

Underreporting of Food Intake in Obese Diabetic and Nondiabetic Patients

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The close relationship between excess body weight, insulin resistance, and type 2 diabetes is well known (1). A decrease in weight improves insulin sensitivity, metabolic control, and the necessity for oral or insulin treatment (2). Dietary monitoring is a cornerstone of diabetes treatment, being essential to both improve current food intake and aid in the explanation of any disturbance in metabolic control. Dietary monitoring of food and energy intake (EI) therefore assumes that the dietary reports of diabetic patients are valid. Meanwhile, underreporting of food intake is widely acknowledged in obese individuals (3,4) yet is generally disregarded in the type 2 diabetic population, despite the fact that a significant percentage of this population is obese. The issue of EI underreporting and diabetes was first raised by Prentice et al. (5) and has since been discussed in only a few studies conducted in type 2 diabetic patients (6–8). The doubly labeled water (DLW) method is a state-of-the-art technique used to estimate total energy expenditure (TEE) (9). TEE refers to the energy requirement of an individual, which corresponds to EI under conditions of weight stability. The comparison of the ratio of EI to resting energy expenditure (REE) and the ratio of TEE to REE (i.e., the physical activity level) is the tool conventionally used to detect for misreporting (4). To date, the DLW method has been used in the measurement of TEE in only one study (10), which involved a small number of subjects. However, the DLW method has not

been used to quantify misreporting in the type 2 diabetic population, and current evidence relies on the results of proxy measurements of TEE, such as REE prediction equations and physical activity monitors (6–8). We have therefore undertaken this study to directly measure and compare TEE and REE with EI in a group of 21 obese patients, 12 of whom have type 2 diabetes.

RESEARCH DESIGN AND METHODS

Twelve weight-stable, obese, type 2 diabetic patients treated with metformin only (11) and 9 obese nondiabetic patients participated in this study, which was approved by the hospital's ethical committee. Height was measured to the nearest 0.1 cm (SECA, Hamburg, Germany). Weight was measured to the nearest 0.01 kg (DS Medica, Rome, Italy). Percentage of fat and fat-free mass were determined using a four-compartmental model to measure body volume and bone mineral content, with the estimation of total body water conducted using bioelectrical impedance (12,13). An experienced dietitian estimated usual food intake using a 3-day food recall and calculated the total daily EI, i.e., the energy from all reported meals and snacks combined, using computerized French food composition tables (BILNUT 4.0. S.C.D.A. Nutrisoft, 1995). Protein, lipid, carbohydrate, and alcohol intake were calculated in the same way. REE was measured by indirect calorimetry using a ventilated hood system (Vmax Spectra; SensorMedics, Yorba Linda, CA)

as already described (14). TEE was measured using the DLW method as previously described by Ritz et al. (15). Briefly, subjects consumed a weight-dependent dose of DLW. Urine samples were collected before dosing and everyday for the following 14 days. Isotopic analyses were performed as described by Ripoché et al. (16), using the multipoint method (15). Statistical analysis was performed using Statview software (Abacus Concept, Cary, NC). Results are expressed as means \pm SD. Cross-sectional differences between categories were assessed by ANOVA.

RESULTS— Table 1 summarizes the characteristics of the two patient groups who were matched for weight, body composition, and BMI. The diabetic patients were older and had a higher HbA_{1c} than their nondiabetic counterparts. TEE and REE did not significantly differ between the groups. Reported EI was, however, significantly lower in the diabetic group. The ratio of TEE to REE fell within the expected range (4) and was similar between the diabetic and nondiabetic groups. Although the ratio of EI to REE was low in nondiabetic patients, it was significantly lower in the diabetic patients, suggesting that these patients reported eating 22% less energy than is necessary for them to maintain even basic functions to live. Furthermore, given that the range of EI to REE ratios was between 0.5 and 1.23 in this diabetic group, all 12 of these patients underreported (4). All but one patient in the nondiabetic group had an EI to TEE ratio that fell below 0.79, which represents the lower 95% CI of the cutoff value for underreporting (6). In both patient groups, women underreported to a greater extent than men (data not shown), as has been shown in previous studies (8).

CONCLUSIONS— Underreporting food intake has been suggested as a problem in diabetic patients. The present data has validated this in an unquestionable way, given that we used a state-of-the-art tool (DLW) to measure TEE. In this study, reported EI was just adequate to match REE values in the nondiabetic patient group but was wholly insufficient to meet the REE values in the diabetic group. This

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Abbreviations: DLW, doubly labeled water; EI, energy intake; TEE, total energy expenditure; REE, resting energy expenditure.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

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Table 1—Characteristics of the diabetic and the nondiabetic patient groups

	Diabetic patients	Nondiabetic patients	P
Weight (kg)	105.7 ± 17.2	100.3 ± 19.0	0.504
BMI (kg/m ²)	37.1 ± 4.67	37.0 ± 3.40	0.951
Fat mass (%)	39.7 ± 4.7	40.6 ± 7.6	0.980
HbA _{1c} (%)	7.52 ± 1.11	5.15 ± 0.40	<0.0001
TEE (kcal/day)	3,863 ± 1,890	3,389 ± 887	0.496
REE (kcal/day)	2,020 ± 421	1,805 ± 470	0.283
EI (kcal/day)	1,520 ± 266	1,934 ± 331	0.005
TEE to REE	1.857 ± 0.503	1.881 ± 0.198	0.891
EI to REE	0.778 ± 0.198	1.109 ± 0.251	0.0031
EI to TEE	0.438 ± 0.129	0.600 ± 0.178	0.026

Data are means ± SD. P by ANOVA.

suggests that in this group we have to multiply reported food intake by ~2.5 to attain a credible EI. This factor, however, varies considerably between patients and probably does not affect carbohydrate and fat intake to the same extent. Further studies are necessary to understand the reasons why diabetic patients underreport more than their obese counterparts. Dietary educational programs should consider this aspect when dealing with patients to better understand how their feeding behavior can be improved.

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