SHOULD GRAPHS OF RISK OR RATE RATIOS BE PLOTTED ON A LOG SCALE?

Editors to ban graphs of ratio measures that do not employ a log scale (2). The policy of the *American Journal of Epidemiology* nearly achieves this ban; the Instructions to Authors state, “When plotting relative measures of effect (e.g., relative risks, relative odds), a logarithmic scale must be used unless there is a compelling reason to use an arithmetic scale” (http://aje.oxfordjournals.org/).

The conventional view presumably stems from the principle that the null effect of 1.0 divides the scale into 2 regions that are equivalent in terms of strength of association. For every point above 1.0, there is a corresponding inverse point below 1.0. Yet, visually, on an arithmetic scale the preventive effects (those below the null) are squeezed into a small finite region from 0 to 1, whereas the causative effects stretch across the infinite region above 1. When effects are plotted on a log scale, there is symmetry between preventive and causative effects, addressing this apparent visual imbalance.

So can there be a compelling reason for an arithmetic scale? Even when ratio measures are employed, the corresponding differences in risks or rates hold more relevant information about the burden of disease caused or prevented in a population (3). Furthermore, risk difference measures are central to personal decision-making about comparative risks—for example, in the clinical setting. Thus, one could argue that risk or rate differences have primacy over ratio measures for many of the key applications of epidemiologic research. Plotting ratio measures on a logarithmic scale, however, does not scale effects according to risk or rate differences, whereas the arithmetic scale does. Thus, a relative risk of 10 is equivalent to a 900% increase in disease risk, whereas the inverse of 0.1 is equivalent to a 90% decrease in disease risk. Imagine an unexposed population of 1,000 people in which 10 cases occur over a year. Then imagine 2 exposures, one a preventive exposure with a relative risk of 0.1 and the other a cause with a relative risk of 10. If the same population were exposed (counterfactually) to each of the 2 exposures, the first would prevent 9 people from developing disease, and the second would cause 90 to get disease. On a logarithmic scale, these 2 exposure effects look the same, apart from direction. On an arithmetic scale, the former is only one-tenth of the latter, corresponding to the disparate numbers of cases prevented or caused by the 2 exposures. Consequently, the arithmetic scale will often be less visually misleading than the log scale, even when plotting ratio measures, because the arithmetic scale preserves proportionality with risk or rate differences. Therefore, we believe that the graphing policy of this journal and the attempt to ban ratio graphs with an arithmetic scale are inappropriate.

ACKNOWLEDGMENTS

Conflict of interest: none declared.

REFERENCES


Kenneth J. Rothman¹,², Lauren A. Wise²,³, and Elizabeth E. Hatch² (e-mail: krothman@rti.org)

¹ RTI Health Solutions, RTI International, Research Triangle Park, NC 27709
² Department of Epidemiology, School of Public Health, Boston University, Boston, MA 02215
³ Slone Epidemiology Center, Boston University, Boston, MA 02215

DOI: 10.1093/aje/kwr156; Advance Access publication 29 June, 2011