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Is what you see all there is?

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'Many readers will only look at your display items without reading the main text of your manuscript. Therefore, ensure your display items can stand alone from the text and communicate clearly your most significant results' (Springer Website on 'Writing a Journal Article') [1].

Visual aids have become the major instrument to convey the key findings of scientific studies. With less time to read original articles in detail, the focus of the reader is often directed at the abstract and the figures that accompany a scientific study. Journals have long recognized this trend and have done a great job in improving illustrations that are used to help the reader in understanding complex findings. It is, therefore, of utmost

importance that figures relay the major findings of a study in a way that is unbiased and transparent. Unfortunately, many contemporary illustrations present data in a misleading way. This applies, in particular, to a very common way of displaying longitudinal follow-up (FU) data in stacked percentage columns that add up to 100% but omit censored and mortality data.

The first example to illustrate this problem was taken from a study that presented the echocardiographic outcomes of the MitraClip procedure in 452 patients (Fig. 1A). The text of the corresponding paper provided the reader with information on an estimated 1-year mortality of 15% (1-year FU data were only available in 82%) and the fact that 1-year FU echo with paired

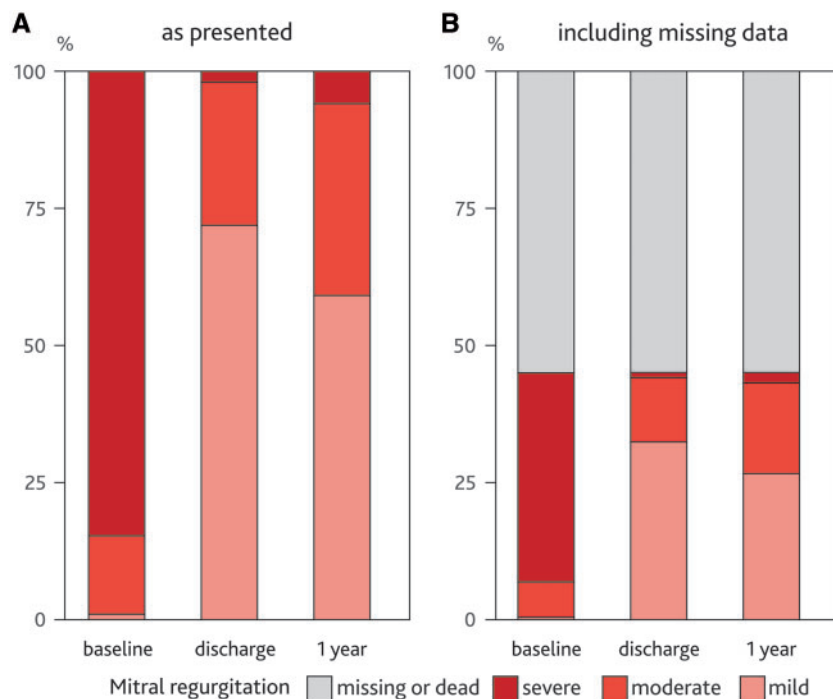


Figure 1: (A) Recreated image of Fig. 3 from [2], a stacked column chart with percentage as scale [2]. This presentation implies at the first glance a complete follow-up. (B) The recreated chart including missing observations. Here, the potential for selection bias and proportion of this selected cohort in relation to the complete study cohort become obvious.

data were available for 264 patients (54% of the total population; however, in the respective table, only 251 patients were listed). With regard to the level of mitral regurgitation (MR) in figure 3 of the original paper, data from only 203 echoes were shown in stacked percentage columns. Although a paired analysis is described in the Methods section for echocardiographic data, sample sizes in the Methods section and the central illustration were inconsistent. The legend accompanying the figure did not mention whether the presented columns represented paired or unpaired data. Hence, the echocardiographic data were presented in such a way that a complete FU and stable results over time with regard to the recurrence of MR were implied [2].

Under the assumption that the figure was constructed based on the echo results of 203 of 452 patients (be it paired or unpaired), missing data for the rate of death or lack of FU echo added up to 55.1%. Based on this finding, the 100% column can be redrawn as shown in Fig. 1B. Although this figure essentially displays the same information with regard to the severity of MR

during FU, the reader immediately becomes aware of the large degree of uncertainty that results from the fact that information for more than half of the study population is lacking. Moreover, the potential selection bias becomes immediately clear to the reader.

As under-reporting of poor outcomes is a well-known human weakness, it is possible that in a large cohort with incomplete outcome reporting, MR recurrence in a number of patients remains undetected. This could potentially lead to a significant reporting bias for the rate of recurrent MR. The authors stated in the text that '... the compliant centers provided nearly complete pair of echocardiographic data ...'. It is unclear from the legend whether the columns in the original paper represented paired echo data or not. Hence, it is possible that the reader effectively looks at totally different cohorts for different time points. It is also unknown how many 'compliant centres' there were in relation to 'non-compliant centres'. This introduces another level of potential bias and uncertainty. Patients with recurrence of MR

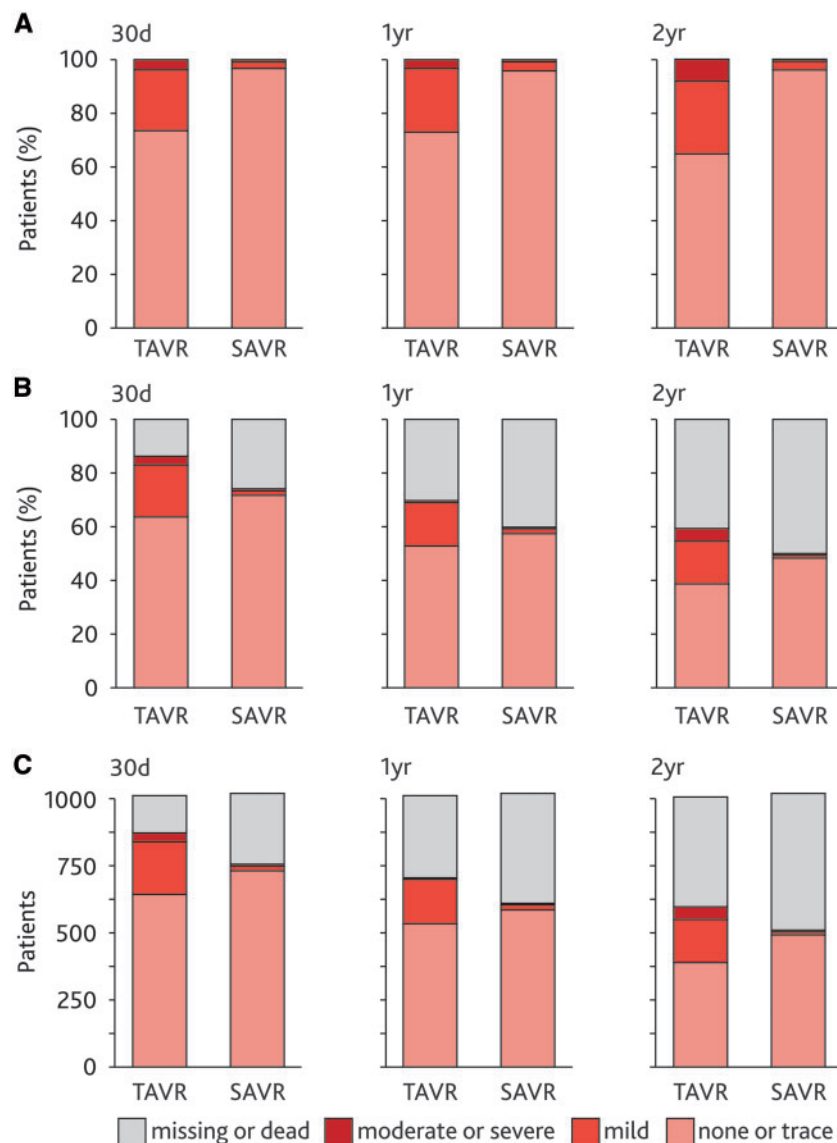


Figure 2: (A) Recreated image of the original Fig. 3B of the PARTNER 2a trial publication [3]. This presentation implies a complete follow-up, an equal cohort size and stable results over time. (B) The percentage scale is retained but incorporates the missing or dead patients into the time course. (C) The percentage scale is not shown but the actual numbers are displayed. SAVR: surgical aortic valve replacement; TAVR: transcatheter aortic valve replacement.

after a mitral repair procedure have a worse outcome and impaired survival. If unpaired data are presented, a paradoxical decrease in the rate of patients with severe MR at FU may simply result from increased mortality. In contrast, stacked percentage columns without accounting for missing data could paradoxically imply a stable or even an improved repair result over time.

Another example is a study taken from the *New England Journal of Medicine*, which presented the 2-year data for paravalvular leakage (PVL) after transcatheter aortic valve replacement (TAVR) from the PARTNER 2a trial [3]. Here, the reader was provided with a stacked percentage column (Fig. 2A) that did not provide information on the missing data of 40.6% of the patients—as a result of death in 16.4% and missing echocardiographic FU data in 24.2% (echo at the 2-year FU was available in only 1014 of 2032 patients). If one would redraw the column according to these numbers (Fig. 2B and C), the reader is not only provided with more information but is also made aware of the remaining level of uncertainty due to missing data at once.

These 2 examples represent a plethora of similar figures that currently fill our journals. The trend of selectively displaying data deserves some attention. This is particularly crucial if these figures imply that cohort results improve over time, as illustrated in this following example. Suppose a study on transcatheter aortic valve implantation reports a relative decrease in moderate or severe PVL over time in a stacked bar chart. As moderate or severe PVL has an impact on mortality, a decrease in severe or moderate PVL over time illustrated in a stacked percentage column may simply be due to an increased mortality in this cohort.

It is suggested that Editorial Boards should provide guidance and standards on the type of data and the way these are reported in figures. This would ideally entail an obligatory declaration of missing data and death in figures and key illustrations, especially when there is a large amount of missing data. In addition, a clear indication if paired or unpaired data are presented is necessary (unpaired data should not be presented at all). This would help to eliminate a potential reporting bias and highlight the level of uncertainty. This does not involve much, other than to include mortality and missing data in stacked percentage columns and to provide a clear statement in the accompanying legend as to whether paired or unpaired data have been presented. Only then can a reader absorb as much unbiased information in as little time as possible.

Conflict of interest: none declared.

REFERENCES

- [1] <https://www.springer.com/gp/authors-editors/authorandreviewertutorials/writing-a-journal-manuscript/figures-and-tables/10285530> (3 March 2018, date last accessed).
- [2] Pighi M, Estevez-Loureiro R, Maisano F, Ussia GP, Dall'Ara G, Franzen O *et al*. Immediate and 12-month outcomes of ischemic versus nonischemic functional mitral regurgitation in patients treated with MitraClip (from the 2011 to 2012 Pilot Sentinel Registry of percutaneous edge-to-edge mitral valve repair of the European Society of Cardiology). *Am J Cardiol* 2017;119:630–7.
- [3] Leon MB, Smith CR, Mack MJ, Makkar RR, Svensson LG, Kodali SK *et al*. PARTNER 2 Investigators. Transcatheter or surgical aortic-valve replacement in intermediate-risk patients. *N Engl J Med* 2016;374:1609–20.