Breezing Metabolism Tracker Validation*

Background: Knowledge of whole body metabolic parameters of energy balance has value in weight management and general understanding of metabolic health. Resting energy expenditure (REE) makes up as much as 75% of total energy expenditure (TEE), with merely 15 – 30% from physical activity (PA), and about ~10% from diet-induced thermogenesis (DIT) [1, 2]. All else being equal, if a significant decrease or increase in REE occurs, maintaining the same caloric intake will cause, respectively, an increase or decrease of body mass (see Breezing Technical Note 1). The gold standard assessment of REE requires the Douglas Bag Method (a form of indirect calorimetry), which is an expensive, cumbersome procedure wherein continuously exhaled gases are collected and analyzed by industry-standard O_2 and CO_2 sensors/detectors. The user-friendly, mobile Breezing™ Metabolism Tracker is over a full magnitude cheaper and is designed to perform indirect calorimetry under free-living conditions [1, 2].

Objective: This study evaluates Breezing™ Metabolism Tracker vs. laboratory-based Douglas Bag Method in oxygen consumption rate (VO_2), carbon dioxide production rate (VCO_2), and REE via indirect calorimetry method.

Results: Scatter plots of VO_2 and VCO_2 measured and REE calculated by Breezing™ Metabolism Tracker vs. Douglas Bag Method are presented in **Fig. 1(a-c)**, showing a strong 1:1 correlation between the two methods of measuring VO_2, VCO_2 and REE, all at $p < 0.0001$ with correlation slopes of 0.99 to 1.00 and squared correlation coefficients (r^2) larger than 0.94. Furthermore, percentage error differences of REE between Breezing™ Metabolism Tracker and the Douglas Bag Method are plotted vs. the mean REE values of the two methods in **Fig. 2**. This Bland-Altman plot also shows agreement between Breezing™ and the Douglas Bag Method, with errors within +/- 10% for REE values between 900 – 3500 kCal/day.

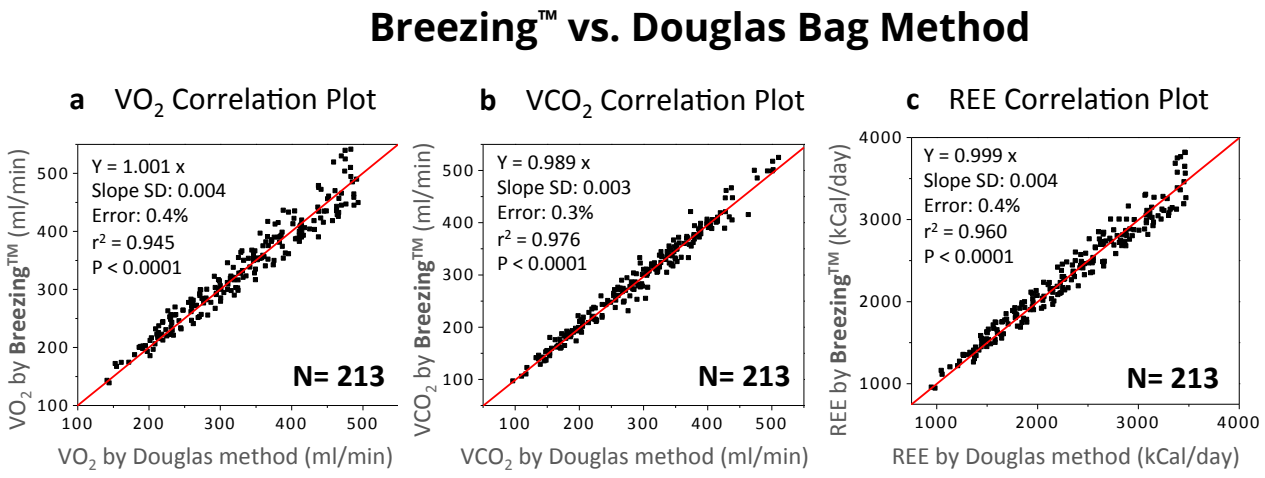

Figure 1. Regression analysis between Breezing™ and Douglas Bag Method, measuring (**a**) VO_2 and (**b**) VCO_2, calculating (**c**) REE with N=213.

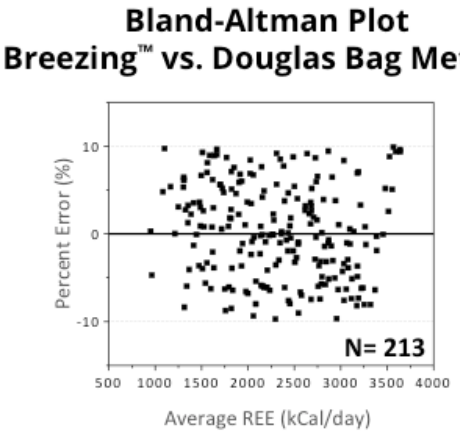

Figure 2. Bland-Altman plot of calculated REE from N = 213 unique breath measurements, differential percent error ([REE(Breezing) - REE(Douglas) / mean]*100) between Breezing™ Metabolism Tracker and Douglas Bag Method vs. mean values (REE(Breezing) + REE(Douglas) / 2). Solid black line (horizontal) indicates the mean difference between the methods and dotted lines represent the maximum and minimum errors from the mean. No significant slope is observed.

Conclusions: Breezing™ Metabolism Tracker's measured VO_2 and VCO_2 values and calculated REE values (based on VO_2 and VCO_2 measurements) demonstrate excellent agreement with the Douglas Bag Method, with $p < 0.0001$. The results validate Breezing™ as an accurate device for tracking metabolic parameters, including calculations of REE & RQ for whole-body metabolic understanding and weight management.

*Conducted and processed in the Center for Bioelectronics and Biosensor, Biodesign Institute, Arizona State University.

References

[1] W. D. McArdle, F. I. Katch, and V. L. Katch, "Exercise Physiology: Energy, Nutrition, & Human Performance," *Lippincott Williams & Wilkins,* 2007.
[2] M. M. Manore, N. L. Meyer, and J. Thompson, "Sport Nutrition for Health and Performance," *Human Kinetics (Ed.),* vol. Second Edition, 2009.