# Title: clear, succinct, declarative, and reflects the main contribution

## Key Tips for Choosing a Title

* **Be Specific and Focused**: Your title should clearly reflect the central contribution of your paper. Avoid broad or vague titles; instead, make sure it directly communicates the main finding or the key aspect of your research.
* **Keep it Concise**: Aim for a title that is succinct yet informative. A shorter, well-crafted title is often more impactful and memorable.
* **Make it Declarative**: Whenever possible, use a title that makes a clear statement about your findings or conclusions. This approach can grab the reader's attention and provide a direct insight into the paper's content.
* **Use Keywords Wisely:** Incorporate important keywords that will help your paper be discovered through search engines and databases. This also ensures that your title resonates with the target audience.
* **Iterate as You Write**: Revisit your title during the writing process to ensure it remains aligned with the evolving focus of your manuscript.

Regularly return to the title to ensure it still aligns with the manuscript as it evolves. *E.g.*

* *‘Genome-wide association study identifies multiple loci for Alzheimer’s disease.’*
* *Integrative Analysis of Multi-Omics Data Reveals Pathways Associated with Neurodegeneration*
* *Epigenetic Modifications in Aging and their Role in Alzheimer’s Disease*
* *Single-Cell Transcriptomics Uncovers Cellular Heterogeneity in Alzheimer’s Disease*

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Abstract: X / X

Manuscript: X / X  
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Number of tables: X

# Abstract

## Key Tips for Writing the Abstract

* **Capture the Big Picture:** Start by clearly stating the broader context of your research and the specific problem you are addressing. Ensure the reader understands the importance of the study from the outset.
* **Be Concise and Specific:** Your abstract should be a succinct summary of your entire paper. Each sentence should convey a critical piece of information. Avoid unnecessary details or background information.
* **Follow the C-C-C Structure:**
  + **Context:** Introduce the broad field and the specific gap your research fills.
  + **Content:** Summarize the methods and key results that address the gap.
  + **Conclusion:** Highlight the implications and broader significance of your findings.
* **Avoid Jargon:** Use clear and straightforward language that can be understood by a broad audience, including those outside your field.
* **Iterate for Clarity:** Revise your abstract multiple times to ensure it is clear, coherent, and directly aligned with the main message of your paper. Consider feedback from colleagues to refine it further.
* **Match the Abstract to the Paper:** Ensure that your abstract accurately reflects the content of the paper. Avoid introducing ideas or results that are not covered in the main text.

Structure the abstract with Context-Content-Conclusion (C-C-C):  
1. Introduce the broader field and narrow down to the specific gap the paper addresses (Context).  
2. Describe the methods used and summarize key findings (Content).  
3. Conclude by interpreting the results and their broader significance (Conclusion).  
Iterate on the abstract to ensure clarity and completeness.

# Introduction

**The introduction should progressively narrow down from the broader context to the specific problem your paper addresses. Use the following subheadings for structure:**

## 1. Broad Gap in the Field:

Introduce the wider context and the general area of research. Explain why this area is important and highlight the broad gaps in knowledge or methodology.

## 2. Subfield Gap:

Focus on a specific area within the broader field. Identify a gap or challenge in this subfield that remains unresolved.

## 3. Specific Gap Addressed by This Paper:

State the precise problem your research addresses.

## 4. Conclude with a brief overview of how the study aims to fill this gap

i.e. “Here we…”

# Methods

**Detail your methods clearly and concisely. Ensure reproducibility by including all necessary information, avoiding jargon where possible.**

Consider the following structure:

## 1. Overview of the Experimental Design:

Briefly describe the study design, including the main experimental approach and any innovative methods used.

## 2. Data Collection and Description

* Data Sources: Briefly describe the datasets used, including how they were obtained and any relevant ethical approvals.
* Participant Characteristics: Provide details about the participants or subjects, including sample size, demographics, and any inclusion/exclusion criteria.

## 3. Data Processing and Preprocessing

* Data Cleaning: Explain the steps taken to clean and preprocess the data, such as handling missing data, outlier removal, and normalization.
* Feature Engineering: Describe any transformations or new variables derived from the original data, such as encoding categorical variables or calculating composite scores.

## 4. Participant and Predictor Selection

* Participant Selection: Detail any criteria or methods used to select participants for specific analyses, such as matching or stratification techniques.
* Predictor Variables: Outline the predictors or independent variables considered in your models, including any rationale for their inclusion.

## 5. Statistical and Computational Modeling

* Model Selection: Describe the types of models used (e.g., logistic regression, machine learning classifiers) and the rationale behind choosing them.
* Model Training and Validation: Explain how models were trained, including any cross-validation methods, hyperparameter tuning, and evaluation metrics.

## 6. Sensitivity Analyses and Robustness Checks

* Alternative Models: Detail any alternative modeling approaches used to test the robustness of your findings, such as different algorithms or variations in model specifications.
* Validation Techniques: Describe any additional validation methods, such as bootstrapping, permutation tests, or external validation cohorts.

## 7. Software and Tools

* Software: List the software packages and tools used for analysis, including versions (e.g., Python, R, specific libraries).
* Computational Resources: Mention any specific hardware or computational resources, such as high-performance computing clusters, that were essential to the analysis.

# Results – present logically structured findings to tell the story in the title

The results section is where you present the findings of your research, logically structured to support the central claim of your paper. The key to a well-structured results section is to follow the **Context-Content-Conclusion (C-C-C) framework** for each major finding or subsection.

**Remember**: I am not defensively stating all the reasons the result stands and the data is okay. I am telling a story, leading with the main result and sticking to the core message of the paper. Other messages and stories can go in other papers!

## Key Tips for Writing the Results Section

* **Stick to the central message**: Ensure each subsection supports the main claim of your paper. Avoid tangential data that do not directly contribute to your central argument.
* **Use clear, declarative headings**: Each result should have a clear and descriptive heading that reflects the key finding.
* **Integrate figures and tables effectively**: Reference figures and tables in the text as evidence for your claims, ensuring that the text and visuals complement each other.
* **Avoid over-speculation**: Interpret your results within the data's limits. Save broader interpretations for the Discussion section.
* **Logical flow**: Arrange your results in a logical sequence, building from the most important findings to supporting analyses.

This structured approach, following the C-C-C model and emphasizing clarity and logical flow, will help you write a more effective and coherent Results section.

## 1. Introduction to the Results Section

Start the Results section with a brief summary of the overall approach and key methods, especially since most readers may skip the Methods section. This introduction should orient the reader to the experimental design and the main techniques used. *E.g. "We employed a genome-wide association study (GWAS) approach to identify loci associated with Alzheimer's disease (AD) in a cohort of 10,000 participants. Using both standard logistic regression and a novel machine learning classifier, we tested for associations between genetic variants and AD status, followed by validation in an independent cohort."*

## 2. Presenting Major Findings

Each major finding should be introduced in a separate paragraph. Use the C-C-C model:

* **Context:** Introduce the specific research question or hypothesis you are addressing with this result.
* **Content:** Present the data, including any figures or tables that support this finding. Be clear and concise in describing the results.
* **Conclusion:** State the implications or significance of this result in relation to your research question.

*E.g. 2.1. Identification of AD-Associated Loci*

* ***Context****: "To determine the genetic loci associated with AD, we first conducted a GWAS on the discovery cohort. Previous studies have identified several loci, but many remain unvalidated or inconsistently reported."*
* ***Content****: "Our analysis identified three novel loci on chromosomes 2, 7, and 12 that showed significant association with AD (p < 5 x 10^-8). The locus on chromosome 12 was the most significant, with a log-odds ratio of 1.45, suggesting a strong effect. These loci were not previously reported in AD studies."*
* ***Conclusion****: "These findings suggest that these novel loci are potential candidates for AD risk factors, warranting further investigation into their biological roles."*

## 3. Supporting or Secondary Findings

For each supporting finding or secondary analysis, follow the same C-C-C model. If your results include validation experiments, robustness checks, or additional analyses, these should be presented after the main findings.

*E.g. 2.2. Validation of Loci in an Independent Cohort*

* ***Context****: "To confirm the validity of the identified loci, we replicated our findings in an independent cohort of 5,000 participants. Given the heterogeneity observed in previous studies, this step was crucial to validate the robustness of our associations."*
* ***Content****: "The loci on chromosomes 7 and 12 were successfully validated (p < 0.05), with consistent effect sizes observed. The locus on chromosome 2, however, did not replicate, suggesting a possible false positive or population-specific effect."*
* ***Conclusion****: "The replication of loci on chromosomes 7 and 12 strengthens the evidence for their role in AD, while the non-replication of the locus on chromosome 2 highlights the importance of validation in genetic studies."*

## 4. Robustness Checks and Alternative Approaches

If you performed additional experiments or analyses to ensure the robustness of your results (e.g., alternative modeling approaches, additional controls), these should be clearly described. These are crucial for demonstrating the reliability of your findings.

*E.g. 2.3. Robustness of Findings Through Alternative Modelling*

* ***Context****: "Given the complexity of genetic association studies, we performed additional robustness checks using alternative statistical models and data validation techniques."*
* ***Content****: "We applied a ridge regression model and a random forest classifier to cross-validate our findings. Both models identified the same loci on chromosomes 7 and 12 as significant, with minimal variation in effect size. Additionally, we performed permutation tests to ensure that our results were not due to random chance, with p-values remaining significant across 1,000 permutations."*
* ***Conclusion****: "These additional analyses confirm the robustness of our findings, providing strong evidence that the identified loci are genuinely associated with AD and not artifacts of the initial analytical approach."*

## 5. Integrating Additional Findings

When you have secondary analyses or findings that don't fit neatly into your primary narrative but are still important, consider creating separate subsections or integrating them into a broader discussion of the results. Or save them for another paper, a presentation or have them in your back-pocket for review requests. Not everything needs to make it into the paper!

*E.g. 2.4. Gene-Environment Interactions*

* ***Context****: "To explore potential interactions between genetic variants and environmental factors, we conducted an interaction analysis with smoking status as a covariate, given its known association with AD."*
* ***Content****: "We observed a significant interaction between the locus on chromosome 12 and smoking status, suggesting that the genetic risk conferred by this locus is modified by environmental exposure (interaction p-value = 0.01)."*
* ***Conclusion****: "This finding highlights the potential for gene-environment interactions in modulating AD risk, suggesting avenues for personalized prevention strategies."*

## 6. Concluding the Results Section

Finish the Results section with a brief summary of your findings and their significance. This provides a natural transition into the Discussion section.

*E.g. "In summary, our results identified two novel loci associated with AD, which were validated in an independent cohort. These findings were robust to alternative analytical approaches and were further supported by the identification of gene-environment interactions. Collectively, these results provide new insights into the genetic architecture of AD and highlight the importance of replication and robustness checks in genetic research."*

# Discussion - interpret findings in the context of existing knowledge

## Key Tips for Writing the Discussion

* **Recap the Key Findings:** Start by summarizing your main results and how they address the research gap outlined in the introduction. This helps the reader refocus on your central message.
* **Contextualize Your Results:** Discuss how your findings fit into the broader field. Compare them with previous studies, highlighting agreements, contradictions, and novel contributions.
* **Address Limitations Transparently:** Acknowledge any limitations in your study, such as sample size, methodology constraints, or potential biases. Discuss how these limitations might affect your interpretations.
* **Suggest Future Directions:** Based on your findings and limitations, propose future research avenues. This shows that your work has laid the groundwork for further study and invites others to build on your research.
* **Avoid Overreach:** Be cautious not to over-interpret your results. Stick to what your data can robustly support and avoid speculative conclusions that aren’t directly backed by evidence.
* **End on a Strong Note:** Conclude with a statement on the broader impact of your work. Emphasize how your study advances the field and why it is significant.

## 1. Recapitulation of Findings:

Summarize your key findings and how they address the gap identified in the introduction.

## 2. Interpretation and Limitations:

Discuss the implications of your results. Address any limitations in your study and how they might affect the interpretation of your findings.

## 3. Broader Impact and Future Directions:

Explain the broader significance of your findings. Suggest future research directions that could build on your work.

**Data availability**

*E.g. Data X may be accessed on application to the Y. Summary statistics of top variants from all models required to reproduce results are available in Supplementary Tables 1-3 and 7-9. Additional data for replicating analyses are publicly available for annotation (dbSNP build 156).*

**Code availability**

*All code is available on GitHub (link).*

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**Author Contributions**

*E.g. X and Y contributed equally to the study conception and design, analysis and interpretation of data, creation of code for analysis and primary drafting and revision of the manuscript. Z contributed to the study design, interpretation of data or substantial revisions. All remaining authors contributed to data acquisition and/or minor revisions.*

**Competing Interests**

*E.g. X declares competing interest in Y. All other authors declare no competing interests.*

# References

# Figure Legends

**Write clear and concise figure legends that explain the data presented.** Each legend should allow the figure to be understood independently of the main text.

## Key Tips for Creating Figures Based on Edward Tufte’s Principles

* **Simplify and Focus:** Strip away unnecessary elements and focus on the data that directly supports your paper's core message. Avoid clutter—every element in your figure should have a purpose.
* **Enhance Data-Ink Ratio:** Maximize the amount of “data-ink” (the non-redundant ink used to display data) relative to the total ink used in the figure. This means reducing extraneous graphics, gridlines, and labels that do not contribute to understanding the data.
* **Tell a Clear Story:** Arrange your figure to guide the viewer’s eye through the data in a logical sequence that supports your narrative. The order and grouping of elements should reinforce the main points of your paper.
* **Use Consistent and Clear Labeling:** Labels, scales, and legends should be straightforward and consistently applied across all figures. Ensure that the key message of the figure is immediately apparent through effective use of titles and annotations.
* **Integrate with the Text:** Refer to the figure at critical points in your results section to ensure it is part of the flow of your narrative. The figure should complement and enhance the textual description, not just repeat it.
* **Emphasize Comparisons:** Design your figures to facilitate easy comparisons. Use consistent scales and align similar elements side by side to allow the reader to quickly grasp differences and trends.
* **Avoid Chartjunk:** Eliminate decorative elements or any non-essential graphics that don’t contribute to the understanding of your data. Tufte emphasizes that simplicity and clarity are key to effective visual communication.

# Tables

**Organize tables logically and ensure they are fully labeled.** Include a brief description of the content and significance of each table.