Using Statistical Simulation to Visualize and Quantify Day-to-Day Measurement Error in Indirect Calorimetry

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Indirect calorimetry and oxygen consumption (VO_2) is an accepted tool in exercise science. A common study design entails VO_2 testing before and after a training, nutrition or equipment intervention. Changes in metabolic cost as small as 3% have been suggested to be "significant"; however, it is unknown if small variations in VO_2 are actually able to be detected by indirect calorimetry. **PURPOSE:** Use a custom statistical simulation, specific to the ParvoMedics TrueOne 2400, which probabilistically determines if two day-to-day measurements in VO_2 are different. Specifically, the simulation will determine the probability that a VO_2 of 3.66 L/min is different from 3.77 L/min (3% difference). **METHODS:** Day-to-day repeatability data and standard error for the ParvoMedics TrueOne 2400 were extracted across a continuum of volumes from previous validation study (Crouter et al., 2006). Based on this data, multivariate normal distributions (n=2000) were simulated for the hypothetical VO_2 data. The two multivariate normal distributions for 3.66 L/min and 3.77 L/min were assessed with a fuzzy clustering analysis and the normalized Dunn's partition coefficient was calculated to determine the probability that the measures are separate. **RESULTS:** Standardized plots of simulated data and assigned clusters (blue lines) are in the figure. The normalized Dunn's coefficient was 0.62, indicating a 62% probability that the two measurements are different. **CONCLUSION:** Claims that interventions can cause measurable changes in oxygen consumption need to be re-examined. The present simulation suggests that the measurement error of indirect calorimetry is too great to make definitive claims about small changes in VO_2 in response to an intervention.