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ORIGINAL ARTICLE

Predicting resting energy expenditure in young adults

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Summary
Purpose: To develop and validate a REE prediction equation for young adults.
Methods: Baseline data from two studies were pooled ($N = 318$; women = 52%) and randomly divided into development ($n = 159$) and validation samples ($n = 159$). REE was measured by indirect calorimetry. Stepwise regression was used to develop an equation to predict REE (University of Kansas (KU) equation). The KU equation and 5 additional REE prediction equations used in clinical practice (Mifflin—St. Jeor, Harris—Benedict, Owens, Frankenfield (2 equations)) were evaluated in the validation sample.
Results: There were no significant differences between predicted and measured REE using the KU equation for either men or women. The Mifflin—St. Jeor equation showed a non-significant mean bias in men; however, mean bias was statistically significant in women. The Harris—Benedict equation significantly over-predicted REE in both men and women. The Owens equation showed a significant mean bias in both men and women. Frankenfield equations #1 and #2 both significantly over-predicted REE in non-obese men and women. We found no significant differences between measured REE and REE predicted by the Frankenfield #2 equations in obese men and women.

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Conclusion: The KU equation, which uses easily assessed characteristics (age, sex, weight) may offer better estimates of REE in young adults compared with the 5 other equations. The KU equation demonstrated adequate prediction accuracy, with approximately equal rates of over and under-prediction. However, enthusiasm for recommending any REE prediction equations evaluated for use in clinical weight management is damped by the highly variable individual prediction error evident with all these equations.

Introduction

Data from the National Health and Nutrition Survey (2011—2012) indicated that the prevalence of overweight and obesity (BMI $\geq$ 25 kg/m^2) in young adults age 20—39 years was 60.3%, with 30.3% classified as obese (BMI $\geq$ 30 kg/m^2) [1]. Thus, young adults represent a large segment of the population in need of weight management. Successful weight management is aided by the establishment of realistic goals for energy intake and energy expenditure based on resting energy expenditure (REE), which represents the largest component of total daily energy expenditure. Although REE can be accurately assessed using indirect calorimetry, the costs of equipment, the need for trained personnel, and the logistics associated with this assessment make its use impractical in the majority of clinical settings.

In lieu of directly assessed REE, weight management clinics typically utilize equations, based on easily assessed parameters such as age, height, and weight, to predict REE. Several REE prediction equations are frequently used in clinical practice. However, information relative to the validity of these equations in young adults across the weight spectrum in limited [2—9]. Several of these studies have been conducted in only women [2,3,5,8] only normal weight individuals [6,7] or in specific population sub-groups including Hispanics [2] and Chinese [6,7]. To date, there is no prediction equation developed specifically for use in young adults across the weight spectrum. Therefore, the purpose of this analysis was to develop and evaluate the accuracy of an equation that uses easily assessed physical characteristics (age, height, weight, sex) to predict REE in a sample that includes normal, overweight and obese young adults, and to compare the accuracy of this equation with other prediction equations frequently used in clinical practice including: Mifflin—St. Jeor [10], Harris—Benedict [11], Owens [12], and Frankenfield [9].

Methods

Participants

Baseline data from two recently completed randomized trials conducted at University of Kansas Energy Balance Lab, that used similar inclusion/exclusion criteria (age 18—30 yrs, healthy, non-smoking, planned physical activity <500 kcal/wk) were pooled and served as the basis for this analysis: Trial 1: n = 173, age = 22.2 $\pm$ 2.8 yrs, BMI = 25.7 $\pm$ 4.6 kg/m^2 [13]; trial 2: n = 145, age = 22.8 $\pm$ 3.2 yrs, BMI = 30.7 $\pm$ 4.6 kg/m^2 [14]. The pooled sample was then divided randomly into 2 equal samples; a development (n = 159) and a validation sample (n = 159). The University of Kansas—Lawrence Institutional Review Board approved the research protocols for both trials. All participants provided written informed consent prior to the initiation of study procedures.

Weight/height

Participants were weighed on a digital scale accurate to $\pm$0.1 kg (PS6600, Befour Inc., Saukville, WI) while wearing in a standard hospital gown. Weight was assessed between 7 and 10 a.m., prior to breakfast, and after attempting to void. Height was measured to the nearest 0.125 cm on a standardized, wall-mounted stadiometer. Body mass index (BMI) was calculated as weight in kg/height in m^2. Height and weight were measured during the same laboratory visit where REE was assessed and were used in all prediction equations.