

P values in standard form

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In the first article [1] of the statistics bites series it was stated that ideally, exact P values should be reported, for example  $P = 0.039$ , rather than inequalities such as ' $P < 0.05$ ' or ' $P > 0.05$ '. Information presented this way enables clinicians to make their own interpretations [1]. It was also recommended that confidence intervals be reported in addition to P values, as they are more informative [1, 2].

There are guidelines produced by journals on how many things in an article should be written, P values are no exception. The International Committee of Medical Journal Editors (ICMJE) [3] advises that they should not be solely relied upon and the American Medical Association (AMA) manual of style [4] states that when P values are reported they should be written to two decimal places, regardless of whether they are significant. Sterne, [5] suggested that making it more precise helped the researcher make the appropriate decision. However, Prayle [6] reported the following P values;  $P = 2.6 \times 10^{-9}$ ,  $P = 4.4 \times 10^{-11}$ ,  $P = 2.2 \times 10^{-16}$ . The authors [6] have chosen to report exact P values, which will allow readers to interpret how important they are. Clearly, these are not written in the usual manner, normal form, but they are reported in a method known as standard form or scientific notation [7]. This leads to two problems, firstly, how should these numbers be interpreted, and secondly why are P values being reported this way?

Standard form is a method used to report either very large or very small numbers easily [7]. A number is said to be in scientific or standard form when it is written as a number greater than 1 and less than 10 ( $1 < a < 10$ ) multiplied by a power of 10 [8]. Any number could be written in standard form, but often it is not necessary. For example, 0.05 could be written as  $5 \times 10^{-2}$  or 6,124 could be written as  $6.124 \times 10^3$ . So, choosing the first of the P values reported by Prayle [6],  $2.6 \times 10^{-9}$ , it can be written in normal form as 0.0000000026. However, this takes up much more space, and all of the zeros does make it difficult to read and interpret. It is simply more convenient to write it in standard form [8]. When standard form is used, it should also be noted that positive powers indicate that the decimal point should be moved a number of places to the right, and negative powers indicate that the decimal point should be moved a number of places to the left. So,  $2.34 \times 10^3$  becomes 2340, while  $5 \times 10^{-2}$  becomes 0.05.

Clearly, reporting P values correctly is considered important by Journal editors. In some designs such as meta-analysis, not reporting the exact values is considered to be incomplete reporting [4]. What specific style manuals state as to the reporting of P values has already been mentioned. However, the online version of the AMA manual of style [9] provides some direction as to the use of standard form and scientific notation when reporting statistical results. The new online edition emphasises it may be important to express P values to more significant figures. It then offers the example of genome research where P values could be very small numbers. Lastly, it advises editors retain the values as authors present them, even if they are written in standard form [9].

Being able to interpret study findings is important and P values are part of the interpretation. Reporting P values in standard form is becoming an accepted method. Readers need to be able to understand the information that is presented before them.

## References

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