Adults in All Body Mass Index Categories Underestimate Daily Energy Requirements

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ABSTRACT

Objective: To compare the difference between self-reported and calculated daily energy requirements of adults within different body mass index (BMI) categories.

Methods: Adults (n = 978) self-reported daily energy requirements, demographic information, and height, weight, age, and physical activity level (PAL) to calculate total energy expenditure.

Results: The main effects of BMI, gender, PAL, and dieting status on the difference between self-reported and calculated energy requirements for weight maintenance were significant ($P < .05$); age, race/ethnicity, level of education, and being in a health-related field had no effect. Individuals across all BMI categories underestimated their energy requirements, but obese individuals underestimated to the greatest degree. Males, current dieters, and those who reported a low-active or active PAL underestimated to the greatest extent in each category.

Conclusions and Implications: There is a lack of basic nutrition knowledge about personal energy needs in individuals across all BMI categories regardless of age, race/ethnicity, level of education, or work/training in a health-related field.

Key Words: energy requirements, body mass index, obesity, physical activity, diet (*J Nutr Educ Behav*. 2013;45:460-465.)

INTRODUCTION

As a result of the new menu labeling laws mandating that restaurant chains and vending machine operators with ≥ 20 locations post the energy content of food items,[1] consumers will have greater access to nutrition information. This should empower them to make more informed decisions regarding food choices, especially because many find it difficult to accurately estimate the energy content of foods.[2,3] The ability to select foods that fit within one's daily energy requirements assumes knowledge of how many calories are required per day. Few studies have examined consumers' understanding of their daily energy requirements. In 2006, Krukowski et al[4] conducted a telephone survey in community and college populations. Participants were asked to estimate the number of calories they believed they should eat each day. Estimated daily needs were considered to be accurate if the reported needs fell between 1,500 and 2,500 kcal/d. Overall, 67% of participants were able to correctly estimate their daily needs, and women were more accurate in their estimation.[4] Using the same definition of accuracy (ie, estimates between 1,500 and 2,500 kcal/d), Elbel[5] found that approximately 30% of consumers from a low-income, racially and ethnically diverse sample correctly estimated the daily energy requirements of the average American for maintenance of normal body weight, and approximately 50% of survey participants underestimated daily requirements. Using a telephone survey, Bleich and Pollack[6] asked a nationally representative sample of adults to estimate the daily energy requirements for moderately active men and women and inactive adults. Response categories were in 1,500-kcal increments, from < 1,500 kcal to ≥ 4,500 kcal. More than two thirds of respondents correctly identified the recommended daily energy needs for moderately active men and women, but only one third was able to correctly identify the requirements for inactive adults. The ability to correctly identify energy requirements of an inactive adult differed significantly by gender, race/ethnicity, and age. Females and older adults underestimated their needs and blacks and Hispanics overestimated their daily energy needs. No differences were observed with level of education or body mass index (BMI) category.[6]

None of these studies compared an individual's estimated daily energy requirement with calculated requirements based on age, gender, body weight, height, and level of physical activity. In addition, no studies to our knowledge have determined whether individuals who are at a normal BMI (18.5 to < 25 kg/m^2)[7] are more likely than those who are obese to accurately report their own energy requirements. Therefore, the purpose of this study was to compare the difference between self-reported daily energy

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requirements and calculated daily energy requirements for weight maintenance. It was hypothesized that obese adults would overestimate their daily energy requirements for weight maintenance and that the difference between self-reported and calculated daily energy requirements would be greatest in this subpopulation. The results of this study will be helpful to nutrition educators as the new menu and vending machine labeling laws are implemented.

METHODS

A short questionnaire (10 questions total) was designed as an anonymous, voluntary, self-report consisting of 2 questions related to anthropometric measurements (height and weight) and 5 to obtain demographic data (race/ethnicity, age, gender, level of education, and training in a health-related field). The remaining 3 questions were: "How many calories do you need to maintain your current weight?"; "Amount of moderate or vigorous activity (such as brisk walking, jogging, biking, aerobics, or yard work) you do in addition to your normal daily routine, most days—< 30 minutes, 30–60 minutes, > 60 minutes;"[8] and, "Are you currently dieting to gain or lose weight?" The format included both multiple-choice and fill-in-the-blank questions. The University of Florida Institutional Review Board approved the study protocol.

A convenience sample of 978 adults from a university community in the Southeastern United States was obtained after a power analysis determined that a sample of this size was necessary to acquire the n = 20 participants who were underweight (BMI < 18.5)[7] for statistical significance between BMI weight categories with $\alpha = .05$ and 80% power. Similarly trained study coordinators administered questionnaires from January to March, 2011 at various campus locations, public areas of the university hospital, local businesses, and sporting and community events. At the time the questionnaire was administered, study coordinators obtained verbal consent from each participant. Participants were encouraged to complete the questionnaire on their own with study coordinators available to answer questions. To maintain anonymity, all returned questionnaires, regardless of completion, were folded and inserted in a sealed box until the time of data entry. Upon questionnaire completion, participants were given a business card with contact information and the Web address for MyPyramid,[8] where they could determine their energy requirements independently, if desired. At the time the study was completed, MyPyramid was the United States Department of Agriculture nutrition education tool used by health professionals and available to the public; hence, its use in the study. MyPyramid has since been replaced by MyPlate.[9]

The Total Energy Expenditure (TEE) (Table) equation,[10] which was used to calculate personalized plans on MyPyramid,[8] was used to determine daily calculated energy requirements. The physical activity level (PAL) (sedentary, low active, and active), which was chosen by each participant based on descriptions from MyPyramid,[8] was used in this equation. The TEE formula remains pertinent because MyPlate[9] continues to employ this equation in combination with PAL for energy requirement calculations.

For each participant, calculated energy requirements (ie, TEE calculations for weight maintenance) were subtracted from the self-reported energy requirements for weight maintenance. If participants gave a range for their caloric needs (n = 8), an average of the range was used. The main effects of questionnaire results (BMI, age, gender, race/ethnicity, education, classification as a student or professional in a health-related field, PAL, and whether dieting to lose or gain weight) on the difference between self-reported and calculated energy requirements were considered in a single model using multifactor ANOVA. Although not all the data were normally distributed (Shapiro-Wilks test; $P < .001$), ANOVA is considered robust with regard to the assumption of normality given a large sample size,[11] with the central limit theorem also assuming a normal distribution.[12] Significance within characteristics with more than 2 levels was tested using *post hoc* ANOVA Least Significant Difference multiple comparison tests. To determine whether self-reported energy requirements were significantly underreported compared with calculated energy requirements, 2-tailed, 1-sample Wilcoxon signed rank tests were used to compare the differences between self-reported daily energy requirements and calculated energy requirements to the hypothetical median of 0 for each BMI category. Unless stated otherwise, data represent the mean ± SD. Significance was denoted at $P \leq .05$.

RESULTS

Of the 978 questionnaires that were administered, 29 were eliminated for the following reasons: lack of data necessary for calculating estimated energy requirements, such as height, weight, age and PAL (n = 12); illegible responses (n = 1); or extreme responses (< 10 or > 10,000 kcal; n = 16). Inability or unwillingness to self-report daily caloric requirements accounted for the removal of an additional 36 questionnaires. The remaining questionnaires (n = 913) were analyzed.

The 36 participants who were not included in the analyses because of the inability or unwillingness to self-report their caloric requirements were significantly older (43 ± 24 vs 33 ± 17 years; $P = .005$), more educated (44% [n = 16] had at least some graduate education or a graduate or professional degree vs 25% [n = 225]; $P = .03$), and had a lower PAL (< 30 min/d 56% [n = 20] vs 32% [n = 294]; $P = .01$) than participants who self-reported their caloric needs. The characteristics of the 16 outliers who reported extreme values (ie, < 10 or > 10,000 kcal/d) were similar to those reported for the main study group (Table), with the exception that those with the extreme values were predominantly male (13 of 16).

The main effects of BMI ($P < .001$, effect size [η^2] = .025), gender ($P = .002$, $\eta^2 = .011$), PAL ($P < .001$, $\eta^2 = .024$), and dieting status ($P = .03$, $\eta^2 = .005$) on the difference between self-reported and calculated energy requirements were significant. On average, individuals across all BMI categories underestimated their energy requirements, but the difference between self-reported and calculated energy requirements was greatest for individuals who were obese (Figure and Table) ($P < .05$). Males underestimated to a greater degree than females ($P = .002$). Participants who reported