

Statistical methods for the meta-analysis of reliability estimates reported in biological variability studies

Kostas Tryposkiadis^{1,2}, Jac Dinnes^{1,2}, Alice Sitch^{1,2}, Malcolm Price^{1,2}, Jon Deeks^{1,2}

¹ *Test Evaluation Research Group, Institute of Applied Health Research, University of Birmingham, Edgbaston, Birmingham B15 2TT, United Kingdom*

² *NIHR Birmingham Biomedical Research Centre, University Hospitals Birmingham NHS Foundation Trust and University of Birmingham, UK*

Background: Biomarkers and tests are often used to diagnose or monitor a condition, or function as outcomes in clinical trials. Key questions arise on the measurement properties of biomarkers when used for such purposes, as measurements are subject to variability, such as analytical, biological, and intra/inter-rater. Methods for meta-analysis are required in order to synthesize results in systematic reviews from individual studies assessing the reliability of biomarkers or tests.

Aim: To review the current state of methods used for meta-analysis of reliability estimates reported in biological variability studies.

Methods: Published systematic reviews reporting the reliability of any test measuring presence or progress of any pathological condition were identified by searches of Medline and Embase from 2010-19. Detailed information was extracted regarding: the experimental test; the condition; the review methodology including the literature search, approach to quality assessment, the statistical methodology used to examine reliability; and the results each study reported.

Results: 228 reviews were identified, with only 23 performing a meta-analysis of the reported estimates. The most common meta-analytical estimate was the intra class correlation (61%), with 3 studies using the Fisher's Z transformation to account for the non-normal distribution of ICC data. Other reported statistics include the Kappa coefficient, standard error of measurement, coefficient of variation, limits of agreement, repeatability coefficients, linear regression based R^2 , and correlation coefficients. The majority of studies (78%) constructed forest plots and used random effects models to account for differences between studies. One study used a fixed effects model, while the method was not specified in 2 studies. Other approaches include pooling the data and performing linear regression, Bland-Altman analysis on the test-retest values, and describing the distribution of the study results.

Conclusion:

Any limitations in the statistical estimates and meta-analysis methods used to date will be explored and presented.

Keywords

Biomarker, reliability, meta-analysis