Breezing Pro™ Validation*

Background: Knowledge of whole-body metabolic parameters, such as energy expenditure is valuable for weight management [1,2] and for understanding of metabolic health. Resting energy expenditure (REE) makes up more than 80% of total energy expenditure (TEE) in sedentary populations. 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 weight. The gold standard assessment of REE requires the Douglas Bag Method (a form of indirect calorimetry), which is an expensive and cumbersome procedure wherein continuously exhaled gases are collected in a bag and analyzed by industry-standard O_2 and CO_2 sensors/detectors along with gas volume measurement. Breezing Pro™ is designed to perform indirect calorimetry in a mobile, patient-friendly manner.

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

Results: VO_2, VCO_2 and REE parameters were measured by Breezing Pro™ and Douglas Bag Method in a population of forty-four 44 subjects at resting conditions. **Fig. 1(A-C)** shows the comparative correlation plots for both measurements, indicating 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 close to 1.00 and squared correlation coefficients (r^2) close to 0.9. Furthermore, percentage error differences of REE between Breezing Pro™ and the Douglas Bag Method are plotted vs. the Douglas Bag Method REE values of the two methods in **Fig. 2** as Bland-Altman plot. This plot also shows agreement between Breezing Pro™ and the Douglas Bag Method, with relative errors within ±10% for REE for 95% of the values between 1000 – 3000 kCal/day.

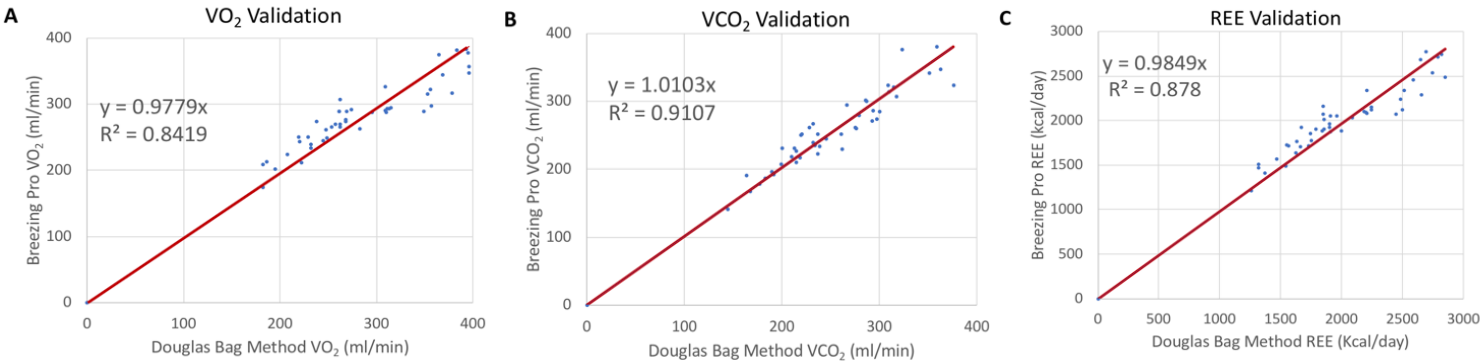

Figure 1: Correlations between Breezing Pro ™ and the Douglas Bag Method for (A) VO_2 and (B) VCO_2, and (C) REE for 44 subjects

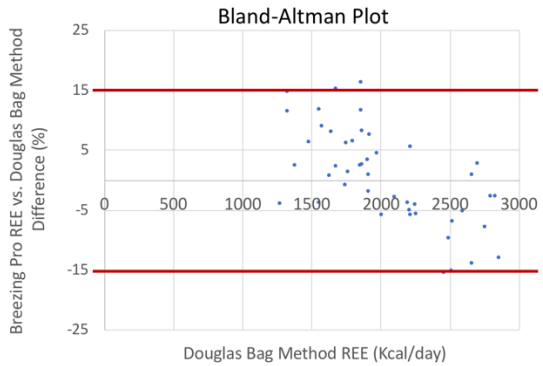

*Figure 2: Bland-Altman plot of calculated REE from N = 44 unique subjects at resting conditions, differential percent error ([REE (by Breezing Pro™) – REE (by Douglas Bag Method) / REE (by Douglas Bag Method)]*100) between Breezing Pro™and Douglas Bag Method*

Conclusions: Breezing Pro™ measures VO_2 and VCO_2 and determines REE from the measured VO_2 and VCO_2. The results are in excellent agreement with the Douglas Bag Method, with $p < 0.0001$. The study validates Breezing Pro™ as an accurate device for tracking metabolic parameters, which helps healthcare providers assess the metabolic health of their patients and develop personalized weight management programs with better clinical outcomes.

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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.