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Resting Energy Expenditure Equations Have Lower Validity For Overweight And Obese Versus Healthy Weight Adolescents

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Objective

- The pediatric obesity epidemic has created an urgent need for improved treatment and prevention plans.
- Resting energy expenditure (REE) is a particularly important metric as it accounts for the majority of daily energy expenditure.
- Clinicians often rely on metabolic equations to predict REE as other direct measures such as indirect calorimetry are often impractical for use in a clinical setting.
- Over 200 equations have been developed over the past century. However, few equations have been validated for use in overweight and obese adolescents.
- The purpose of this research was to assess whether REE equations have comparable validity for overweight and obese versus healthy weight adolescents.

Methods

- Ten previously developed equations were used to predict REE for 109 adolescents ages 13-18 years old (n = 77 males, n = 32 females; 63.3% healthy weight, 36.7% overweight or obese).
- Nine equations were age specific. The tenth, Harris-Benedict (non-age specific), was included due to its widespread use on adolescent populations.
- 95% equivalence testing was used to assess how well each equation agreed with the criterion measure of indirect calorimetry.
- Criterion REE was measured via indirect calorimetry using a Parvo Medics TrueOne 2400 ventilated hood system following a 12 hour fast.

Table 1. Predictive Equations for Resting Energy Expenditure (REE).

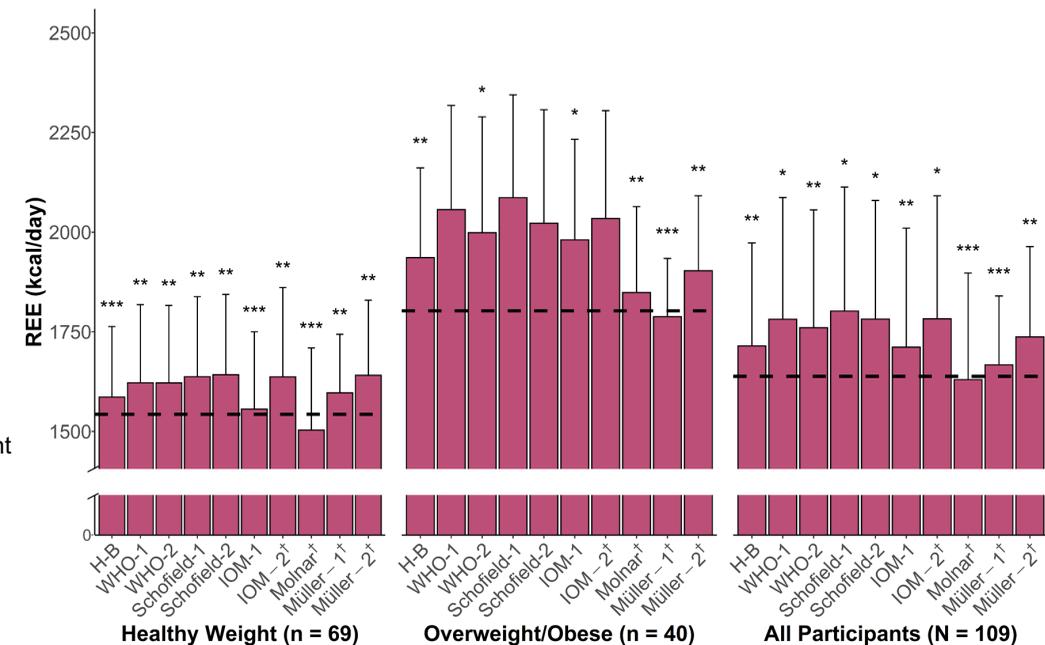
Harris-Benedict	M: (kcal/day) = 66.4730 + 13.7516(W) + 5.0033(Hcm) - 6.7550(A) F: (kcal/day) = 655.0955 + 9.5634(W) + 1.8496(Hcm) - 4.6756(A)
WHO-1	M: (kcal/day) = 17.5(W) + 651; F: (kcal/day) = 12.2(W) + 746
WHO-2	M: (kcal/day) = 16.6(W) + 77(Hm) + 572; F: (kcal/day) = 7.4(W) + 482(Hm) + 217
Schofield-1	M: (MJ/day) = 0.074(W) + 2.754 ; F: (MJ/day) = 0.056(W) + 2.898
Schofield-2	M: (MJ/day) = 0.068(W) + 0.574(Hm) + 2.157; F: (MJ/day) = 0.035(W) + 1.948(Hm) + 0.837
IOM-1	M: (kcal/day) = 420 - 33.5(A) + 418.9(Hm) + 16.7(W); F: (kcal/day) = 516 - 26.8(A) + 347(Hm) + 12.4(W)
IOM-2	M: (kcal/day) = 79 - 34.2 (A) + 730(Hm) + 15.3(W); F: (kcal/day) = 322 - 26.0(A) + 504(Hm) + 11.6(W)
Molnar	M: (kJ/day) = 50.9(W) + 25.3(Hcm) - 50.3(A) + 26.9; F: (kJ/day) = 51.2(W) + 24.5(Hcm) - 207.5(A) + 1629.8
Müller-1	(MJ/day) = 0.02606(W) + 0.04129(Hcm) + 0.3111(sex) - 0.08369(A) - 0.808
Müller-2	(MJ/day) = 0.07885(FFM) + 0.02132(FM) + 0.327(sex) + 2.694

Results

- For healthy weight adolescents, all ten equations were significantly equivalent to the criterion measure within $\pm 8.4\%$ ($p < 0.05$).
- For overweight or obese participants only three equations were equivalent within the same range ($p < 0.05$).
- The three equations, Molnar, Muller-1, and Muller-2, that were significantly equivalent to the criterion measure within $\pm 8.4\%$ ($p < 0.05$) were originally developed with specific inclusion of overweight and obese participants.

Conclusions

- Prediction equations tend to be biased toward higher accuracy in healthy weight versus overweight/obese adolescents, unless the original sample specifically included overweight/obese participants.
- The findings of this research underscore the importance of sample diversity in original development procedures for prediction equations.
- Careful consideration is required when choosing a prediction equation as commonly utilized equations may not be valid for adolescents across all weight status groups.



*Significant equivalence ($p < 0.05$) within 15% of measured REE; **Significant equivalence ($p < 0.05$) within 10% of measured REE; ***Significant equivalence ($p < 0.05$) within 5% of measured REE; †Equation originally developed with specific inclusion of overweight and obese participants; REE, resting energy expenditure.

Figure 1. Measured versus predicted basal energy expenditure (kcal/day) for different weight classes.