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ORIGINAL ARTICLE

Dietary habits in type II diabetes mellitus: how is adherence to dietary recommendations?

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Objective: To clarify adherence of type II diabetic patients to dietary recommendations.
Subjects and methods: The dietary habits of a group of 540 patients, with type II diabetes (male 322/female 218, mean age 61 ± 5 years, body mass index (BMI) 29.7 ± 5.2 kg/m^2; mean $\pm$ s.d.) referring to six Italian diabetes centres were evaluated by means of a 3-day diet record (2 workdays, 1 holiday). Diet records were analysed according to Italian food composition tables and compared with the dietary recommendations of the Diabetes and Nutrition Study Group of the European Association for the study of Diabetes.
Results: Calorie intake was 1725 ± 497 kcal (1800 for men, 1610 for women). Mean intake for each nutrient was close to the recommended amount, except for fibre (12/1000 vs 20 g/1000 kcal). Calculating the percentage of patients who complied with each recommendation, the intakes of saturated fat and fibre least reflected the dietary target: in 43% of patients saturated fat was $>10\%$ of total calories, in only 6% was fibre intake $\geqslant 20$ g/1000 kcal (considered ideal), and in 25% it was $\geqslant 15$ *g*/1000 kcal (acceptable).
Conclusions: These results indicate that compliance to dietary recommendations is not completely satisfactory, even in Italy. Calorie intake is a bit elevated, given the high BMI of our diabetic population. As to dietary composition, there are two crucial issues: the high intake of saturated fat and – most importantly – the low intake of fibre. All strategies aiming to a proper implementation of guidelines should take these results into due account.
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Keywords: diet; type II diabetes mellitus; dietary recommendations; saturated fat; dietary fibre

Introduction

Diet plays a pivotal role in the therapeutic strategy to keep patients with diabetes in good glycemic control and prevent micro and macrovascular complications. As a matter of fact, the scientific societies involved in the treatment of diabetes have been prescribing dietary recommendations for the treatment of this disease since many years. The most recent ones issued, independently, by the American Diabetes Association (ADA) and the Nutrition and Diabetes Study Group (NDSG) of the European Association for the study of Diabetes (EASD), have been formulated according to the principles of evidence based medicine (ADA, 2004; Mann *et al*., 2004).

Although the importance and the scientific basis of these recommendations are very well recognized, their translation into daily routine is very difficult. In fact, the few studies that have evaluated this specific aspect have shown poor adherence to dietary recommendations by diabetic patients, especially those with type II diabetes (Toeller *et al*., 1996; Thanopoulou *et al*., 2004).

Since the 'Mediterranean diet' is indicated as one of the best dietary patterns for the treatment of diabetes and the prevention of cardiovascular diseases (Riccardi and Rivellese,

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2000), in particular for their main characteristics – low intake of saturated fat and high intake of monounsaturated fat and dietary fibre – it has been hypothesized that Italian type II diabetic patients may somehow be advantaged in following this kind of dietary recommendations. The only study evaluating Italian type II diabetic patients in these respects seems to contradict this hypothesis (Thanopoulou *et al*., 2004). Furthermore, it clearly showed very different dietary habits among the various Mediterranean countries (Thanopoulou *et al*., 2004). Therefore, as most Italian regions differ for traditional gastronomic background, it is also likely that dietary habits of type II diabetic patients may differ according to regions.

Evaluation of dietary habits is a very difficult task, and many methods – food frequency questionnaires, diet history and dietary records – are available (Bates *et al*., 2005). For epidemiological purposes, food frequency questionnaires are generally used, even if weighed dietary records remain the most precise method of reference (Toeller *et al*., 1997; Bates *et al*., 2005).

Therefore, the aim of this study was to evaluate the real adherence to the most recent dietary recommendations (DNSG 2004) by a large sample of Italian type II diabetic patients referring to diabetic clinics of different regions, evaluating also possible interregional differences.

Subjects and methods

Type II diabetic patients participating in the Multifactorial Intervention Study in type II Diabetes – Italy (Mind.it) were asked to fill in a 3 day weighed dietary record before enrollment in the study. The Mind.it study was performed in 10 different diabetic centres, and involved type II diabetic patients aged between 50 and 75 years, with a diabetes duration of more than 2 years, at least two other major cardiovascular risk factors, no history of prior cardiovascular events and normal renal function defined as serum creatinine below 1.5 mg/dl.

At the baseline visit, before starting any intervention, patients were asked to report in a diary all the foods and beverages consumed on 3 consecutive days (2 weekdays and 1 holiday), with the corresponding weight measured on their own scales. The diary was first checked by the dietitian or doctor who collected it and was then analysed by a single dietitian, utilizing the Italian food composition tables (Carnovale and Marletta, 2000).

Four centres did not participate to this part of the study for lack of personnel.

The results are expressed as daily energy intake; carbohydrate, protein and fat intakes are expressed as percentage of total daily energy intake; dietary fibre is expressed as g/1000 kcal, cholesterol as mg/day and alcohol as g/day.

In addition, weight, height and waist circumference were measured according to a standard protocol. Venous blood was drawn in the morning in the fasting state. Total and high-density lipoprotein cholesterol, triglycerides and glycosylated haemoglobin were measured by standard methods at each participating centre. Low-density lipoprotein cholesterol was calculated according to the Friedwald formula (Friedwald *et al*., 1972).

An External Quality Control Assessment (EQAS) was implemented to verify reproducibility and comparability between laboratories in order to ensure, during the study, an adequate compliance to the analytical goals based on biological variability.

The EQAS was provided by the laboratory of Clinical Chemistry Standardization of the St Raffaele Hospital, which is a member of the Cholesterol Reference Method Laboratory Network and participates in the activities of JCTLM (Joint Commission for Traceability in Laboratory Medicine). During the cross-sectional phase, the mean percent bias of each laboratory from the target value was calculated. For all the laboratories exceeding the bias limit, a correction factor was calculated and patient results were corrected accordingly (Fraser *et al*., 1997).

Statistical analysis

Data are presented as mean $\pm$ s.d. unless reported otherwise. Variables with skewed distributions were log-transformed before statistical analysis. Analysis of variance and *t*-test, corrected by multiple comparisons, were used. $P<0.05$ was considered statistically significant (two-tailed). All the statistical analyses were performed using the SPSS 10.0 for Windows.

Results

Of all the patients ($n=1012$) participating to this part of the Mind.it study, and referring to six different Italian diabetic clinics (Bari, Pescara, Perugia, Pisa, Piacenza, Pavia), 540 completed the 3-day dietary record, which was acceptable for all. The others did not bring back the records.

The main characteristics of the group who filled in the dietary records are very similar to that of the group who did not: age 61 ± 5 vs 61 ± 5 years; diabetes duration 7 ± 7 vs 7 ± 8 years; body mass index (BMI) 29.7 ± 5.2 vs 29.6 ± 4.9 kg/m^2, except for the percentage of males, which was significantly higher (60 vs 48%, $P<0.05$). Table 1 shows the comparison between the characteristics of the diet followed by the patients (by gender) and the nutritional recommendations recently issued by DNSG. There were no main differences between men and women, except for calorie and alcohol intake, as expected. Energy intake was slightly higher than suggested, considering the patients' BMI and the possible under-reporting typical of all the methods used for the evaluation of dietary habits. Furthermore, calculating the energy needs with a formula based on body weight and activity level (very light for all our patients) (Ghils and Goodhart, 1980), the results were 1471 ± 289 kcal for men

Table 1 Dietary habits of type 2 diabetic patients compared to dietary recommendations (DNSG 2004)

	Men (n = *322*)	*Women* (n = *218*)	*Recommendations*
Energy (kcal) (from nutrients + alcohol)	1800 ± 470	1610 ± 516	↓ for overweight/obese
Protein % TE	19 ± 3	19 ± 3	10–20
Lipids % TE	32 ± 6	32 ± 6	25–35
Saturated fat % TE	10 ± 3	10 ± 3	<10
Monounsaturated fat % TE	15 ± 4	15 ± 4	10–20
Polyunsaturated fat % TE	4 ± 1	4 ± 1	<10
Cholesterol mg/day	214 ± 93	195 ± 87	<300
Carbohydrates % TE	49 ± 7	49 ± 6	45–60
Fibre g/1000 kcal	12 ± 4	13 ± 5	20 g/1000 kcal
Alcohol g/day	13 ± 16	5 ± 10	10g/day (women) 20g/day (men)

Abbreviation: TE, total energy; DNSG, Diabetes and Nutrition Study Group.
Mean ± s.d.

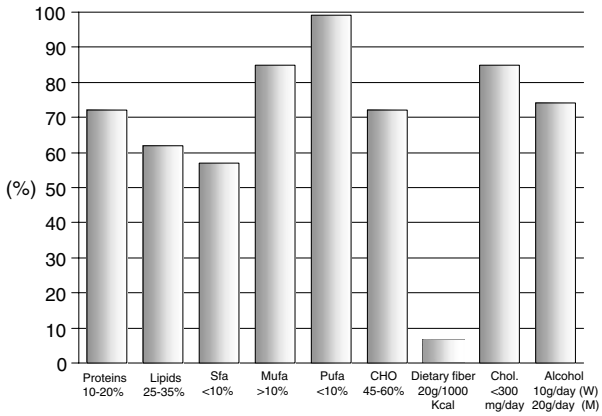

Figure 1 Percentage of patients adhering to each dietary recommendation (DNSG 2004).

and 1427 ± 274 kcal for women compared with the reported intake, 1800 ± 470 and 1610 ± 516 kcal.

The diet composition seemed almost adequate, at least on average, to the recommendations, except for saturated fat intake, which was slightly higher, and for dietary fibre intake, which was much lower than recommended (12 and 13 g/1000 kcal, respectively, for men and women, vs 20 g/1000 kcal). This result was even more clear cut when we analysed patients adhering to each recommendation, expressed as percentage (Figure 1): as to the intake of proteins, monounsaturated fat, polyunsaturated fat, cholesterol, carbohydrates and alcohol, adherence was almost satisfactory; as to saturated fat (57% of patients), it was less satisfactory; on the contrary, adherence to the recommendations regarding dietary fibre was surely inadequate whether we considered the ideal intake, 20g/1000 kcal (6%), or the more acceptable one of 15g/1000 kcal (25%). Only 3% of patients followed all the recommendations.

Dividing patients into three groups according to tertiles of energy intake and all characteristics of the diet, no relationships was found with either anthropometric or metabolic parameters (data not shown).

Since patients fulfilling dietary records were from six different diabetes clinics located in different parts of Italy, we analysed the data separately for each centre. The main differences in dietary habits are summarized in Table 2. With respect to energy intake, there is a trend toward a significant increase as we move north from Bari (Southern Italy) to Pavia (Northern Italy). With respect to diet composition, patients from Pavia have the highest intake of saturated fat (in this case, together with people from Bari, even if the differences are really small) and cholesterol, and the lowest intake of dietary fibre. In particular for fibre intake, there seems to be a significant trend toward lower values as we move from southern to northern Italy ($P<0.0001$). As to alcohol, patients from Pisa had the highest intake albeit within the recommended limits for people with diabetes.

Discussion

The main result of this study is that adherence to dietary recommendations is not completely satisfactory in terms of dietary composition even in a population of Italian type II diabetic patients, who may be thought to be favored on the basis of their gastronomic background. Unfortunately, the two recommendations least followed were the intake of saturated fat (with 43% of patients eating >10% of saturated fat) and fibre (with only 6% approaching the ideal intake of 20 g/1000 kcal, and 25 % consuming the more acceptable and achievable 15 g/1000 kcal).

Both are key points of the recommendations and, moreover, also represent the main features of the so-called 'Mediterranean diet', at least the one followed some decades ago (Trichopoulou *et al*., 1993).

In addition, even the energy intake of the population – another fundamental point of dietary recommendations for diabetic patients – is a little bit higher in comparison with their requirements, being on average 300 kcal more for men and 200 kcal for women.

Our results, obtained with a reference method for the evaluation of dietary habits, are in line with those obtained

Table 2 Mean differences in dietary habits among the 6 Italian diabetic clinics in geographical order from south (Bari) to north (Pavia)

	Bari (n = *100*)	*Pescara* (n = *30*)	*Perugia* (n = *32*)	*Pisa* (n = *91*)	*Piacenza* (n = *187*)	*Pavia* (n = *100*)	*ANOVA* P-*value*
Kcal (nutrients + alcohol)	1505 ± 401	1516 ± 351	1713 ± 399 ○	1706 ± 490	1739 ± 434	1992 ± 628 ○○	0.0001
SFA% TE	11 ± 3	10 ± 3	9 ± 2 ■	10 ± 2	10 ± 3	11 ± 3 ■■	0.001
MUFA% TE	15 ± 3	15 ± 4	15 ± 3	16 ± 4	15 ± 4	15 ± 3	0.0001
Cholesterol mg/day	194 ± 78	189 ± 68	204 ± 76	221 ± 100	196 ± 96	230 ± 91 ▼	0.01
Fibre g/1000 kcal	15 ± 4	15 ± 5	13 ± 5	13 ± 5 ◆	12 ± 4 ◆◆	10 ± 3 ◆◆◆	0.0001
Alcohol g/day	7 ± 11	6 ± 12	9 ± 10	15 ± 19	12 ± 16	7 ± 11	0.0001

Abbreviations: ANOVA, analysis of variance; MUFA, monounsaturated fat; SFA, saturated fat; TE, total energy.
T-test between centres (*P*): ○○ < 0.001 vs all; ○ < 0.006 vs Bari; ■■ < 0.001 vs Perugia, Piacenza, Pisa, ■ < 0.02 vs Bari; ▼ < 0.003 vs Bari, Piacenza; ◆◆◆ < 0.001 vs all, ◆◆ < 0.001 vs Bari, ◆ < 0.03 vs Bari, Pescara, Piacenza; < 0.002 vs Bari, Pescara, Piacenza; < 0.05 vs Bari.

in the two Italian cohorts of diabetic patients participating into the Multicenter Study of the Mediterranean Group for the study of Diabetes (MGSD), where dietary habits were evaluated by a food frequency questionnaire (Thanopoulou *et al.*, 2004).

In our study, we looked also at possible differences between diabetic clinics located in different Italian regions. Energy intake tended to be significantly higher moving from southern (Bari) to northern Italy (especially Pavia). These differences, however, are not accompanied by differences in BMI and waist circumferences. Pavia seems to be characterized by a slightly more negative dietary pattern (higher intake for saturated fat and cholesterol, lower for monounsaturated and dietary fibre), in addition to higher energy intakes.

Although fibre consumption was very low in all centers, there seemed to be a certain gradient toward a higher intake going from the north to south ('more Mediterranean' regions). Finally, type II diabetic patients from Pisa, a city located in Tuscany, a region producing high quality wine, are characterized by a higher alcohol intake, although within the recommended limits.

In this cross-sectional study, no clear relationship was found between dietary habits and anthropometric (BMI, waist circumferences) or metabolic data (HbA1c, plasma lipids), at odds with Eurodiab, a study performed in type I diabetic patients of different European countries (Buyken *et al.*, 2001). The reason may be either that in our population the range of both calorie intake and nutrients was too narrow to highlight any relationship, or that diabetic patients with a higher levels of overweight/obesity, blood glucose, plasma lipids and blood pressure tried to follow a healthier diet.

One possible limitation of our study may be represented by the fact that we chose to use a really quantitative but complex method for dietary habits evaluation, which resulted in a limited number (540) of participants who filled in the dietary records. However, the main characteristics of the two populations were similar except for a difference in the percentage of males filling in the records, which unlikely might influence the results. Therefore, the group completing the dietary records may be considered representative of the whole population.

In conclusion, our study clearly indicates that the adherence to dietary recommendations for the treatment of diabetes is not completely satisfactory just for the points considered more important, that is, energy, saturated fat and fibre intake. This is also true of populations thought to be favored on the basis of their traditional gastronomic background. Therefore, strategies for implementation of dietary recommendations should be principally tailored to reduce both total energy intake in overweight people and saturated fat and in increase dietary fibre intake in the whole diabetic population.

Participating centers
Bari: A Damato, R Giorgino; Pescara: E Devangelio, A Consoli; Perugia: P De Feo, C Di Loreto; Pisa: R Miccoli, C Bianchi; Piacenza: D Zavaroni; Pavia: G De Rosa, L Ciccarello.

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