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May Obesity and Nutritional Knowledge Influence the Assessing Energy Intake Underreporting in Adults?

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Authors' contributions

This work was carried out in collaboration between all authors. Authors KQ and EVM contributed in the conception and design of the manuscript. Author LMGN performed the data analysis. Authors NPM and CRPD managed the experimental process and helped on the discussion. Authors SMB and KQ helped on the discussion and wrote the final version of paper. All authors read and approved the final manuscript.

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ABSTRACT

Aims: Investigate the influence of the nutrition knowledge and nutritional status in the assessing energy intake underreporting.
Methodology: It's a cross-sectional study in 52 adults treated in an ambulatory. The nutritional knowledge was measured through the Nutritional Knowledge Scale. The anthropometric data analyzed were: waist circumference, height and weight. The food consumption was checked by three recalls of 24 hours. The resting metabolic rate was calculated by the Mifflin's formula, and the assessing energy intake underreporting was calculated after Goldberg's formula. Statistical analysis

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was performed by the “Bioestat 5.0” program and the Chi Square test for trend was used to evaluate the association between variables (p≤0,05).
Results: The studied group showed an average age of 38,90±9,52. The assessing energy intake underreporting was noted in 92,3% of the sample. It was observed that the average energy intake related (1583,27±575,29 Kcal) was less than the average of the resting metabolic rate (1802,71±227,02 Kcal). Higher values of IMC (A = 0,153; p = 0,85) and in waist circumference (A = 2,769; p = 0,05) were associated with the increase of the assessing energy intake underreporting. In the other hand, there was a decreasing tendency (A = - 0,384; p = 0,750) in the association between energetic underreporting and nutritional knowledge.
Conclusion: It was observed a higher tendency of assessing energy intake underreporting between individuals with higher IMC and waist circumference and lower nutritional knowledge.

Keywords: Obesity; nutritional knowledge; food consumption; dietary survey; anthropometric data.

1. INTRODUCTION

The prevalence of overweight and obesity is increasing worldwide with deep physical and psychosocial consequences. It has contributed to the development of chronic complications such as diabetes mellitus and cardiovascular diseases that are among the leading causes of death worldwide. Lifestyle modifications related to eating behaviour and physical activity are the critical components in the prevention and treatment this eating disorder [1].

Eating habits are influenced by cultural, emotional, environmental and social factors what interferes in the quality, perception and memory of food consumption [2], determining the food consumption behavior and consequently their nutritional status [3].

Methods for the assessment of food consumption are developed to identify the dietary pattern and to propose changes in daily individuals eating habits [3]. However there are many difficulties to apply these methods because individuals are involved in many subjective and intrinsic ways of living [4].

A possibility of assessing the dietary pattern is through the food consumption report which includes specific quantitative and qualitative information in the nutrient intake and energy [5].

The energy intake is measured by dietary questionnaires based on self-report of food consumption. However, studies on the validation of these methodologies show that may be underestimation or overestimation in the self-report when it is compared to biological markers [6-9].

The assessing energy intake underreporting has been associated with a number of different individual characteristics, however, obesity is considered the main cause [9-11]. Moreover, the construction of a "food consciousness" has been shown to influence the description of food consumption report, leading individual to change food consumption habits or even hiding information when the habits are considered unhealthy [8]. But there is still a lack of data about the influence of nutrition knowledge in the assessing energy intake underreporting.

Studies evaluating the accuracy of the assessing energy intake data and the factors that may influence the report of the food consumption are important to the improvement of the methodologies. Based on this, the objective of our study was to investigate the influence of the nutrition knowledge and nutritional status in the assessing energy intake underreporting.

2. MATERIALS AND METHODS

This was a cross sectional study in which the sample was randomly selected. Patients aged 20 to 59 years, assisted at the Nutrition and Medicine Ambulatory at the University of Marilia, São Paulo, Brazil were included in this study. Patients who agreed to participate were asked to sign a free and informed consent form before entering the study. Patients should not: be pregnant or breastfeeding; use medications such as steroids, appetite suppressants, anxiolytics, antidepressants or appetite stimulants; present hypothyroidism and hyperthyroidism; be an athlete or very intense physical activity practicing and present weight loss up to 2 kg during the study period.

The sample has included fifty-two volunteers (forty-seven were female and five were male).

The assessing energy intake was performed by a trained dietician and a twenty-four-hour dietary

recall (24hR) was used to collect data from 3 nonconsecutive days (two of them were weekdays and one was during the weekend, thus ensuring representativeness of the full week). Using a semi-structured interview, the individuals were asked to report all foods, drinks, and food supplements consumed on the previous day. The amounts of food ingested were reported in terms of house hold measures. Energy intake data were analyzed with Avanutri Software [12] version 4.0.

Nutritional knowledge was measured through a Nutritional Knowledge Scale developed by Harnack et al. [13] and translated, adapted and validated to Brazilian population by Scagliusi et al. [14] and it was applied in this work only once. This questionnaire was evaluated in three parts: 1) The relationship between diet and disease; 2) amount of fiber and lipids in food; 3) Recommendations of fruits and vegetables. The criteria for the classification scores were: total scores between zero and six indicated low nutritional knowledge; between seven and ten indicated moderate nutritional knowledge and above ten indicated high nutritional knowledge [14].

The analyzed anthropometric data were: weight, height and waist circumference. The body mass index (BMI) were calculated as follows: weight (kg) divided by the individual height (in meters) squared. To the anthropometric measurements we have used a digital anthropometric scale (Sanny®) with a capacity of 200 kg and properly calibrated, a fixed stadiometer (Alturaexata®) provided with metric scale and inelastic tape measuring 150 cm. The methodology for these measures followed Gibson [15]. The resting energy expenditure was estimated by the Mifflin formula [16].

Underreporting assessment was based on the difference between the ratio rEI:RMR (reported energy intake:resting metabolic rate) [17]. This ratio was calculated for all the studied subjects and later it was associated with the score of nutritional knowledge questionnaire, the BMI and the waist circumference (WC). For the assessing energy intake underreporting we used the cutoff point proposed by Goldberg et al. [17], which takes into account the number of patients and the number of days of the assessed food intake. To the determination of the cutoff points, we have used n=52, with a confidence interval of 99.7% and an average of 3 days for assessment of food consumption. Underreporting was detected when rEI:RMR ratio was lower than 1,41.

Statistical analysis was carried out with BioEstat 5.0 and the data were expressed as mean ± standard deviation and quartiles for the population. The Chi square test for trend was used to compare the proportion of underreporters found in each approach. The level of significance was set at 5% ($P < 0.05$).

This study was approved by the Research Ethics Committee – Medical School of Marilia - São Paulo - Brazil, in August 21, 2014, under protocol number 770.836.

3. RESULTS AND DISCUSSION

The participants of this study presented a mean age of 38.90±9.52 years, mean body weight of 82.96±21.68 kg and height of 1, 62±6.46 meters. BMI ranged from 18 to 59 kg/m², with a mean 30.98±7.61 kg/m^2 and average WC of 94.05±15.07 (Table 1).

The studied group was composed predominantly by women (90.4%). According to the BMI, patients were classified as eutrophic (17.3%), low weight (1.9%) and overweight (80.8%). Most of the patients (84.6%) presented WC above the recommended cut-off point.

The score obtained in the nutritional knowledge questionnaire indicated moderate knowledge.

Table 1. Subject age and anthropometric data (n = 52)

Variables	Mean ± Standart deviation	Median	Minimum	Maximun
Age (years)	38,90±9,52	40,5	20	59
Weight (Kg)	82,96±21,68	80	49	164
Height (m)	1,62±6,46	1,62	1,50	1,81
BMI[a](Kg/m$^{2)}$	30,98±7,61	30	18	59
WC[b] (cm)	94,05±15,07	89,5	66	139

[a]BMI: Body Mass Index; [b] WC: Waist circumference

The energy balance variables (reported energy intake and estimated resting metabolic rate) and the reason rEI:RMR used to evaluate the energy underreporting are described in Table 2. It was observed that the average energy intake report value was less than the value of resting energy expenditure.

Fig. 1 illustrates a comparison between energy intake (EI) and the resting metabolic ratio (RMR) of the patients. The average of the reported energy intake (repEI) of the 24hR was 1583.27±575.29 kcal/day and the mean ratio for repEI:est RMR was 0.88±0.33. It is known that the smaller the reason IE:RMR, the greater the probability of assessing energy intake underreporting.

The assessing energy intake underreporting was observed in 92,3% of the volunteers (Fig. 2), after the cut-off point EI:RMR (1,41) proposed by Goldberg et al. [17] The prevalence of underreporting varies in the literature from 25% to 85% [18,19]. However, we observe many different methodological approaches, making the studies difficult to compare.

It is noteworthy to say that the high percentage of the assessing energy intake underreporting found in our study may be justified by the estimation of the RMR because the prediction equations may overestimate energy requirements and consequently decrease the ratio EI:RMR, increasing the percentage of underreporters [20]. Although many studies have not found significant differences in the prevalence of underreporting considering estimated or measured RMR [21].

More than half of the sample (73%) reported consumption below the RMR. Johansson et al. [22] found that 40% of the patients of their study reported EI lower than RMR. The BMI and WC were positively associated with lower food consumption report.

Table 2. Variables of the energy balance in the patients (n = 52)

Variables	Mean ± Standart deviation	Median	Minimum	Maximun
rEI [a] (Kcal)	1583,27±575,29	1466,30	628,97	3408,56
estRMR[b] (Kcal)	1802,71±227,02	1754	1441	2705
Rep EI: estRMR[c]	0,88±0,33	0,80	0,36	1,84

[a]rEI: Reported Energy Intake and energy expenditure estimated at rest) and the ratio rEI:RMR [b]estRMR: estimated resting metabolic rate; [c]ratio rEI/estRMR

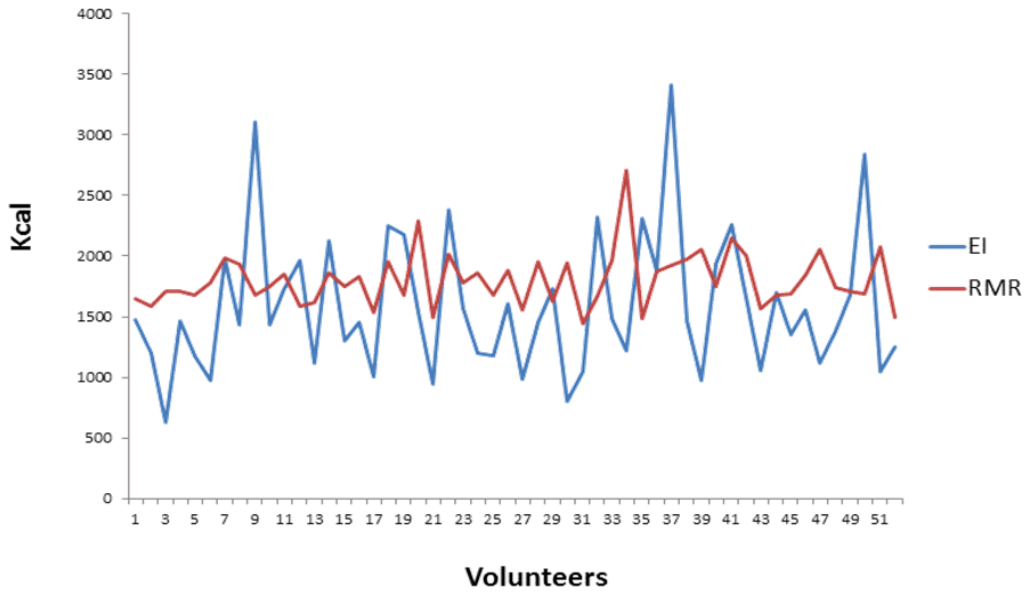

Fig. 1. Comparison of Energy Intake (EI) with the Resting Metabolic Ratio (RMR).

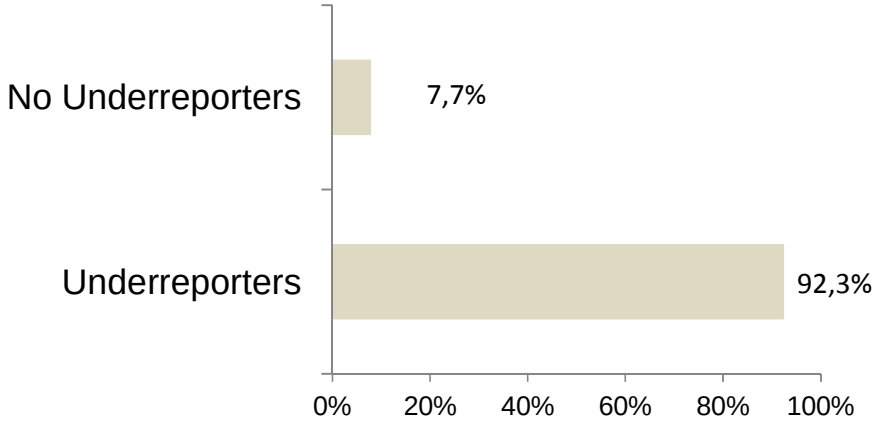

Fig. 2. Percentage of assessing energy intake underreporting in the volunteers (n = 52)

The association between BMI and the assessing energy intake underreporting showed a higher number in higher BMI values, but not significant. When we compare the assessing energy intake underreporting with the WC we observe an increasing tendency, although not significant (*P* =.05) (Tables 3 and 4).

In Brazil the assessing energy intake underreporting and the variables associated to this phenomenon are still poorly researched. Santos et al. [23] describe that the overweight seems to be one of the most significant factors in predicting the underreporting, whereas the desire of losing weight and the perceptions about themselves may influence the way that individuals report food consumption.

When comparing nutritional status according to BMI, there was a prevalence of overweight in 75% of the underreporters. These data show that underreporting is more common and highly prevalent among individuals with excessive body weight, which agrees with most authors [24,25].

On the other hand, there was a downward trend (A = - 0.384), although not significant when we associate assessing energy intake underreporting and the classification of nutritional knowledge (Table 5). It is possible to observe that there is more assessing energy intake underreporting when the nutritional knowledge decreases.

In this study there was a higher frequency of moderate nutritional knowledge (59.6%). Similar findings were found by Prates et al. [26] and Castro et al. [27]. When we compare the nutritional knowledge with the assessing energy intake underreporting, there is a limitation in the Brazilian literature. Scagliusi [9] did not found any association between nutritional knowledge and inaccurate reporting of energy intake.

Some studies have found that patients tend to underreport the foods that they consider not healthy [28], therefore there was the assumption that underreporters would have more knowledge about nutrition. However, this study found an opposite tendency, i.e., the higher the underreporting lower the nutritional knowledge.

It is known that the underreporting phenomenon is not simply explained by the lower underreport of unhealthy foods. Other possible errors may distort the information about the food intake, as the perception of what is eaten, the interviewee's memory, effects of age, sex and interview setting and the daily food variation and seasonality. The very situation of being subject of the research may affect the pattern of intake and the accuracy of the information, as well as the interviewer's ability to get information and a willingness to collaborate with the study [29].

In addition, the healthy choices are associated with a better nutritional status, not only to the knowledge [30]. According to Prates [26], people who have better nutritional knowledge may add to the usual diet the consumption of fruits and vegetables, but keep, between eating habits, the consumption of foods rich in sugars and fats.

These findings lead us to consider that there are several challenges that must be faced in the process of assessment of food intake, once the assessing energy intake underreporting has been found frequently in studies involving dietary surveys.

Table 3. Association between the assessing energy intake underreporting with the Body Mass Index (BMI)

	Low weight	Eutrophic	Overweight	Chi square
Underreporters	1 (2%)	8 (23%)	39 (75%)	
No Underreporters	---	1 (2%)	3 (6%)	A = 0,153* *P*= .85

**Growing tendency (A > 0) by Qui-square test (Chi Square test for trend)*

Table 4. Association between the assessing energy intake underreporting with the Waist Circumference (WC)

	CC Adequate	CC High	CC Very High	Chi square
Underreporters	6 (11,5%)	12 (23%)	30 (65,5%)	
No Underreporters	2 (96%)	1 (2%)	1 (2%)	A = 2,769* *P* =.05

**Growing tendency (A > 0) by Qui square test (Chi Square test for trend)*

Table 5. Association between the nutritional knowledge and the assessing energy intake underreporting

	Low	Moderate	High	Chi square
Underreporters	12 (23%)	29 (56%)	7 (13%)	
No Underreporters	1 (2%)	2 (4%)	1 (2%)	A = **-** 0,384* *P*= .75

**Growing tendency (A > 0) by Chi square test (Chi Square test for trend)*

Our study was limited to the use of predictive equation to detect underreporting, however, the use of other methods, such as doubly labeled water is difficult because of its high cost and complexity. Since obesity is a public health problem, we should consider different, simple and cheaper methods to determine the food consumption and thus make a differentiated approach to the patients in order to help the treatment.

4. CONCLUSION

In this study the assessing energy intake underreporting was high in the sample. We found a higher underreporting tendency among individuals with higher BMI and WC and lower nutritional knowledge. More studies are necessary to validate the dietary surveys due to their importance for carrying out a nutritional management, dietary prescription and proceed to the determination of the nutritional status of the individuals.

CONSENT

All authors declare that a written informed consent was obtained from the patient for publication of this research.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee (Research Ethics Committee – Medical School of Marilia - São Paulo - Brazil, in August 21, 2014, under protocol number 770.836) and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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