Letter to Editor

A Critical Choice in Data Presentation: "Should Standard Deviation (SD) or Standard Error of the Mean (SEM) be Given?"

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Dear Editor

In scientific studies conducted in the fields of veterinary, agricultural, and health sciences, the manner of data presentation is of paramount importance for the accurate interpretation of findings and the transparent communication of information. In this context, the question of whether to report the standard deviation (SD) or the standard error of the mean (SEM) as a measure of variability alongside the mean has led to persistent confusion and erroneous practices in the literature. This letter aims to clarify the functional differences between these two fundamental statistical measures and to emphasize correct usage practices in the interest of upholding scientific integrity.

The fundamental distinction lies in what these two measures represent. The standard deviation (SD) is a descriptive statistic that indicates how much individual data points in a sample deviate from that sample's mean. Its purpose is to reveal the internal spread or biological variability of the data. In contrast, the standard error of the mean (SEM) is an inferential statistic that indicates how precisely the sample mean estimates the true population mean (SEM = SD/√n). Consequently, these two concepts answer different scientific questions and cannot be used interchangeably [1].

However, it is frequently observed in the scientific literature that SEM is incorrectly used to mask the true variability of the data. Because SEM decreases as the sample size (n) increases, it makes error bars appear narrower, creating a misleading impression that the data are less variable and more precise than they actually are [2]. This situation can cause the reader to misjudge the overlap between groups and to exaggerate the significance of the findings. One study highlighted how this deceptive perception of precision adversely affects scientific communication and urged researchers to make a conscious choice in this regard [3]. Similarly, an analysis of animal experiments emphasized that the use of SEM does not reflect true biological variation and that SD should be preferred, as required by the principle of scientific transparency [4].

The scientific consensus on this issue is also reflected in the publication guidelines of prestigious journals. For instance, a study in the field of veterinary medicine has stated that adopting the mean ± SD format for presenting

experimental results should be a standard for data transparency and reproducibility [5]. Likewise, articles published in prominent journals like the BMJ have repeatedly warned against the potential of SEM to conceal variability [1,6].

In conclusion, when presenting their data, researchers should ask themselves the following fundamental question: Is my goal to demonstrate the spread and heterogeneity of the data within my sample, or is it to report the precision with which my sample mean estimates the population mean? If the purpose is descriptive -that is, to show the distribution of the data itself- then the correct and transparent choice is unequivocally the standard deviation (SD). The standard error of the mean (SEM) is a technical component used in inferential statistics for calculating confidence intervals and should only be reported in cases where its purpose is explicitly defined in the text.

In accordance with the principles of transparency and integrity that form the foundation of scientific publishing, authors, reviewers, and editors must be more meticulous regarding this critical distinction. This is an indispensable step for the credibility of science and the correct interpretation of findings.

Sincerely.

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