Standard Error as Standard?

To the Editor:

I am concerned about errors in simple statistical concepts in articles recently published in Circulation. First, I worry about the widespread use of the standard error of mean (SEM) to describe the variability of numerical data. Specifically, SEM was used in 30% of the clinical investigations and reports and in 76% of the basic science reports analyzed for this purpose (the first 50 clinical investigations and the first 50 basic science reports in Circulation for the year 2001; restricted to studies reporting numerical data). So, at least in basic science reports, SEM has become standard. However, as discussed previously, SEM does not describe the variability of the sample but the precision of the sample mean. Thus, the use of SEM is rarely justified. Many authors probably use SEM because it is smaller than the standard deviation (SD). Using SEM, however, creates the illusion that the variability is smaller than it actually is. Tolerating SEM, as currently happens, also creates an unnecessary pressure for future authors to wrongly use SEM to not be among those authors who apparently show highly variable data.

Second, I worry about the use of the mean to describe the location of data without checking whether the data follow at least approximately a normal distribution. Specifically, in only 7% (clinical) and 4% (basic science) of the articles analyzed, authors were careful enough to apply a test for normality. As a consequence, the mean was probably used incorrectly in 26% and 23% of the articles, respectively, to describe clearly skewed data or ordinal data (rank or score). Third, the minority of authors (only 17% and 2%, respectively) determine the sample size that is necessary to demonstrate a difference with an adequate statistical power. However, the determination of the sample size is crucial to all studies interested in differences or treatment effects. This is particularly true for negative studies to make sure that the difference did not go undetected because the sample size was too small.

Maybe it is time to offer authors some statistical guidelines analogous to the instruction to authors. These guidelines could include: (1) do not use SEM to describe the variability of data; (2) calculate the minimal sample size necessary to demonstrate a certain difference of the variable(s) of interest; and (3) check your data for normal distribution before applying the mean (and standard deviation, t test, ANOVA, or other parametric procedures).

Christian E. Zaugg, PhD
University Hospital,
Department of Research
Hebelstr. 20
ZLF 319
4031 Basel, Switzerland
Christian.Zaugg@unibas.ch

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