Converting Oxygen Uptake to Energy Expenditure Substantially Increases Prediction Error

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The authors' proposal to use energy expenditure (EE) instead of oxygen uptake (VO_2) to express exercise intensity (1) is an interesting proposition; however, the appropriateness of this data conversion is highly dependent upon the research question. We need to stress that this data conversion introduces assumptions and a substantial increase in predictive error. Modeling indirect calorimetry error via Tenan's method (4) and Macfarlane et al's data (3), we simulated the error from VO_2 alone. Since the author's do not directly specify the equation for converting VO_2 to EE (except at RER ≥1.0), we used the Brockway Equation (2), with no protein contribution (an added assumption):

$$EE\ (kJ) = 16.58 \times VO_2 + 4.15 \times VCO_2$$

As Brockway notes, numerous "fudge factors" exist in the equation, such as assuming 100% of carbohydrate metabolism is starch, as opposed to glucose or glycogen. We therefore apply a reasonable assumption that each constant arises from a standard normal distribution (mean ± 1 sd). As Table 1 shows, the conversion to EE more than doubles the resultant error in many instances. There are undoubtedly instances where the conversion of VO_2 to EE is necessary, but converting a "measured" variable into a "predicted" variable increases both error and additional assumptions that need to be carefully considered when undertaking such studies.

		Simulated Distribution Mean	Simulated Distribution Median	Simulated Distribution Standard Deviation	Coefficient of Variation	Δ Error for EE vs. VO_2
VO_2 = 0.5 L/min RER = 0.85	VO_2	0.50	0.50	0.03	5.2%	+2.6%
	EE[1] (kJ)	10.21	10.20	0.79	7.8%	
VO_2 = 1.0 L/min RER = 0.93	VO_2	1.00	1.00	0.03	2.6%	+4.3%
	EE[1] (kJ)	20.79	20.78	1.44	6.9%	
VO_2 = 1.5 L/min RER = 0.97	VO_2	1.50	1.50	0.03	2.0%	+4.8%
	EE[1] (kJ)	31.43	31.45	2.15	6.8%	
VO_2 = 2.0 L/min RER = 1.00	VO_2	2.00	2.00	0.07	3.2%	+4.0%
	EE[1] (kJ)	42.19	42.21	3.05	7.2%	
	EE[2] (kJ)	43.49	43.44	2.44	5.6%	+2.4%

Table 1. Results of 10,000 simulations and resulting distribution for measurement error of VO_2 and EE.

[1]Using Brockway Equation and assuming constants have a 'standard' normal distribution (i.e. ± 1 sd).

[2]Using the author-specified equation when RER ≥1.0: EE = VO2*21.745. Assuming a 'standard' normal distribution around constant.

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