



# A Picture Tells 1000 Words (but Most Results Graphs Do Not)

## 21 Alternatives to Simple Bar and Line Graphs

Jay Hertel, PhD, ATC<sup>a,b,\*</sup>

### KEYWORDS

• Data visualization • Graphs • Plots • Scientific writing

### KEY POINTS

- Bar graphs and line graphs that plot group means and SDs do not provide readers with a thorough understanding of the distribution of individual participant measures.
- Investigators should consider alternatives to bar graphs and line graphs, such as dot plots or box and whisker plots, to visualize individual data points for studies with smaller sample sizes, and violin plots, to display full data distributions in studies with large sample sizes.
- Novel forms of graphs that can illustrate magnitudes of difference, strength of relationships, or multivariate relationships between measures should be considered when presenting research results.

### INTRODUCTION

The adage, “a picture tells 1000 words,” is often used by experienced investigators when mentoring students, residents, fellows, and other junior colleagues on the intricacies of scientific writing. Graphical representation of research results is often a more effective way to convey findings than text or tables. One wise scholar once told me the ultimate results section of an original research article should contain just 3 words: “see Figure 1.” Alas, many investigators default to simple bar graphs or line graphs that are easy to make in common software packages but often have shortcomings when it comes to thoroughly illustrating research findings. When this happens, results figures may not be “worth 1000 words” and, more critically, they may not be a holistic visual representation of the study results.

---

Disclosure Statement: The author has no conflicts to disclose.

<sup>a</sup> Department of Kinesiology, University of Virginia, PO Box 400407, Charlottesville, VA 22904-4407, USA; <sup>b</sup> Department of Orthopaedic Surgery, University of Virginia, PO Box 800159, Charlottesville, VA 22908, USA

\* Department of Kinesiology, University of Virginia, PO Box 400407, Charlottesville, VA 22904-4407.

E-mail address: [Jhertel@virginia.edu](mailto:Jhertel@virginia.edu)

Clin Sports Med 37 (2018) 441–462  
<https://doi.org/10.1016/j.csm.2018.04.001>

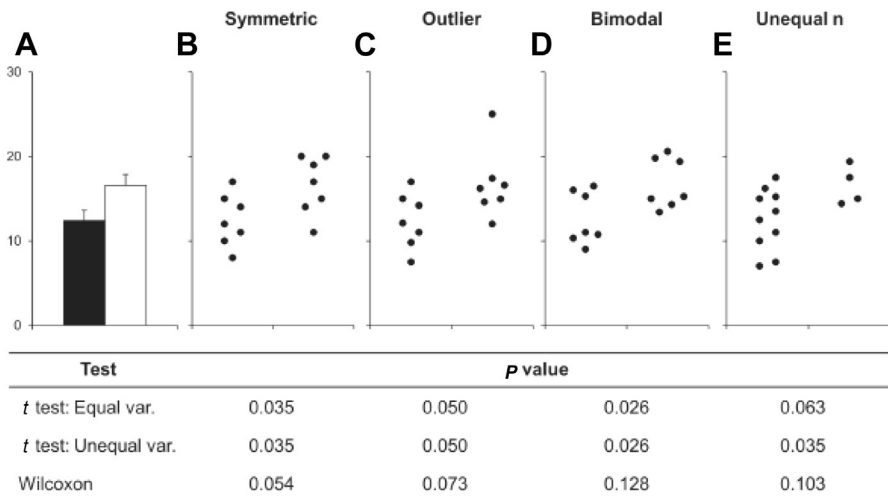
[sportsmed.theclinics.com](http://sportsmed.theclinics.com)

0278-5919/18/© 2018 Elsevier Inc. All rights reserved.

The primary criticism of bar graphs and line graphs is that drastically different data sets can produce identical mean and SD (or SE) values. This phenomenon was first described by Anscombe<sup>1</sup> in 1973 and has more recently been championed in the life sciences by Weissgerber and colleagues.<sup>2</sup> The primary concern is that differences in group means may be driven by large differences from a small subset of research participants rather than by consistent differences across a majority of participants (Fig. 1). A related concern is that the depiction of data distribution with the group SD (or SE) may be a misleading representation of the distribution of a data set. These concerns have led to a call for investigators to explore alternative ways of illustrating research results with a particular emphasis on graphing the values obtained from individual participants in an effort to allow readers to fully comprehend relationships and trends in a data set.<sup>2-11</sup>

Another concern is that graphs of single, or a select handful of, outcome measures fail to describe the multifactorial relationships that often exist between variables.<sup>7</sup> Investigators frequently limit graphs to only 1 or 2 axes or dimensions, thus placing constraints on how data and relationships can be illustrated and interpreted. Advances in data visualization techniques should be used by investigators in an effort to best represent their research findings to readers. Clinicians and researchers are constantly combing the literature for novel developments in clinical and laboratory techniques; likewise, advances should be sought in methods to visualize research results.

The aim of this article is neither to provide a treatise on statistical distributions and analysis techniques nor to provide a tutorial on the step-by-step procedures of how to construct different types of graphs in specific software programs. Instead, the aim is to provide readers with a (nonexhaustive) set of alternatives to simple bar graphs and line graphs in an effort to spur thought and inspiration about the optimal way to illustrate results.



**Fig. 1.** Schematic of 4 data sets with nearly identical group means and SDs (A) but very different distributions (B–E). The dot plots provide readers with more information on trends in the data set than the bar graph. var, variances. (From Weissgerber TL, Milic NM, Winham SJ, et al. Beyond bar and line graphs: time for a new data presentation paradigm. *PLoS Biol* 2015;13(4):e1002128; with permission.)

Download English Version:

<https://daneshyari.com/en/article/8797917>

Download Persian Version:

<https://daneshyari.com/article/8797917>

[Daneshyari.com](https://daneshyari.com)