Reviewer’s report

Title: Is There a Role for Expectation Maximization Imputation in Addressing Missing Data in Research Using WOMAC Questionnaire? Comparison to the Standard Mean Approach and a Tutorial

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Reviewer: Tim Spelman

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Sample attrition and missing data are common characteristics of many real-life studies. Although the first response to expected attrition should rightly involve maximizing response rates within the logistic and financial constraints of an investigation, there is a clear need for researchers to be informed on available and suitable statistical contingencies for dealing with missing data.

This paper is a well-written, concisely presented addition to the ongoing development and refinement of probabilistic modelling, particularly in the field of quality of life orthopaedics where there is a paucity of formal testing of imputation techniques. Providing an alternative simulation at a higher rate of attrition expands the generalisability of the paper and the provision of a tutorial is an excellent idea.

Discretionary revisions

1) Whilst I have no argument with the mechanics of what the authors have undertaken, I have reservations regarding the assumptions made. The results and conclusions here are only as good as these assumptions. Expectation maximization works on the assumption that the pattern of attrition is missing at random (i.e. the probability that subscale data is missing is not related to the outcome of interest). With percent missing ranging from 2.9% to 14.5% for the various WOMAC items I would be surprised if the pattern of attrition here is genuinely missing at random, as has been assumed in order to demonstrate the benefits of EM. To be fair the authors have cited this as a potential limitation, however if the context here is the use of EM in quality of life research such as WOMAC, with it’s reliance upon Likert scales, I would suspect data attrition would rarely be random. As such even though the authors have clearly demonstrated the advantages of EM I’m wondering just how broadly applicable EM could be in this type of research. Given a random pattern of attrition is one of the fundamental assumptions underlying EM it would be very useful to include a brief guide to assessing the pattern of missing data. This would greatly assist researchers in the process of deciding whether EM is a suitable contingency for dealing with missing data and avoid erroneous or misguided applications of EM.

2) There is a similar issue here with the assumption that the study data follows a multivariate normal distribution, which the authors point out is rarely the case with
Likert scale items. Did the authors consider testing non-normal EM algorithms? Although computationally more difficult, these would arguably be more realistic in the context of quality of life score data.

**Level of interest:** An article whose findings are important to those with closely related research interests

**Quality of written English:** Acceptable

**Statistical review:** Yes, and I have assessed the statistics in my report.

**Declaration of competing interests:**

I declare that I have no competing interests