrahepatic shunts may close spontaneously during the first year of life (2,6). In this patient, follow-up Doppler ultrasonography showed spontaneous resolution of the shunt.

Conclusion

Abernethy syndrome is a rare congenital condition that may affect several organ systems and present with a wide range of findings, including hypertransaminasemia, neonatal cholestasis, hypoglycemia, hyperammonemia, and hypergalactosemia. In addition to these, serious complications such as pulmonary arterial hypertension, portopulmonary syndrome, and hepatic encephalopathy may also develop. Even when patients are asymptomatic, regular clinical assessment and imaging are important to identify complications early and guide appropriate follow-up. Awareness of this condition can help clinicians recognize subtle presentations and prevent delayed diagnosis.

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Conflict of Interest

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Ethical Declaration

Informed consent was obtained from the participant and Helsinki Declaration rules were followed to conduct this study.

Authorship Contributions

Concept: MET, Design: MET, YSO, Supervising: MET, YSO, GT, Financing and equipment: MET, GT, Data collection and entry: MET, YSO, Aİ, GT, Analysis and interpretation: MET, YSO, Aİ, GT, Literature search: MET, YSO, Writing: MET, YSO, Aİ, GT, Critical review: MET, YSO, Aİ, GT

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