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Original Article

Misreporting of dietary energy intake in adolescents

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Abstract

Objectives: To examine the prevalence of under and overreporting of energy intake in adolescents and their associated factors.

Methods: Cross-sectional study with 96 postpubertal adolescents (47 normal-weight and 49 obese), mean age of 16.6±1.3 years. Weight and height were measured, and body mass index was calculated. Body composition was assessed by dual energy X-ray absorptiometry. Dietary intake was evaluated by a 3-day dietary record. Biochemical assessment was performed (serum total cholesterol, LDL-cholesterol, HDL-cholesterol, plasma glucose, and insulin). Underreporters reported energy intake < 1.35 x basal metabolic rate (BMR), whereas overreporters reported energy intake > 2.4 x BMR.

Results: Energy intake misreporting (under or overreporting) was identified in 65.6% of adolescents (64.6 and 1% of under and overreporting, respectively). Obese adolescents were 5.0 times more likely to underreport energy intake (95%CI 2.0-12.7) than normal-weight participants. Underreporters showed higher rates of insufficient intake of carbohydrate (19.3 vs. 12.1%, $p = 0.046$) and lipids (11.3 vs. 0%, $p < 0.001$) than plausible reporters. Cholesterol intake was also lower in underreporters ($p = 0.017$). There were no significant differences in body composition and biochemical parameters in relation to misreporting.

Conclusions: The results obtained demonstrated a high percentage of misreporting of energy intake among adolescents, especially among obese subjects, which suggests that energy-adjusted nutrient intake values should be employed in diet-disease risk analysis in order to contribute to a reduction in errors associated with misreporting.

J Pediatr (Rio J). 2010;86(5):400-404: Adolescents, dietary assessment, energy intake, misreporting, underreporting.

Introduction

Understanding the relationship between diet and health outcomes requires accurate self-reporting of dietary intake. Although misreporting occurs in both directions, underestimation of energy intake is more prevalent.[1,2] It is well known from large-scale studies that underreporting is pervasive and associated with body mass index (BMI), female gender, low income, older age, and higher social desirability.[2] However, few studies have examined issues regarding the accuracy of dietary intake measurements in an adolescent population.

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Adolescence is a transition period that often results in changes in dietary habits, such as higher consumption of sweets and fast food and lower fruit and vegetable intake, as a sign of increasing independence.[3,4] Kourlaba et al.[5] evaluated 2,118 Greek adolescents and observed that unhealthy dietary behavior was associated with unhealthy lifestyle and increased obesity prevalence.

Adolescent obesity tends to persist into adulthood and is associated with an increase in adult morbidity and mortality, including type 2 diabetes mellitus, cardiovascular, orthopedic and respiratory disease.[6] Pearson et al.,[7] after monitoring Copenhagen schoolchildren for four years, identified a potential stagnation in the obesity epidemic among children, but a continuing increase among adolescents.

Adolescents' food habits may contribute to misreporting of food intake during dietary assessment, regardless of the method of measurement. Commonly used methods, including 24-hour dietary recall interviews, food frequency questionnaires, and food diaries, are all associated with challenges for an accurate assessment. The magnitude of underreporting varies widely among studies.[1,7-9] Thus, the purpose of this study was to examine the prevalence of under and overreporting among obese and normal-weight adolescents and their associated factors.

Methods

A cross-sectional study was conducted with normal-weight and obese adolescents. Estimated sample size was 80 participants based on the proposed evaluation period (three months) and service capacity. Adolescents were defined as the target population due to an interest in studying misreporting at this stage of life and the scarcity of similar studies. Subjects were recruited through community service agencies and newspaper advertisements. Those adolescents who met the inclusion criteria (sedentary lifestyle,[10] postpubertal according to Tanner stages,[11] non-pregnant, and healthy) were invited to participate, and a sample of 96 adolescents was obtained.

Anthropometric measurements of body height and body mass were performed according to standard procedures.[12] Body composition (bone mineral and soft tissue mass) was assessed by dual energy X-ray absorptiometry (DXA), Hologic QDR-4500 (Hologic Inc., Waltham, USA). Soft tissue mass was divided into fat mass and lean body mass. Fat mass was determined in the trunk region, arms and legs (both were considered peripheral fat).

The adolescents were then divided into two groups according to BMI-for–age percentiles:[13] 47 normal-weight (BMI < 85th percentile for age and gender) and 49 obese (BMI ≥ 95th percentile) subjects. The groups were matched for age and gender.

Furthermore, a venous blood sample was obtained after a 12-hour fast to measure triglycerides, total cholesterol, low-density lipoprotein cholesterol (LDL-c), high-density lipoprotein cholesterol (HDL-c), plasma glucose, and insulin. Blood lipids and triacylglycerol were measured by enzymatic colorimetric methods; LDL-c was calculated by the Friedlander equation; serum glucose concentrations were determined using a spectrophotometer UV-1601PC (Shimadzu Corp., Kyoto, Japan); and serum insulin levels were determined with a radioimmunoassay kit (Molecular Research Center, Inc., Cincinnati, USA).

Dietary intake was assessed by a three-day food record obtained over three non-consecutive days. The food record method for evaluation of nutrient intake was used due to its high specificity for describing foods and food preparation methods.[14]

All subjects were instructed to write down their total daily food intake, in household measures, describing the amount consumed of each food during three non-consecutive days. When subjects returned their records, a dietitian reviewed the records and clarified information with the participants.

Nutrient intake was calculated using NutWin 1.5 software (Universidade Federal de São Paulo, São Paulo, Brazil) and macronutrient distribution was evaluated based on proposed values for this life stage.[9]

To recognize misreporting a comparison between total energy intake and basal metabolic rate (BMR) was performed for each participant.[15] Underreporters reported energy intake < 1.35 x BMR, whereas overreporters reported energy intake > 2.4 x BMR.[1,15] BMR was calculated using formulas proposed by FAO/WHO/ONU[16] according to the adolescent's age, gender, weight, and height.

All data were analyzed using SPSS 13.0 for Windows (SPSS Inc., Chicago, USA). The Kolmogorov-Smirnov normality test was performed. The Student *t* test was used to compare means between groups. The chi-square or Fisher's exact test was used to compare proportions. Odds ratio was used to verify the probability of underreporting among participants.

Results were expressed as mean ± standard deviation for continuous data with normal distribution and as median [95% confidence interval (CI)] for other variables. A p value of < 0.05 was considered to be significant.

The study was approved by the Ethics Committee of Universidade de São Paulo (USP) and by the Ethics Committee of Universidade Federal de São Paulo (UNIFESP), Brazil. Written informed consent was obtained from both the parents and adolescents in the study group.

Results

A total of 96 postpubertal adolescents (47 normal-weight and 49 obese), mean age of 16.6 (±1.3) years, participated in the study. Mean energy intake of the sample was 1895.2 (±630.3) kcal/day, with no differences between groups ($p = 0.881$). Percentage distribution of macronutrients was also similar between obese and normal-weight adolescents ($p > 0.05$) (Table 1).

Energy intake misreporting was identified in 65.6% of participants, with a significantly higher frequency among obese adolescents (Table 1). Under and overreporting were observed in 64.6 and 1% of adolescents, respectively.

Since only one adolescent was classified as overreporter, the following analyses considered only underreporting as misreporting, that is, the adolescent classified as overreporter was excluded.

Age ($p = 0.182$) and gender were not associated with underreporting ($p = 0.327$). In contrast, obese adolescents were 5.0 times more likely to underreport energy intake (95%CI 2.0-12.7) than normal-weight participants.

Underreporters showed higher rates of insufficient intake of carbohydrate (19.3 vs. 12.1%, $p = 0.046$) and lipids (11.3 vs. 0%, $p < 0.001$) than plausible reporters. Protein intake was statistically similar between underreporters and plausible reporters (Figure 1). None of the groups showed excessive protein intake.

Cholesterol intake was lower in underreporters than in those not underreporting: 174.1 (78.8) mg/day vs. 215.4 (78.5) mg/day, respectively ($p = 0.017$). Saturated fat intake was also lower in underreporters, although without statistically significant difference: 9.5 (2.8) mg/day vs. 10.7 (2.9) mg/day, $p = 0.054$.

There were no significant differences in body composition and biochemical parameters between underreporters and plausible reporters (Table 2).

Discussion

The results showed high frequency of misreporting among adolescents in this study, especially among obese subjects. Similar to other studies, underreporting was higher than overreporting.[1,7]

The frequency of underreporters was higher than that observed in studies with adults, probably due to a high participation rate of obese individuals in this study and sample differences between studies. Bazanelli et al.[1] evaluated 40 patients treated by peritoneal dialysis and verified that 52.5% of the overall patients studied

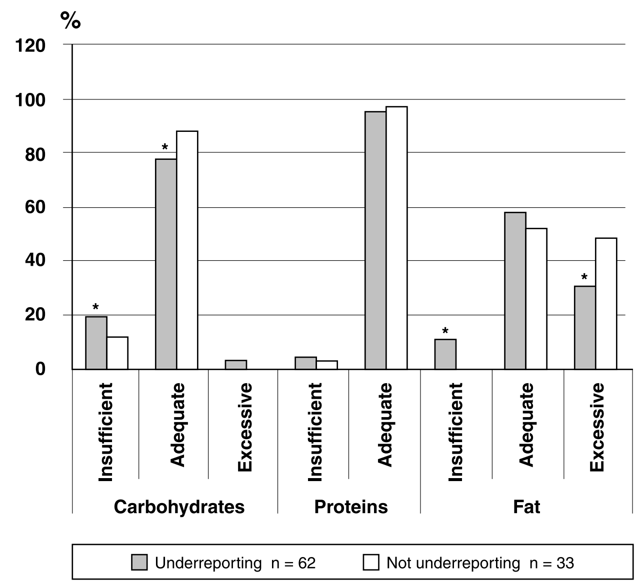

Figure 1 - Macronutrient distribution among adolescents according to presence of underreporting

Table 1 - Characteristics of adolescents according to nutritional status

	Normal-weight (n = 47)	Obese (n = 49)
Age (years)	16.6±1.26	16.6±1.39
Female, n (%)	36 (76.6)	37 (75.5)
Male, n (%)	11 (23.4)	12 (24.5)
Dietary intake		
Energy intake (kcal/day)	1,905.2±394.8	1,885.7±789.0
Carbohydrate (%)	52.2±5.6	52.2±7.7
Protein (%)	14.8±3.1	15.6±4.8
Fat (%)	32.9±4.9	32.2±7.0
Underreporters, n (%)	22 (46.8)	40 (81.6)*
Overreporters, n (%)	0 (0)	1 (2.0)

* p < 0.05.

Table 2 - Body composition and biochemical parameters of adolescents according to underreporting

Characteristics	Normal-weight (n = 47)		Obese (n = 48*)	
	Not underreporting (n = 25)	Underreporting (n = 22)	Not underreporting (n = 8)	Underreporting (n = 40)
Body composition				
Body fat mass (%)	26.3 (7.6)	24.1 (6.8)	41.2 (5.7)	40.8 (5.0)
Trunk fat mass (%)	21.0 (7.6)	19.9 (6.7)	40.1 (5.2)	41.0 (5.7)
Peripheral body fat (%)	30.0 (9.2)	27.4 (8.7)	43.9 (7.5)	42.8 (5.9)
Biochemical parameters				
Total cholesterol (mg/dL)	144.4 (19.6)	149.9 (25.4)	166.7 (23.3)	158.2 (26.6)
LDL cholesterol (mg/dL)	71.8 (17.6)	79.6 (21.3)	94.4 (21.6)	23.2 (21.6)
HDL cholesterol (mg/dL)	52.2 (9.0)	54.4 (9.6)	51.1 (7.9)	47.1 (9.6)
Triglycerides (mg/dL)	89.9 (30.7)	88.4 (40.3)	106.6 (47.7)	97.8 (40.8)
Glucose (mg/dL)	85.9 (7.5)	89.9 (6.5)	90.6 (6.8)	88.4 (4.1)
Insulin (μU/mL)	7.6 (2.6)	7.6 (3.3)	13.7 (4.9)	17.1 (8.6)

HDL = high-density lipoprotein; LDL = low-density lipoprotein.
* One subject was excluded because of overreporting.

underreported against 83.3% in the overweight group. Nielsen et al.[17] found that, in 309 Danish men, aged 40 to 65 years, 35% underreported.

The few studies found in the literature on underreporting of energy intake among adolescents show diverse results. Lanctot et al.[18] evaluated 284 girls, aged 8 to 10 years, and 54.8% of the girls were classified as underreporters. Similarly, Singh et al.[19] identified underreporting by 35±20% among girls and boys, aged 12-15 and 12-14 years, respectively. However, Lazarou et al.[20] found that 72% of 50 Brazilian adolescents, aged 11-18 years, underreported. The scarce data for this life stage demonstrates the importance of conducting further studies with adolescents.

Gender-related underreporting differences have been reported in the literature. Some authors have identified greater prevalence of underreporting among women.[8,9] Differently, in the present study gender was not associated with underreporting (p = 0.327). The small number of men may have contributed to this result.

Likewise, underreporting was not associated with age (p = 0.182), in contrast to other studies.[2,9] In adult and elderly populations, compromised dietary intake and health status may offer alternative explanations for underreporting.[21] In the present study, the homogeneity of sample, with only postpubertal adolescents, aged 13.3 to 19.8 years, may explain this lack of association.

In this study, underreporting was positively associated with obesity, corroborating the findings by Nielsen et al.[17] Overweight appears to be one of the most consistent factors in predicting underreporting of energy intake in nutritional assessment studies, since perceptions of body weight and the desire to lose weight influence how obese individuals report their dietary intake.[8,9,22]

The underreporters evaluated in this study had lower dietary intake of carbohydrate (p = 0.046), total and saturated fat (p = 0.054), and cholesterol (p = 0.017). Similar results have been reported showing that underreporters have dietary habits that more closely resemble dietary guidelines.[8,23] Among female Japanese students, the percentage of energy from carbohydrate was significantly higher, whereas energy from fat and protein was significantly lower among underreporters.[24] Probably, these subjects estimated lower energy from potentially socially undesirable food groups (e.g., snacks, sweets, and fried foods) than did plausible reporters.

The present study found 1% of overreporting, and only a few studies have evaluated overreporting of energy intake. Biltoft-Jensen et al.[25] identified values similar to those found in the present study. Furthermore, in a study with Danish men aged 40-65 years, Nielsen et al.[17] found that 7% were overreporters. Among adults, Bazelmans et al.[8] identified that 7.9% of participants overreported. Age differences between samples and different cutoff points for overreporting may explain these results and provide directions for further investigation.

This study has some limitations. First, this is a cross-sectional study and a temporal relationship could not be established between underreporting and its associated factors. Second, we did not have a biomarker of energy intake. However, the validity of using the ratio of energy intake to BMR (EI:BMR) to estimate underreporting has been demonstrated in previous studies. Although our sample is not representative of the population of Brazilian adolescents, it is the only national study evaluating postpubertal adolescents with different nutritional status.

The results obtained demonstrated a high percentage of misreporting of energy intake among adolescents, especially among obese subjects. Underreporting was more prevalent than overreporting, suggesting that energy-adjusted nutrient intake values, according to the nutrient residual model, should be employed in diet-disease risk analysis in order to contribute to a reduction in errors associated with misreporting.

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