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Misconduct in research: The troubling practice of salami slicing

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Among various scientific misconducts like fabrication, falsifications, plagiarism, and salami slicing, salami slicing is very difficult to identify and is also considered less serious misconduct and got less attention as compared to others.¹ In research, salami slicing refers to the improper or unwarranted splitting of data that has the potential to be included in a single meaningful article or the practice of preparing and submitting two or more articles derived from the same data set, typically in the “minimum publishable unit of research” or “least publishable unit” merely with the purpose of increasing the number of publications.^{2,3} It is also defined as publishing or seeking to publish parts of a study in several papers by authors instead of providing the full story in a single paper.⁴ The sliced publications tend to have similar authors, research questions, hypotheses, methodologies, and participant cohorts but may differ by specific outcomes or subgroups.⁵ The concept of salami slicing refers to a variety of deceitful tactics encompassing psychological manipulation, including hacking, confidence tricks, and theft.⁶ Salami slicing takes place when the primary goal of advancing scientific knowledge is overshadowed by a secondary motive of pursuing external benefits.⁵ While the concept of salami slicing in medical research is not new, its implications and the accompanying debate surrounding it have gained prominence with the advancement of time.⁷ There are primarily two reasons why salami slicing occurs: one is unintentional, stemming from a lack of awareness regarding itself and ethical considerations, and the other is intentional and fraudulent. Publications produced through salami-slicing tactics often reflect propaganda rather than genuine contributions to scientific knowledge.⁶

Features of salami slicing:

- I. Each publication tests the same hypothesis
- II. Two or more publications drawn from the same body of data except in some conditions which are described below where multiple publications can be made with a single study
- III. Repeating the same results,⁶ overlapping words particularly data⁸

Reasons for intentional salami slicing:

- IV. The aspirations of authors, particularly in a culture where the pressure is built to publish for tenure, promotion, increase in salary, and career advancement is high⁹
- V. Pressure from grant funders¹⁰
- VI. Pressured to inflate their curriculum vitae through the addition of publications¹¹

Conditions where multiple publications can be made with a single study:

In certain situations, it may not be possible or appropriate to publish data from extensive clinical trials and epidemiological studies simultaneously in a single article either due to different and distinct research questions or having multiple unrelated endpoints. In such cases, presenting significant outcomes of these studies separately is acceptable. However, each paper should explicitly state its hypothesis and be acknowledged as a distinct section of a broader and comprehensive principal study.¹²

Basically, the following two criteria must be met while writing multiple articles from a single large study:

1. It is not possible to consolidate all the findings into a single cohesive article:

When it is impractical to encompass all the outcomes within a single article, it is essential to ensure that the written article is clear, easily understandable, and meaningful. The article should be structured in a way that prevents confusion and frustration among readers.

2. Each article has a distinct purpose

If the articles (a) address different research questions and (b) use different relevant literature.

If it is not feasible to write a single, comprehensive article (meeting criterion 1), but the purposes addressed by the multiple articles are not unique or separate (failing to meet criterion 2), then publishing multiple articles is not acceptable.¹³

It is very difficult for readers, editors, and reviewers to identify it as there is no software and clear-cut approach to detect it. However, in rare circumstances, editors and reviewers could suspect it.¹⁴ Although there are no definitive methods to identify it, manuscripts that are suspected of being salami publications often exhibit similarities in sample size, hypothesis, research methodology, and results, and frequently have the same authors.¹⁴ Sometimes the objectives, hypothesis, and results may look different at first glance, but when you go through deeper through the articles you may find similarities in the sliced articles.

Salami slicing may lead to self-plagiarism. Self-plagiarism is also known as text recycling¹⁵ or auto-plagiarism.⁷ Self-plagiarism refers to the act of incorporating one's own data or previously written work in a 'new' publication without providing proper acknowledgment or disclosure that the data set or written work has been utilized or published elsewhere.¹⁵ But no clear statement of how much text

using causes self-plagiarism. Samuelson in 1994 implies that "as a rule of thumb if one reuses no more than 30% of one's prose in another article, that's ok".¹⁶ Almost after a decade in 2007, Bretag et al.¹⁷ considered self-plagiarism as "the article which contained 10% or more of any one of the author's previous publications without appropriate attribution".

Nowadays some journals clearly state plagiarism in their author guidelines while others do not mention it. Those who had mentioned are also not checking properly before publications.¹⁵

Issues with salami slicing:

- I. The practice exaggerates research findings, potentially threatens and skews the evidence base for care (e.g. systematic reviews) i.e. reduces the quality.⁹
- II. Readers may not understand the importance of the work if the results are published in several papers.
- III. Readers who access only one of the papers may misinterpret the findings.¹⁸
- IV. Takes up valuable journal space and makes further demands upon and wastes the resources of editorial teams, peer reviewers, readers, and libraries.⁹
- V. Misunderstanding or misrepresentation of evidence: When evidence is distorted, it creates flawed guidelines for clinical practice, resulting in patient care that is, at best, less than ideal and, at worst, potentially harmful.
- VI. Unethical practice.
- VII. Decreases motivation to pursue large-scale, methodologically rigorous studies that confirm and expand on preliminary findings.
- VIII. Discovery of salami publication may damage the author's reputation and negatively impact their future career, especially if duplicitous attempts were made to conceal this malpractice.⁵

How to prevent or decrease salami-slicing:

It can be prevented by taking action from the author in the first phase followed by journal/editors and peer reviewers.

Author's Role:

An author should be very clear and cautious starting from the research proposal writing. All the processes starting from the research hypothesis, aims/objectives, and data collection technique should be clearly written and adhered to the protocol during the data collection and analysis technique. No data dredging should be done.

Recommendation for authors:

Try to publish a single research paper from a single study unless it is a large one.¹⁴ Author should focus on quality research rather than quantity.⁵

A sliced article derived from previously published data should:

- Authors must alert the editor whenever two or more papers based on a subset of a larger data set have been published or are under review;¹⁹
- Provide explanations as to why multiple articles are required;⁹
- Appropriately cite the previously published article and provide all the references;
- Make a clear declaration that it is an integral component of a previously published study;
- Indicate all the additional knowledge incorporated in the subsequent manuscript;
- Avoid duplicating any of the data presented in the preceding article.
- Give a detailed explanation to the journal's editor on all the above-mentioned points because transparency is crucial.¹⁴

Peer Reviewers:

Reviewers should be aware of it and look at the manuscript cautiously, if any fishy is found then they should alert the editors.⁴

Journal's role/Editors:

- Journal should make criteria while submitting the manuscript and must mention the potential problems with plagiarism, auto-plagiarism, and salami-slicing in guidelines.⁷
- They are in the array of authority to check for the quality of evidence to deliver valid and correct information. Therefore all the editors must be fully cautious regarding salami slicing and prepare the appropriate guidelines for inspecting and handling it.
- To avoid self-plagiarism/text recycling all the journals should first look for plagiarism using valid software of plagiarism checker.
- Should clearly state the punishment for salami-slicing.⁴

Even within the journals that explicitly addressed salami publication, the specific guidelines have frequently been

ambiguously defined, lacking mention of the repercussions for non-compliance. A loosely defined policy statement, such as "it is crucial to refrain from fragmenting a single study into multiple parts for the purpose of increasing submissions," clearly lacks practical feasibility.²⁰

The International Committee of Medical Journal Editors (ICMJE) has established strict criteria to address the unethical practice of "salami slicing" in scientific research. The ICMJE guidelines aim to ensure that each publication represents a unique and substantial contribution to the scientific community. According to the ICMJE, researchers should refrain from dividing their research into multiple publications if the information can be adequately presented in a single manuscript. These criteria promote the integrity and transparency of research, discouraging the unnecessary proliferation of publications based on the same dataset. By adhering to the ICMJE guidelines, researchers contribute to the dissemination of valuable knowledge while maintaining ethical standards in scientific publishing.²¹

There is no clear idea about detection and if detected then no certainty of punishment, ranging from no action to rejection^{7,22} and retraction of articles and inform to author institutions²³ and blacklisting authors⁷. If it is detected earlier before publication editor can reject it. If the authors managed to publish their articles then editors are obliged to publish public retractions, which are expected to have consequences for all the authors involved.²³ Therefore, it is always better to think twice and consult with seniors, research expertise persons, and editors before making slices of the main article. Authors are encouraged to publish quality articles rather than quantity.

Overall, salami slicing is a deceptive practice that impedes the integrity of scientific research and can lead to public mistrust in academia. Researchers, institutions, and the scientific community (editors, journals, reviewers) as a whole have a crucial responsibility to uphold ethical conduct and prioritize the quality and significance of research over mere quantity.

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