



Research Paper

Anatomy of Research Paper in Medical Biochemistry

¹Kavindra Borgaonkar, ²Ranjit Patil

Associate Professor, Department of Biochemistry V.D. Government Medical College Latur 413512 India

Professor, Department of Medical Biochemistry SSR Medical College Belle Rive Mauritius

Abstract

The anatomy of a research paper in medical biochemistry serves as a structured framework to effectively present scientific findings and contribute to academic and clinical advancements. This review highlights the essential components of such papers, which include the title, abstract, introduction, materials and methods, results, discussion, conclusion, and references. Each section plays a unique role in ensuring clarity, coherence, and the reproducibility of findings.

The title encapsulates the research's core objective and relevance, serving as the first point of engagement for readers. The abstract provides a concise summary of the study's background, objective, methods, key results, and conclusions, allowing readers to quickly grasp its essence. The introduction sets the stage by establishing the research context, knowledge gap, and objectives. The materials and methods section emphasizes transparency and reproducibility, detailing study design, experimental protocols, and statistical analyses.

The results section presents findings in a clear, unbiased manner, using textual descriptions, tables, and figures to enhance comprehension. The discussion interprets these findings in light of existing literature, outlines their implications, addresses study limitations, and proposes future research directions. The conclusion succinctly reiterates the study's contributions and significance.

Additionally, sections on funding sources, acknowledgments, and conflicts of interest enhance transparency and ethical adherence, while a comprehensive reference list validates claims and guides further inquiry. By following these structured guidelines, researchers can produce impactful manuscripts that foster innovation and progress in medical biochemistry, advancing our understanding of biochemical mechanisms and their clinical applications.

Keywords: Medical Biochemistry, Research Paper, Scientific Writing, Biomedical Paper

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I. Introduction

Medical biochemistry forms the cornerstone of modern medicine, elucidating the molecular underpinnings of physiological and pathological processes. Research in this field not only uncovers mechanisms of disease but also identifies biomarkers and therapeutic targets. The ability to effectively communicate these findings through well-structured research papers is indispensable. The anatomy of a research paper in medical biochemistry adheres to a standardized format that ensures clarity, reproducibility, and accessibility for diverse audiences. The structure of a research paper serves as a framework for organizing and presenting data, allowing readers to follow the scientific narrative and draw informed conclusions. This paper provides a detailed examination of each section of a medical biochemistry research paper, offering guidance on content development and writing strategies to produce impactful manuscripts.

Title

The title is a critical component of a research paper, as it is the first element encountered by readers. A well-crafted title is concise yet informative, reflecting the essence of the study and attracting the target audience. Titles in medical biochemistry often incorporate key terms related to the study's primary focus, such as specific biomarkers, diseases, or biochemical pathways. For instance, a title like "The Role of Glycated Hemoglobin in Early Diagnosis of Type 2 Diabetes Mellitus" immediately conveys the study's scope and relevance.

A successful title achieves a balance between brevity and specificity. It avoids technical jargon that may alienate non-specialist readers while ensuring that it is descriptive enough to facilitate indexing and retrieval in scientific

databases. Researchers are encouraged to refine their titles iteratively, ensuring alignment with the paper's core objectives and findings.

Abstract

The abstract is a succinct summary of the research paper, providing an overview of its objectives, methods, key findings, and conclusions. Typically limited to 250-300 words, the abstract functions as a standalone section that enables readers to quickly grasp the essence of the study. In medical biochemistry, the abstract often emphasizes the clinical or molecular implications of the findings.¹

A structured abstract comprises several distinct components:

The abstract must articulate the study's objective, the employed methodology, and encapsulate the findings and significant conclusions. Typically, it is composed in the IMRAD format and referred to as a structured abstract.²

I- Introduction in the initial sentence must articulate the issue being addressed.

M: Methodology—what method was selected to complete the experiment?

R: Results—articulate the significant findings of your research.

A: And,

D: Discussion —articulate the significance of your research

Provide the subsequent information:

- Significant findings accompanied with statistical data (p-values, confidence intervals, standard deviation/mean deviation).
- Organize all information in chronological sequence.
- Avoid reiterating any information.

The concluding sentence must articulate the recommendations derived from your study.

The abstract must be composed in the past tense.

For example, an abstract might state: "This study analyzed glycated hemoglobin (HbA1c) levels in 200 patients to evaluate its efficacy as a diagnostic biomarker for Type 2 Diabetes Mellitus (T2DM). The findings indicate that HbA1c levels correlate strongly with fasting glucose levels, supporting its use in early T2DM detection.

Keywords:

These are important words that are repeated throughout the manuscript and which help in the indexing of a paper. Depending upon the journal 3–10 key words may be required which are indexed with the help of MESH (Medical Subject Heading).

Introduction

The introduction sets the stage for the research, providing the context and rationale for the study. It typically begins with a broad overview of the research area, gradually narrowing to the specific problem addressed by the study. In medical biochemistry, introductions often highlight the biochemical mechanisms underlying the research question, emphasizing their clinical relevance.

Key elements of the introduction include:³

- **Background Information:** A summary of existing knowledge in the field, including relevant studies and unresolved questions.
- **Knowledge Gap:** A clear identification of the gap in the current understanding that the study aims to address.
- **Objective Statement:** A concise articulation of the research objectives or hypotheses.

For example, an introduction might outline the limitations of existing diagnostic tools for T2DM, leading to the hypothesis that HbA1c is a superior biomarker for early detection. The introduction should engage the reader by highlighting the study's significance and potential impact on medical biochemistry and clinical practice.

For a medical research paper, the length of the introduction should be less than 10–15% of the total length of the manuscript. All sections in a medical research paper except the conclusion should contain references. It has been suggested that an introduction should have four or five or at the most one-third of the references in the whole paper.⁴

It is essential to remember the following criteria when composing the Introduction,⁵

It should be articulated in straightforward words and in the present tense.

This section will introduce numerous terminologies for the first time, necessitating the use of abbreviations subsequently.

This section should mention works published in reputable journals, namely those with a high impact factor.

The objectives, issues, and hypotheses must be explicitly stated.

Commence with a broad overview of the subject, subsequently transitioning to specific details pertinent to your investigation.

II. Materials and Methods

The materials and methods section is the backbone of a research paper, detailing the experimental design and procedures used to generate the study's findings. This section must provide sufficient detail to allow other researchers to replicate the study, ensuring its scientific rigor and reproducibility.⁶

In medical biochemistry, the materials and methods section typically includes the following components:

1. **Study Design:** Provide a comprehensive description of the study type (e.g., observational, experimental, cross-sectional). Clearly outline the rationale for the chosen design.
2. **Participants and Ethics:** Include detailed information on participant recruitment, demographics, and criteria for inclusion and exclusion. Explicitly state that the study has received approval from an institutional review board (IRB) or ethics committee, and indicate that informed consent was obtained where applicable.
3. **Sample Preparation and Storage:** Outline the methods for sample collection (e.g., blood, tissue, or other biological specimens), including handling and storage protocols to ensure sample integrity. For example, "Serum was separated within two hours of collection and stored at -80°C until analysis."
4. **Biochemical Assays:** Describe the biochemical methods in detail, including reagent compositions, calibration techniques, and instrumentation used (e.g., spectrophotometers, chromatography systems). For example, "Serum glucose levels were measured using the glucose oxidase-peroxidase method on an automated biochemical analyzer."
5. **Quality Control:** Specify the steps taken to ensure the accuracy and reliability of biochemical measurements. Include information on internal and external quality control procedures.
6. **Data Collection:** Provide a clear description of the data collection methods, including any questionnaires, software, or tools used to record results. Specify any digital tools utilized for laboratory automation or sample tracking.
7. **Statistical Analysis:** Clearly outline the statistical methods employed to analyze the data. Include details on the software used (e.g., SPSS, R, or GraphPad Prism) and specify the statistical tests applied for each type of data (e.g., t-tests for continuous variables, chi-square tests for categorical variables). Indicate the threshold for statistical significance (commonly $p < 0.05$).
8. **Replication Details:** Ensure the methods section contains enough information to facilitate reproducibility. Mention whether protocols are novel or adapted from previous studies, and provide references when using established techniques.

Clarity and precision are paramount in this section. Researchers should avoid unnecessary technical jargon while ensuring that all critical details are included.

All methodology should be articulated in the past tense, preferably using an active voice.⁷ Accordingly, you should employ verbs such as 'investigated', 'evaluated', or 'executed'. Recently, phrases indicating ownership of the investigation such as 'we conducted', 'we assessed', and 'we executed' have been predominant. Communication to the reader must be lucid and devoid of any convoluted ideas. This section ought to be composed in clear English and should be thorough.

Important points should not be missed in Materials and Methods

Date of commencement and conclusion.

Criteria for inclusion and exclusion.

Outcome measure accompanied by definitions.

Statistics used

Study design type.

Common errors in Materials and Methods⁸

1. **Insufficient Detail:** Researchers often omit critical details about protocols, reagents, or instruments, making replication impossible.
2. **Unclear Study Design:** Failing to clearly state the type of study and its rationale leaves readers uncertain about the research's framework.
3. **Incomplete Ethical Information:** Not mentioning IRB approval or informed consent violates ethical standards and undermines credibility.
4. **Poorly Described Biochemical Assays:** Lack of detail on the composition of reagents, assay procedures, or calibration techniques can confuse readers and compromise reproducibility.
5. **Inadequate Quality Control Measures:** Omitting descriptions of internal and external quality checks raises doubts about data reliability.
6. **Ambiguous Statistical Methods:** Failing to specify which tests were applied to which data types or omitting software details can lead to misinterpretation of results.
7. **Missing Sample Handling Protocols:** Not detailing how samples were collected, processed, or stored can result in irreproducible findings.

8. **Overuse of Jargon:** Excessive technical language without explanation can alienate non-specialist readers.

Addressing these issues ensures a robust and transparent Materials and Methods section, enhancing the overall impact of the research paper.

III. Results

The results section presents the study's findings in a clear and objective manner. It includes both textual descriptions and visual representations, such as tables, graphs, and figures. This section should focus solely on the data, without interpretation or speculation.

Key components of the results section include:⁹

The results section serves as the foundation for presenting the outcomes of the study in an organized and objective manner. It highlights the findings derived from the experiments and provides the data that supports the conclusions of the research. This section should maintain a clear and logical flow, avoiding subjective interpretation, which is reserved for the discussion.

Key Elements of the Results Section:

1. **Descriptive Data:** This involves summarizing the demographic and baseline characteristics of the study population or samples. For instance, "The study included 200 participants, of which 120 were male (60%) and 80 were female (40%), with an average age of 45.3 ± 12.7 years."

2. **Presentation of Primary Outcomes:** Clearly outline the primary findings relevant to the research question. Statistical measures such as means, standard deviations, and p-values should be presented to provide scientific rigor. For example, "The mean HbA1c levels in diabetic patients ($8.1 \pm 1.2\%$) were significantly higher than in non-diabetic controls ($5.4 \pm 0.6\%$, $p < 0.001$)."

3. **Secondary Outcomes:** Any additional findings that provide further context or support to the primary outcomes should be detailed. For instance, "Serum insulin levels showed a strong correlation with HbA1c ($r = 0.72$, $p < 0.001$)."

4. **Visual Representations:** Data should be supplemented with well-designed tables, graphs, and figures that enhance clarity and reader comprehension. Each visual should have a descriptive title and caption. For example, a table might display comparative glucose levels across groups, and a graph could illustrate trends in biomarker levels.

5. **Statistical Analysis Details:** Ensure that all statistical tests used are clearly mentioned alongside the results. Include confidence intervals and effect sizes where applicable to provide a more complete picture of the findings.

6. **Unexpected Findings:** If the study yielded any unexpected or anomalous results, these should be reported transparently with potential explanations reserved for the discussion section. For example, "Contrary to expectations, participants in the high-risk group exhibited lower-than-expected triglyceride levels."

Example of an Expanded Results Section: "The mean fasting glucose levels in the intervention group (105 ± 15 mg/dL) were significantly lower compared to the control group (130 ± 20 mg/dL, $p < 0.001$). Similarly, postprandial glucose levels decreased by an average of 25% in the intervention group compared to 10% in the control group ($p = 0.03$). Analysis of variance showed a significant interaction effect between treatment type and baseline HbA1c levels ($F(2,198) = 4.56$, $p = 0.01$). Figure 1 depicts the relationship between HbA1c levels and treatment duration, highlighting a progressive reduction over 12 weeks."

Important points must be considered while writing the results section of the Medical manuscript¹⁰

- ✓ Structure your manuscript to optimize clarity and enhance the transmission of information to the audience. Construct uncomplicated sentences to accomplish this objective.
- ✓ The initial statement should effectively rephrase the research inquiries posed in the study.
- ✓ Subsequently, provide the total number of patients screened, the number of individuals enrolled, as well as the criteria for inclusion and exclusion of participants.
- ✓ The primary results should be articulated clearly.
- ✓ All tables and figures must be sequentially numbered in accordance with their appearance within the manuscript. Each table must include a descriptive caption at the top. The figures and tables should necessitate minimal elucidation within the results or discussion sections.
- ✓ Systematically evaluate the language and scientific accuracy of your draft, making iterative revisions to optimize the quality of the final output. It is essential to ensure the accuracy of all graphs and figures, verifying that no values from the observations have been incorrectly transcribed.
- ✓ Please consult the Instructions to Authors provided on the journal's website regarding this section. Examine the permissible quantity of graphs and figures utilized to illustrate the results. This will assist in restructuring the manuscript in accordance with the specified guidelines.

- ✓ Make sure that the results section jells with the other sections and does not look like a stand-alone piece. At this stage, it is essential to verify the accuracy of grammar and tense usage. All results were required to be reported in the past tense.
- ✓ Data that is not presented in the results section cannot be addressed in subsequent discussions. In instances where an excessive number of results is generated, it is advisable to further categorize these findings into subheadings for enhanced clarity and organization.

The Role of Statistics in the Results Section¹¹

Statistics play a crucial role in the results section by providing a framework for analyzing and interpreting data objectively. They allow researchers to determine the significance of their findings, assess variability, and draw conclusions based on evidence. Common statistical tools, such as p-values, confidence intervals, and correlation coefficients, help establish relationships and trends within the data. By presenting results with statistical backing, researchers enhance the credibility and reproducibility of their study. Clear reporting of statistical methods and outcomes ensures transparency and facilitates comparison with other studies.

IV. Discussion

The discussion section is where researchers interpret their results in the context of existing knowledge, offering insights into the significance of the findings and their implications. In medical biochemistry, this section often bridges the gap between molecular mechanisms and clinical applications. Writing a robust discussion requires critical thinking, clarity, and structured argumentation.

Key Components of the Discussion Section:¹²

1. **Summary of Key Findings:** Begin by briefly summarizing the most significant findings of your study, ensuring you emphasize their relevance. For instance, "This study demonstrated that serum HbA1c levels correlate strongly with fasting glucose levels, reinforcing its potential as a diagnostic biomarker for early detection of Type 2 Diabetes Mellitus."
2. **Contextualization:** Compare your results with previous studies to highlight similarities, differences, or advancements. For example, "Our findings align with those of XXXX et al. (2020), who reported a similar correlation between HbA1c and glucose levels, although our study observed a stronger association ($r = 0.82$ vs. $r = 0.76$)."
3. **Mechanistic Insights:** Discuss the potential biochemical or molecular mechanisms underlying your findings. For example, "The strong correlation between HbA1c and glucose levels may be attributed to the non-enzymatic glycation of hemoglobin, which reflects long-term glucose exposure."
4. **Implications:** Elaborate on the clinical, diagnostic, or therapeutic implications of your findings. For instance, "These results suggest that incorporating HbA1c measurements into routine screening could enhance early detection rates of T2DM, particularly in resource-limited settings."
5. **Limitations:** Acknowledge the limitations of your study, such as sample size, study design, or potential biases. "One limitation of our study is its cross-sectional design, which precludes causal inference."
6. **Future Directions:** Propose areas for further research, building on the strengths and addressing the weaknesses of your study. "Future studies should explore longitudinal changes in HbA1c levels to establish its predictive value for T2DM progression."

Illustrative Example:

"This study provides evidence supporting the utility of HbA1c as an early diagnostic biomarker for T2DM. Similar to prior research by XXX et al. (2018), we observed elevated HbA1c levels in patients with undiagnosed diabetes, although our cohort exhibited a higher average HbA1c ($8.1 \pm 1.2\%$). This discrepancy could be due to variations in demographic factors, such as age and ethnicity, which warrant further investigation. Mechanistically, the observed correlation between HbA1c and fasting glucose levels reflects the glycation process over the lifespan of red blood cells. Clinically, these findings advocate for routine HbA1c testing, particularly in high-risk populations. However, our study's reliance on a hospital-based sample may limit its generalizability, necessitating larger, community-based studies to confirm these results."

General Considerations for writing a discussion^{13,14}

Initiate the discussion by addressing the particular issues at hand, subsequently transitioning to the broader implications.

The discussion must be structured to avoid presenting a disorganized collection of disparate information.

It is essential for the data derived from various studies to be presented in a manner that facilitates comprehension and comparison.

It is advisable to focus exclusively on publications that have emerged within the 5-10 years regarding the subject matter.

Ensure that all sources of information are appropriately cited and accurately referenced.

Verify that you have not engaged in plagiarism by ensuring that any words directly quoted from a source are appropriately attributed.

How long should be the Length of the Discussion?

Many academic journals do not impose specific restrictions on the length of discussions, provided that they remain concise and pertinent to the subject matter. Typically, the length of the discussion section should not surpass the cumulative length of the introduction, materials and methods, and results sections. The discussion section of a well-structured article typically spans 3 to 4 pages, comprising 6 to 7 paragraphs, or approximately 10 paragraphs, with a total word count ranging from 1000 to 1500 words.¹⁵

Common Pitfalls to Avoid while Writing the Discussion¹⁶

1. **Repetition of Results:** Avoid simply restating results without interpretation.
2. **Overgeneralization:** Ensure conclusions are supported by data.
3. **Neglecting Limitations:** Addressing limitations demonstrates transparency and scientific rigor.
4. **Speculation without Evidence:** Base all claims on data or established literature.

By following these guidelines, researchers in medical biochemistry can craft a compelling discussion section that highlights the significance of their work, acknowledges its limitations, and paves the way for future advancements.

V. Conclusion

Writing an effective conclusion for a medical biochemistry research paper involves summarizing the core findings, highlighting their significance, and providing a forward-looking perspective. The conclusion should be concise and focused, avoiding repetition or introducing new information. Instead, it should synthesize the study's results and implications in a meaningful way.

Key Steps to Write an Effective Conclusion¹⁷

1. **Restate the Key Findings:** Begin by summarizing the most critical outcomes of the study. For example, "This study demonstrated that serum HbA1c levels are a reliable biomarker for the early detection of Type 2 Diabetes Mellitus, with strong correlations to fasting glucose levels."
2. **Emphasize the Implications:** Highlight how the findings contribute to the field of medical biochemistry and their potential clinical or therapeutic applications. For instance, "These findings support the integration of HbA1c testing into routine diagnostic workflows, particularly in resource-limited settings."
3. **Acknowledge Limitations:** Briefly mention any limitations of the study to provide a balanced perspective. For example, "However, the study's cross-sectional design limits causal inference, necessitating further longitudinal research."
4. **Propose Future Directions:** Offer suggestions for future research based on the study's findings. For instance, "Future studies should explore the longitudinal impact of HbA1c variations on disease progression and investigate its utility across diverse populations."

Illustrative Example:

"This study establishes HbA1c as a robust biomarker for the early detection of Type 2 Diabetes Mellitus, with significant implications for improving diagnostic accuracy and patient outcomes. The findings align with existing literature, reinforcing the biochemical basis of HbA1c's role in glycemic monitoring. Despite the study's limitations, such as its hospital-based sample, the results pave the way for broader, population-based studies to validate these conclusions and expand their applicability. Integrating HbA1c testing into standard diagnostic protocols could enhance early intervention strategies, ultimately reducing the burden of diabetes globally."

References

References validate the research paper, providing credibility and enabling readers to explore the source material. Researchers must adhere to a consistent citation style, such as APA or Vancouver, ensuring that all cited works are accurately referenced.

Ethical Considerations

Ethical integrity is fundamental in medical research. Researchers must obtain IRB approval, secure informed consent from participants, and adhere to guidelines for data reporting and authorship. Transparency in conflicts of interest and funding sources is also crucial.

Funding Sources, Acknowledgment, and Conflict of Interest

Funding Sources

Funding sources provide the financial backbone for research and must be explicitly disclosed to maintain transparency. Researchers should detail:

- Grants or financial support received from institutions, governments, or private organizations.
- Specific grant numbers and funding agency names.

Example: "This work was supported by the National Institute of Health (Grant No. NIH-2023-BIOMED-001)."

Acknowledgment

The acknowledgment section recognizes individuals or organizations that contributed to the research but do not qualify as authors. This may include:

- Technical staff, mentors, or collaborators.
- Institutions providing resources or facilities.
- Editorial assistance.

Example: "The authors thank Dr. Jane Doe for her invaluable insights during the study's design phase and XYZ Biochemistry Lab for technical support."

Conflict of Interest

Declaring conflicts of interest ensures objectivity and integrity in research. Authors must disclose:

- Any financial, personal, or professional relationships that could influence the study.
- Statements affirming the absence of conflicts if applicable.

Example: "The authors declare no conflict of interest regarding the publication of this manuscript."

VI. Conclusion

The anatomy of a research paper in medical biochemistry embodies a systematic approach to presenting scientific findings. Each section, from the title to the references, plays a crucial role in ensuring the study's clarity and credibility. By adhering to the structured guidelines outlined in this review, researchers can effectively communicate their findings, contributing to advancements in medical science. This structured framework not only aids in the dissemination of knowledge but also fosters critical discussions that drive innovation and progress in medical biochemistry.

References

- [1]. Bahadoran Z, Mirmiran P, Kashfi K, Ghasemi A. The Principles of Biomedical Scientific Writing: Abstract and Keywords. *Int J Endocrinol Metab* [Internet]. 2020 Jan;18(1):e100159. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/32308700>
- [2]. Tullu M. Writing the title and abstract for a research paper: Being concise, precise, and meticulous is the key. *Saudi Journal of Anaesthesia*. 2019.
- [3]. Jawaid S, Jawaid M. How to write introduction and discussion. *Saudi Journal of Anaesthesia*. 2019.
- [4]. Sharma A. How to write an article: An introduction to basic scientific medical writing. *J Minim Access Surg*. 2019;
- [5]. Armagan A. How to write an introduction section of a scientific article? *Türk Üroloji Dergisi/Turkish J Urol*. 2014;
- [6]. Willis LD. How to Write the Methods Section of a Research Manuscript. *Respir Care*. 2023;
- [7]. Erdemir F. How to write a materials and methods section of a scientific article? *Türk Üroloji Dergisi/Turkish J Urol*. 2014 Oct;39(1):10–5.
- [8]. Ezeala C, Nweke I, Ezeala M. Common errors in manuscripts submitted to medical science journals. *Ann Med Health Sci Res*. 2013;3(3):376.
- [9]. Masic I. How to Search, Write, Prepare and Publish the Scientific Papers in the Biomedical Journals. *Acta Inform Medica*. 2011;
- [10]. Tuncel A, Atan A. How to clearly articulate results and construct tables and figures in a scientific paper? *Türk Üroloji Dergisi/Turkish J Urol*. 2014 Oct;39(1):16–9.
- [11]. Labani S, Wadhwa K, Asthana S. Basic Approach to Data Analysis and Writing of Results and Discussion Sections. *MAMC J Med Sci*. 2017;
- [12]. Höfler M, Venz J, Trautmann S, Miller R. Writing a discussion section: How to integrate substantive and statistical expertise. *BMC Medical Research Methodology*. 2018.
- [13]. Masic I. How to Write an Efficient Discussion? *Med Arch*. 2018;72(3):306.
- [14]. Bagga A. Discussion: The heart of the paper. *Indian Pediatr*. 2016 Oct;53(10):901–4.
- [15]. Kearney MH. The Discussion Section Tells Us Where We Are. *Res Nurs Health*. 2017 Aug;40(4):289–91.
- [16]. Gangaraju R, Cushman M. How We Write a Manuscript Discussion. *Research and Practice in Thrombosis and Haemostasis*. 2023.
- [17]. Weinstein R. How to write a manuscript for peer review. *Journal of Clinical Apheresis*. 2020.