DIETARY INTAKE AND SELF-REPORTING IN RELATION TO EATING BEHAVIOUR IN OBESE AND TYPE 2 DIABETES PATIENTS

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Abstract

Background: Underreporting of food intake is important in obese and type 2 diabetes (DM) subjects and could be associated with psychological factors. Objectives: to compare reported energy intake in obese and type 2 diabetes patients and analyze the influencing factors on low energy reporting (LER); to investigate the possible association of Three Factor Eating Inventory (TFEI) scores with energy reporting, body weight, diabetes status, age and gender. Materials and methods: Resting metabolic rate (indirect calorimetry), food intake (seven day food diary) energy reporting level, chronic dietary restraint, disinhibition and hunger (TFEI) were assessed in 131 adult (45 obese; 59 obese with type 2 diabetes; 27 non-obese with type 2 diabetes), aged between 21 and 75 years, with mean (±SE) body mass index from 24.5±1.14 to 38.0±0.7. Results: The percentage of LER was 89% in obese, 90% in obese DM and 74% in non-obese DM groups. LER was associated with high body weight (BW) in obese and with restraint in type 2 diabetes groups. Obesity was associated with disinhibition, whereas diabetes was significant predictor for hunger and restraint (p<0.001). Positive correlation was found for hunger and restraint (r = 0.294, p<0.001) and hunger and disinhibition (r = 0.533, p< 0.001). Female gender was related to higher scores of all TFEI factors (p<0.001). Conclusion: Low energy reporting was associated with obesity. Disinhibition was related to body weight, whereas restraint and hunger to diabetes. Eating behaviour should be considered for a complex treatment of obesity and diabetes.

Keywords energy reporting, Three Factors Eating Inventory, obesity, type 2 diabetes

Introduction

The assessment of habitual food intake is pivotal in the dietary management of Type 2 diabetes mellitus (DM) and obesity. It is well recorded that because assessment of dietary intakes are generally obtained by self-reported means, they are subject to a number of reporting biases, which may lead to misrepresentation of actual intake and therefore compromise the validity of the data. Errors can come from technical limitations associated with recoding food and fluid intake (commonly termed under-recording) or may be associated with the bias of the subject in either overt or covert manner, which is commonly termed misreporting. The degree of underreporting in dietary studies varies greatly, from 10 to 91%, depending on several characteristics (1-8) e.g. high BMI (1, 2), female gender (3, 4), increased age (5, 6), and the desire to lower body weight (7, 8). Only a few studies, however, focus specifically on individuals with type 2 diabetes (9, 10). Using the ratio of energy intake (EI) to basic metabolic rate (BMR) cut-off based on the Goldberg equation, 58% of type 2 diabetic patients were classified as energy under-reporters in one US (10) study and 42% to 73% in another European study (9), dependant on age. The highest correlation between dietary nitrogen intake and dietary assessment method is recorded using weighed dietary records and seven day food diaries assessing the ratio of urine nitrogen:dietary nitrogen (11, 12). Thus, it has been concluded that the results obtained from seven day food diary are the closest to the results of the weighted records and are valid to use for dietary assessment.

Assessment of factors influencing eating behaviour may be important, as it is known to be associated with BMI. The Three Factor Eating Inventory Questionnaire (TFEI) of Stunkard & Messick (13) is a recognized instrument for quantifying influences on eating behaviour, based on 3 constructs termed restraint, disinhibition, and hunger. Dietary restraint is defined as a tendency to consciously restrict food intake either to prevent weight gain or to promote weight loss (14); disinhibition is the tendency to overtake in the presence of palatable foods or other disinhibiting stimuli such as emotional distress and hunger is the susceptibility to perceived body symptoms that signal the need for food (15). Previous studies using the TFEI found that high disinhibition scores were consistently associated with high BMI (16, 17), whereas data on restraint are inconsistent, showing both significant positive (18) and negative (19) association of restraint scores with BMI. Analysis of psychological measures in association with mis-reporting of food consumption revealed that women prone to mis-reporting had higher hunger and disinhibition scores than those intending to report accurately (20). Only a few studies, however, focus specifically on individuals with type 2 diabetes without (9, 10) or with (21) eating disorders.

The aims of this study were: 1) to compare reported energy and dietary intakes of obese (obese without DM), obese type 2 diabetes (obese DM) and type 2 diabetes without DM, obese type 2 diabetes (obese DM) and type 2 diabetes with DM; 2) to compare the energy and dietary intakes of obese and type 2 diabetes patients.
without obesity (non-obese DM) subjects, using a seven day food diary method; 2) to analyze the influencing factors on low energy reporting (LER) in obese (obese without DM and obese DM groups) and type 2 diabetes (obese DM and non-obese DM groups) patients to assess whether obesity and diabetes are significant predictors of LER. 3) to investigate the possible association of TFEI scores with energy reporting, BW, diabetes status, age and gender in all patients group.

Research design and methods

One hundred and thirty-one adult (45 patients with obesity; 59 with obesity and type 2 diabetes; 27 non-obese patients with type 2 diabetes), aged between 21 and 75 years were recruited from Woolmanhill Obesity and Diabetic Clinic in Aberdeen, Scotland and also by newspaper advertisement. Written, informed consent was obtained from all subjects before the beginning of analyses. The study was approved by Grampian Research Ethics Committee.

Inclusion criteria were: male and female aged 18 to 75 years, BMI>30 kg/m² for obese and obese type 2 DM subjects and BMI <25 kg/m² for non-obese type 2 DM subjects (Table 1 shows the subject characteristics at recruitment). Patients were divided into three groups based on diabetic status and BMI, as recommended by The National Institute of Health (21). Patients with any severe cardiac problems, malignant tumours, psychiatric disorders, abnormal thyroid function or taking L-thyroxin, beta-blockers and/or diuretics were excluded from the study.

### Table 1. Clinical characteristic of obese patients without diabetes, obese with type 2 diabetes and non-obese with type 2 diabetes patients

<table>
<thead>
<tr>
<th></th>
<th>Obese without DM</th>
<th>Obese DM</th>
<th>Non-obese DM</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (M/F)</td>
<td>45 (15/30)</td>
<td>59 (31/28)</td>
<td>27 (18/9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age (years)</td>
<td>43.3±1.6</td>
<td>56.1±1.4</td>
<td>62.5±1.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BW (kg)*</td>
<td>105.8±3.0</td>
<td>107.3±2.3</td>
<td>66.7±3.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Height (cm)*</td>
<td>167.0±1.3</td>
<td>168.4±1.2</td>
<td>166.8±1.5</td>
<td>NS</td>
</tr>
<tr>
<td>BMI*</td>
<td>37.4±0.9</td>
<td>38.0±0.7</td>
<td>24.5±1.14</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Waist (cm)*</td>
<td>114.5±2.1</td>
<td>121.0±1.6</td>
<td>88.4±2.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hips (cm)*</td>
<td>122.1±2.2</td>
<td>120.1±1.7</td>
<td>94.02±2.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>W/H ratio*</td>
<td>0.942±0.01</td>
<td>1.01±0.01</td>
<td>0.942±0.02</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>RMR KJ/d*</td>
<td>7530±189</td>
<td>8480±147</td>
<td>6183±232</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>EI rep KJ/d*</td>
<td>7966±513</td>
<td>7291±397</td>
<td>6903±627</td>
<td>NS</td>
</tr>
<tr>
<td>EI rep/RMR*</td>
<td>1.03±0.06</td>
<td>0.89±0.05</td>
<td>1.17±0.08</td>
<td>0.005</td>
</tr>
<tr>
<td>Fat g*</td>
<td>72.0±5.5</td>
<td>67.5±4.2</td>
<td>63.7±6.7</td>
<td>NS</td>
</tr>
<tr>
<td>Protein g*</td>
<td>85.2±4.7</td>
<td>85.5±3.6</td>
<td>73.4±5.7</td>
<td>NS</td>
</tr>
<tr>
<td>CHO g*</td>
<td>221.8±21.0</td>
<td>195.9±16.3</td>
<td>194.0±25.7</td>
<td>NS</td>
</tr>
</tbody>
</table>

Data are means with group standard error (± SE)

Abbreviations: N, number of patients; BW, body weight; BMI, body mass index; W/H, waist to hip ratio; RMR, resting metabolic rate; EI rep, reported energy intake; CHO, carbohydrates; TFEI, Three Factors Eating Inventory; NS, non-significant.

All tests were undertaken in the morning at the Clinical Research Unit at Foresterhill Hospital, under standardized conditions. Subjects arrived after an overnight rest and fast at least 12 hours. They were asked to avoid vigorous physical activity, not to consume coffee or tea or to smoke prior to attending in the Unit.

Measurement of body composition:

Height was measured at the nearest 0.5 cm (Holtain Ltd, Crymnych, Dyfed, Wales) and body weight was measured by digital weighing scales to the nearest 0.1 kg (TANITA Corporation, Tokyo, Japan). These measurements were taken with empty bladder, barefoot, without clothing and wearing a hospital gown of known weight, which then was subtracted from measured body weight. BMI was calculated as proportion of body weight in kg and height in m² using the Quetlet’s index (23). Waist and gluteal (hip) circumferences were measured as described in the International Standards for Anthropometric assessment (ISAA) (24). The W/H ratio was then calculated from the duplicate measurements.

Measurement of resting metabolic rate (RMR)

RMR was measured by indirect calorimetry (ventilated hood) using DELTATRAC™ MBM – 200 Metabolic Monitor (Datex-Engstrom Division, Instrumentarium Corporation, Finland. The monitor was calibrated before
each measurement using Datex-Engstrom calibration gas containing 95% oxygen and 5% carbon dioxide (SW-Vickers, Perth, UK). Subjects were always measured in the morning after overnight sleep. They rested quietly on the bed for about 10 min before measurement and then were instructed to lie still but not to sleep. Data points were collected every minute for 40 minutes. The first 10 min were excluded from calculations. Mean EE was then calculated according to results of 15 min of steady state, when respiratory quotient (RQ), VO2 and VCO2 volumes did not vary >10%. RMR was calculated as follows:

\[
\text{RMR (kJ/24 hours)} = ((15.818 \times \text{VCO2}) + (5.176 \times \text{VO2})) \times 1.44
\]

where VCO2 and VO2 in l/min; 15.818 and 5.176 are the energy equivalents of oxygen and carbon dioxide (25).

### Measurement of food intake

Total food intake was estimated by a seven day dietary record. Subjects received instructions on how to keep a food record and were asked to not change their habitual food intakes. Household measures and two dimensional colour copies of 22 meals were provided from ‘A Photographic Atlas of Food Portion Size’s (26). Average food portion sizes were used to convert the household food portions into grams (27). The data then were entered into a computerized version of McCance and Widdowson composition of foods and supplements program WinDiets (The Robert Gordon University, Aberdeen, Scotland, UK) to obtain an average daily output of energy and nutrient intake. Total energy (in kJ), protein (g), fat (g) and carbohydrates (CHO) (g) intake was calculated each day for 7 days and average was used in statistical analysis.

The ratio of reported energy intake to measured RMR (EI:RMR) was used to classify under-reporting as described by Goldberg et al (28). Under-reporting of energy intake was defined as EI:RMR <1.35 as 1.35 × BMR represents the minimum energy expenditure compatible with a normally active lifestyle (29).

### Assessment of eating behaviour

The Three-Factor Eating Inventory Questionnaire (TFEI) of Stunkard & Messick (13) was used to assess influences on eating behaviour. Questionnaire was scored according to guidelines (13): one point was given for each item in Part I and Part II and the factor number is determined. Correct response was given one point and wrong response was given 0 point. Each factor computed as a sum of correct answers that represent particular factor.

### Statistical analysis

Normal probability plots tests were used to determine whether variables followed a normal distribution. One-way analysis of variance (ANOVA) was then used to compare the means from the three groups. Accumulated ANOVA was used to adjust different variables to age and gender within the groups. Correlation analysis was assessed by Pearson’s correlation. Several regression models were performed by multivariate regression analysis using EI/RMR and TFEI scores as the dependent variables and age, gender, BW, W/H ratio and reported amount of nutrients as independent variables. Statistical analysis was performed with the GenStat statistical program (8th edition for windows, Rothampstead Experimental Station, Harpenden, UK).

### Results

#### Energy intake data

The baseline characteristics of the subjects are shown in Table 1. The means of different variables between the groups were compared using one-way ANOVA. All other variables within each group were adjusted to age and gender before further analysis. As anticipated both obese groups had significantly higher BW and BMI, compared with non-obese DM group (p<0.001), however waist circumference, W/H ratio and RMR kJ/d was the highest in obese DM (p<0.001). The amount of nutrients (fat, protein and CHO) and composition of diet was reported to be similar in all the groups. Reported energy intake did not differ between the groups, despite different body weight, but the ratio of EI rep/RMR was the lowest in obese DM group and the highest in non-obese DM group (p=0.005). The average value of EI rep/RMR was less than cut-off point of 1.35 in all the groups, giving 1.03 value for obese without DM, 0.89 for obese DM and 1.17 for non-obese DM group (p=0.005). The energy intake was underreported by 89%, 90% and 74% of subjects in these groups respectively. The level of self-reporting did not differ between males or females, indicating a similar EI rep/RMR ratio of 1.0 after adjustment to age and BW in both genders.

#### Anthropometry data

EI rep correlated positively with BW, waist circumference and RMR only in obese without DM group, whereas W/H ratio, describing abdominal type of fat distribution, correlated negatively with reported energy intake in non-obese DM group. Restraint, as measured by TFEI, also correlated negatively with reported EI, but only in obese DM patients as shown in Table 2.
Table 2. Correlation coefficients (r) of reported RMR and different variables among obese without DM, obese DM and non-obese DM patient groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obese without DM</th>
<th>Obese DM</th>
<th>Non-obese DM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>p value</td>
<td>r</td>
</tr>
<tr>
<td>BW</td>
<td>0.470</td>
<td>&lt;0.01</td>
<td>0.770</td>
</tr>
<tr>
<td>Fat g</td>
<td>0.776</td>
<td>&lt;0.001</td>
<td>0.770</td>
</tr>
<tr>
<td>Protein g</td>
<td>0.643</td>
<td>&lt;0.001</td>
<td>0.555</td>
</tr>
<tr>
<td>CHO g</td>
<td>0.851</td>
<td>&lt;0.001</td>
<td>0.877</td>
</tr>
<tr>
<td>Waist (cm)</td>
<td>0.347</td>
<td>&lt;0.05</td>
<td></td>
</tr>
<tr>
<td>W/H ratio</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RMR kJ/d</td>
<td>0.571</td>
<td>&lt;0.001</td>
<td></td>
</tr>
</tbody>
</table>

Analysis of correlates of mis-reporting

To analyse the influencing factors on low energy reporting in obese and type 2 diabetes we performed multivariate regression analysis and estimated BW, fat, protein and CHO to be the most important predicting variables in obese and DM groups, explaining 86.0% and 88.5% of variance in EI rep/RMR (P<0.001), however additional variables were different within each group:

- In obese patients group (obese without DM and obese DM groups, n=104) gender or W/H ratio (Table 3) added to the model were significant predictors (p<0.001) giving 2 possible equations:
  
  EI rep/RMR = 0.659 + (0.002 × CHO g) + (0.003 × fat g) + (0.003 × protein g) – (0.005 × BW kg) – (0.109 × male gender);
  
  R² adjusted = 0.88 or EI rep/RMR = 1.171 + (0.002 × CHO g) + (0.003 × fat g) + (0.003 × protein g) – (0.006 × BW kg) – (0.497 × W/H ratio); R² adjusted = 0.88 (p<0.001 for both).

- In type 2 diabetes patients group (obese DM and non-obese DM groups, n=86) 88.9% of variance in energy reporting level was explained by adding the restraint score (p<0.033):
  
  EI rep/RMR = 0.659 + (0.002 × CHO g) + (0.003 × fat g) + (0.003 × protein g) – (0.005 × BW kg) – (0.109 × male gender);
  
  R² adjusted = 0.88 or EI rep/RMR = 1.171 + (0.002 × CHO g) + (0.003 × fat g) + (0.003 × protein g) – (0.006 × BW kg) – (0.497 × W/H ratio); R² adjusted = 0.88 (p<0.001 for both).

Table 3. Coefficient and significance of variables in the multiple regression equation predicting EI rep/RMR in obese patients group (n = 104) with gender or W/H ratio included into the model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>SE</th>
<th>t</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.659</td>
<td>0.071</td>
<td>9.27</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>CHO g</td>
<td>0.002</td>
<td>0.0001</td>
<td>17.95</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Fat g</td>
<td>0.003</td>
<td>0.001</td>
<td>6.07</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Protein g</td>
<td>0.003</td>
<td>0.001</td>
<td>4.68</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BW kg</td>
<td>-0.005</td>
<td>0.001</td>
<td>-7.11</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Male gender</td>
<td>-0.109</td>
<td>0.029</td>
<td>-3.80</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Or</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>1.171</td>
<td>0.144</td>
<td>8.15</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>CHO g</td>
<td>0.002</td>
<td>0.0001</td>
<td>17.47</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Fat g</td>
<td>0.003</td>
<td>0.001</td>
<td>6.22</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Protein g</td>
<td>0.003</td>
<td>0.001</td>
<td>4.52</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BW kg</td>
<td>-0.006</td>
<td>0.001</td>
<td>-8.28</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>W/H ratio</td>
<td>-0.497</td>
<td>0.139</td>
<td>-3.57</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

None of eating behavior factors had influence on energy intake mis-reporting in obese patients group.

A multivariate regression analysis tested a possible association of restraint, disinhibition and hunger with body weight, diabetes status, age and gender in all patients group (n = 131), giving the following results:

Restraint = 5.66 + (0.43 × hunger) – (3.04 × diabetes status) – (2.06 × male gender) + (0.08 × age);

R² adjusted = 0.2 (p<0.001).

Disinhibition = 2.98 + (0.038 × BW) – (1.94 × male gender) + (0.595 × hunger) – (0.155 × restraint);

R² adjusted = 0.39 (p<0.001).

Hunger = (0.477 × disinhibition) – (0.24 × restraint) + (2.51 × diabetes status) – 0.782;

R² adjusted = 0.47 (p<0.001).
All factors of TFEI were interrelated showing positive association between hunger and restraint ($r=0.294$, $p<0.001$) and hunger and disinhibition ($r=0.533$, $p<0.001$). Type 2 diabetes patients were less restrained and felt hungrier, thus diabetes status influence on restraint and disinhibition cannot be ignored. BW was significant positive predictor for disinhibition, but not for restraint or hunger. Male gender was associated with lower restraint and disinhibition scores, however, when data were analysed in male ($n=64$) and female ($n=67$) groups, after adjustment to age and BW, females had significantly higher total TFEI score than the males (mean±SE: $11.4±0.57$ vs. $8.2±0.58$, for restraint; $9.8±0.45$ vs. $7.4±0.46$ for disinhibition; $8.3±0.40$ vs. $6.3±0.41$ for hunger respectively, $p<0.001$ for all) (Figure 1).

Fig. 1. The difference ($p<0.001$) in restraint, disinhibition and hunger scores between male ($n=64$) and female ($n=67$) groups, after adjustment to age and BW

Discussion

In the present study, the level of energy and nutrient self-reporting was studied in association with body weight, diabetes status, gender and psychological scores in obese without diabetes, obese DM and non-obese DM patients.

Degree of mis-reporting

The results of this study showed that 89%, 90% and 74% of subjects underreported EI in obese without diabetes, obese DM and non-obese DM groups respectively. Gender did not influence the level of energy reporting, with males and females mis-reporting to a similar degree.

The high percentage of LER was also found in previous studies with obese (30-34) and type 2 diabetes patients (9, 10). A very wide range of LER can be noted comparing different studies, varying from 27% (31) to 78% (34) in obese and from 42% to 73% in type 2 diabetes groups (9). So significant discrepancy between the results could be explained by different tools used to assess food intake (food frequency questionnaires, 7 day food intake diaries, 24 hour diet recalls), different ratios (EI rep/RMR (measured or estimated) or EI rep/EE) and cut-off limits to identify low energy reporters (from 0.9 to 1.35) and different methods used to calculate actual energy and nutrients intake. We have estimated higher percent of LER, compared to previous studies, which could indicate that some of the participants were dieting but we had no possibility to measure patient’s body weight within the diet recording phase so it is not clear if the body weight of our patients remained stable. Despite they were instructed do not to change habitual food intake, it is possible that some of them ate less than usually, giving additional bias to our results.

We confirmed the results of previous studies, that the level of energy reporting has positive association with amount of nutrients and negative association with BW both in obese and type 2 diabetes patients. We estimated that the male gender was a negative predictor of the level of energy reporting in obese patients, which is controversial, as most other studies have indicated female gender to be associated with lower energy reporting (33, 36, 37).

Psychological influences on eating behaviour

We estimated psychological scores to be positively interrelated in all patients group. Type 2 diabetic subjects had less restraint, but felt hungrier, whereas obese scored higher disinhibition value. The association between EI rep/RMR and psychological measures was significant only in type 2 diabetes group, where restraint was a positive variable influencing the rate of under-reporting i.e. the more restrained the subjects the more they under-reported. We also estimated BW to be significant factor only for disinhibition, showing obese subjects to have higher scores, which agrees with the results of Bellies et al (38), who analyzed TFEI and body adiposity in a study of 2509 adults with a wide range of BMI. Similar results were found in patients with eating disorders in the studies of Lawson et al (17) and Hsu et al (39). Positive correlation between hunger and disinhibition in all patients group was also in agreement with previous investigations (17, 38), whereas diabetes status effect on TFEI scores, to our knowledge, has not been reported before. Diabetes status was significant negative predictor for restraint and positive predictor for hunger, thus patients with type 2 diabetes were less restrained and felt more hunger compared to those without diabetes. Significantly higher all scores of TFEI estimated in female compared to male are concordant with other studies that have found higher scores for disinhibition and restraint in women than in men (40, 41). It appears that women have greater concern about dieting and body weight than men and consciously restrict their food intake to control body weight.

Thus, the analysis of psychological factors provides us with additional information that could be used in daily clinical practice. The longitudinal usage of TFEI may help to assess the compliance to the dietary advice and prescribe effective treatment for weight loss, accounting on good response to information about nutrition and caloric balance in subjects with high restraint, behavioral strategies for stimulus control in subjects with high disinhibition and good response to appetite suppression medications in patients with high hunger scores.

Conclusion

This study was conducted in Caucasian population with obesity and type 2 diabetes to compare the level of mis-reporting of energy and nutrient intake in these patient groups and to further attempt to identify the associated psychological factors associated with under-reporting. We
have estimated very high percent of low energy reporting in all groups which was associated with obesity. Psychological measures were interrelated and only degree of restraint influenced energy reporting in type 2 diabetes patients. Disinhibition score was positively related to body weight, however restraint and hunger were affected by diabetes status. The results of current study confirm that eating behaviour is important factor and can not be ignored when we talk about obesity prevention and treatment. Type 2 diabetes is more one serious situation that could alter eating behaviour and therefore, lead to weight gain. Thus, complex treatment should be considered, based on both physiological and psychological elements.

Acknowledgement

We wish to thank Ms Kathleen Mackinnon at the Clinical Research Unit for the assistance in patient recruitment, Ms Clare Adam and Ms Sandra Murison for the help analysing food diaries.

References


Abbreviations

ANOVA – analysis of variance  
BMI – body mass index  
BW – body weight  
BMR – basic metabolic rate  
CHO - carbohydrates  
DM – diabetes mellitus  
EI - energy intake  
ISAA - International Standards for Anthropometric assessment  
LER – low energy reporting  
RMR – resting metabolic rate  
RQ – respiratory quotient  
SE – standard error  
TFEI - Three Factor Eating Inventory Questionnaire  
W/H – waist – to – hip (ratio)

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