

Measurement in Health and Disease

Exercise: Measurement error

The following is the abstract from a paper. Read the abstract and answer the questions. Note that 'standard error of measurement' is another name for 'within subject standard deviation'.

Abstract

Background: Although stress radiography has been recommended for quantifying posterior tibial displacement in knees with posterior cruciate ligament insufficiency, the intratester reliability and intertester reliability of this measurement method have not been evaluated.

Hypothesis: Stress radiography is a reproducible measurement method in the assessment of posterior knee laxity in patients with posterior cruciate ligament lesions.

Study Design: Cohort study (diagnosis); Level of evidence, 2.

Methods: Stress radiographs of 787 patients with suspected posterior cruciate ligament lesions taken using the Telos device were evaluated independently by 3 testers: 2 of the testers were clinically experienced in the evaluation of stress radiographs, and 1 tester was a novice tester. Change in mean, standard error of measurement with calculated confidence intervals, and intraclass correlation coefficients were determined to assess intratester and intertester reliability.

Results: There was no significant intratester change in mean. Intratester standard error of measurement was 1.03 mm; 95% confidence intervals were ± 2.02 mm for a single measurement and ± 2.86 mm for a change in measurement. The intratester intraclass correlation coefficient was 0.95. Intertester reliability revealed a significant change in mean between the experienced testers and the novice tester ($P < .001$). There was no substantial difference for the standard error of measurement of each tester. The mean intertester standard error of measurement was 1.41 mm; 95% confidence intervals were ± 2.77 mm for a single measurement and ± 3.91 mm for a change in measurement. The intertester intraclass correlation coefficient was 0.91.

Conclusion: Stress radiography was found to be a measurement method with a useful reliability for evaluation of posterior laxity in patients with posterior cruciate ligament lesions. The reproducibility of stress radiography may be influenced by multiple variables, and standardized methods are needed to minimize measurement error.

Source: Schulz MS, Russe K, Lampakis G, Strobel MJ. (2005) Reliability of stress radiography for evaluation of posterior knee laxity. *American Journal of Sports Medicine* **33**, 502-506.

Questions about the abstract

1. The authors give three statistics for the measurement error: 'standard error of measurement', '95% confidence interval for a single measurement' and '95% confidence interval for a change in measurement'. What do each of these mean and how can they be interpreted for the intratester results?
2. What is the 'intraclass correlation coefficient' and how can we interpret an ICC = 0.95?
3. How are 'standard error of measurement' and 'intraclass correlation coefficient' related?

The Abstract of a paper contained the following:

Vitamin E uptake after supplementation varies widely in the healthy population, and preliminary studies have indicated that individual responses are relatively stable over periods in excess of 1 year. We examined the repeatability of both baseline plasma alpha-tocopherol and urinary alpha-tocopherol metabolite concentrations, as well as individual responses of these parameters after vitamin E supplementation. In the first study, 65 subjects (33 males, 32 females, aged 30.7 ± 7.4 years) provided three plasma and urine samples for alpha-tocopherol and metabolite analysis with each collection separated by at least 2 weeks. Plasma alpha-tocopherol concentrations were found to be highly repeatable over this short interval (intraclass correlation coefficient [ICC] = 0.85), although the association deteriorated once values were corrected for plasma cholesterol (ICC = 0.64).

Source: Kelly FJ, Lee R, Mudway IS. (2004) Inter- and intra-individual vitamin E uptake in healthy subjects is highly repeatable across a wide supplementation dose range. *Annals of the New York Academy of Sciences* **1031**, 22-39.

4. What do they mean by 'values were corrected for plasma cholesterol'?
5. Why did the ICC go down once values were corrected for plasma cholesterol?