Body composition and dietary intakes in adult celiac disease patients consuming a strict gluten-free diet[1–3]

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ABSTRACT

Background: Celiac disease responds to dietary gluten withdrawal, but data on the long-term effects of gluten-free diets are discordant.

Objective: Our aim was to evaluate the nutritional status and body composition of adult celiac disease patients consuming a gluten-free diet who were in clinical, biochemical, and histologic remission.

Design: We studied 71 patients (51 women and 20 men; mean age: 27 y; range: 17–58 y) and 142 healthy control subjects matched by sex and age. The subjects' height, weight, body mass index, fat and lean mass, and bone mineral content (evaluated by dual-energy X-ray absorptiometry) were measured; a 3-d dietary questionnaire was administered; and total daily energy, fat, carbohydrate, and protein intakes were calculated.

Results: The weight, height, and body mass index of male celiac disease patients and the weight and body mass index of female celiac disease patients were significantly lower than the corresponding measurements in control subjects. The fat and lean mass of both male and female patients was significantly different from that of control subjects; however, bone mineral content was significantly lower only in females in whom celiac disease was diagnosed in adulthood. Total energy intake was lower in the patients than in the control subjects (9686 ± 1569 and 11 297 ± 1318 kJ/d in males and 6736 ± 1318 and 7740 ± 1715 kJ/d in females), and the diet of the patients was unbalanced, with a higher percentage of energy as fat and a lower percentage of energy as carbohydrates.

Conclusions: Although strictly compliant with their gluten-free diet and in complete remission, patients with celiac disease showed differences in body composition and dietary intakes compared with control subjects. Strict follow-up and dietary advice in terms of the choice and composition of foods seem necessary to prevent malnutrition. *Am J Clin Nutr* 2000;72:937–9.

KEY WORDS Celiac disease, nutritional status, body composition, gluten-free diet

INTRODUCTION

Celiac disease (CD), the most common form of malabsorption in Europe, is the result of intestinal mucosal damage caused in susceptible subjects by the gluten content of some cereals. By definition, the disease responds to gluten withdrawal, resulting in the disappearance of symptoms and the normalization of laboratory and intestinal histology findings (1). Various studies have shown that with adherence to a gluten-free diet (GFD), affected subjects attain a normal height and bone mineral content and their body composition is restored (2–4). However, some authors have suggested that, despite a GFD, treated CD patients continue to show mild malnutrition in terms of low body weight and reduced body mass index (BMI) (5), which may be due to incomplete intestinal mucosal recovery as a result of poor compliance with the GFD [a well-known problem in such patients (6, 7)] or to the GFD itself. To investigate this question thoroughly, we used dual-energy X-ray absorptiometry to evaluate the body composition of a series of adult CD patients who followed a strict GFD and were in clinical, biochemical, and histologic remission and compared the anthropometric data and dietary intakes of the CD patients with data for control subjects.

SUBJECTS AND METHODS

Over a period of 6 mo, 212 treated patients with histologically confirmed CD were seen as outpatients in our department for their yearly follow-up exams. Of these patients, 71 (51 women and 20 men; mean age: 27 y; range: 17–58 y) who were asymptomatic, who had maintained a constant body weight during the previous 6 mo, who had negative results on a medical examination, and who were not taking any drugs were enrolled in the study. The other inclusion criteria were strict compliance with a GFD (evaluated by means of a medical interview), normal routine biochemical data (hemoglobin, serum ferritin and iron, liver function, serum calcium and potassium, and albumin), normal immunoglobulin A antigliadin (Gluten IgA EIA; Pharmacia, Uppsala, Sweden) and antiendomysium antibody concentrations (indirect immunofluorescence; Eurospital, Trieste, Italy), normal results on a permeability test (lactulose-mannitol sugar test), and normal duodenal biopsies obtained endoscopically during consumption of the GFD.

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Received November 10, 1999.

Accepted for publication March 28, 2000.

TABLE 1
Anthropometric measurements, bone mineral density, and daily energy intake for 71 celiac disease patients consuming a gluten-free diet and in clinical, biochemical, and histologic remission and 142 sex- and age-matched control subjects[1]

	Men			Women		
	Patients (n = 20)	Control subjects (n = 40)	P	Patients (n = 51)	Control subjects (n = 102)	P
Weight (kg)	69.2 ± 11.1	73.3 ± 8.5	0.03	55.5 ± 8.0	58.7 ± 8.6	0.04
Height (cm)	175 ± 6.8	178 ± 6.8	0.05	163 ± 6.4	162 ± 6.8	NS
BMI (kg/cm^2)	21.9 ± 2.9	23.5 ± 2.9	0.05	20.9 ± 2.7	22.4 ± 4.3	0.03
Bone mineral density (g/cm^2)	1.1 ± 0.07	1.2 ± 0.12	NS	1.03 ± 0.06	1.1 ± 0.09	NS
Energy intake (kJ)	9686 ± 1569	11 297 ± 1318	0.05	6736 ± 1318	7740 ± 1715	0.05

[1] $\bar{x}$ ± SD.

Forty-three patients had started a GFD in childhood as a result of a diagnosis of CD or dermatitis herpetiformis with intestinal involvement (28 women and 15 men; mean age of 5.2 y at diagnosis and 22 y at enrollment). Twenty-eight patients had their disease diagnosed in adulthood (23 women and 5 men; mean age of 28 y at diagnosis and 34 y at enrollment) and had been consuming a GFD for ≥2 y.

For each patient, two sex- and age-matched healthy control subjects (n = 142) were studied. All patients were invited to attend the hospital with a relative or friend of the same sex and comparable age (±2 y) who agreed to undergo serologic screening for CD, a dietary interview, and a study of body composition; the other control subjects consisted of voluntary medical students, nurses, and physicians. The study was performed in accord with the Helsinki Declaration and all subjects gave written, informed consent.

Anthropometric indexes

Weight (kg) was measured in bare feet with a standard clinical balance and height (cm) was measured with a fixed stadiometer. BMI was calculated as weight divided by height squared (kg/m^2).

Body composition

Fat mass and lean mass (expressed as % of body wt and in kg, respectively) and bone mineral content [measured as bone mineral density (BMD); expressed as g/cm^2] were calculated by means of dual-energy X-ray absorptiometry (Hologic 2000; Hologic Inc, Waltham, MA). The CV for the absorptiometry measurements was 1–1.5% and all measurements were made by the same operator.

Diet

Total food and beverage consumption was assessed by means of a self-completed questionnaire filled in every day for 3 d. The enrolled patients and control subjects were trained by a dietitian to record all food consumed and the completed forms were returned and reviewed during a face-to-face interview at which portion sizes were quantified in standard units. If the questionnaires were incomplete or incorrect, the patients were asked to repeat the exercise the next month. The individual food and beverage items were converted into energy and nutrient factors by using a food-composition table (8). The composition of commercially sold gluten-free food was evaluated on the basis of the information given by the suppliers or written on the packages.

Statistical analysis

The weight, height, BMI, and body composition of the patients and control subjects were compared by using the Kruskal-Wallis test. Daily dietary intakes were compared by using the Kolmogorov-Smirnov test. P values <0.05 were considered significant. Data were analyzed with SAS for NT (release 12; SAS Institute Inc, Cary, NC).

RESULTS

The weight, height, BMI, BMD, and energy intake of the patients and control subjects are given in **Table 1**. The weight and BMI of the female patients (mean age: 26 y; range: 17–58 y) were less than those of the female control subjects, whereas height did not differ significantly between these 2 groups. Six female patients were overweight (12%). Fat mass and lean mass were both lower in the female patients than in the female control subjects [22.9 ± 4.4 compared with 27.5 ± 5.2% ($P < 0.05$) and 38.8 ± 4.2 compared with 40.5 ± 3.2 kg ($P < 0.03$)], but there was no significant difference in BMD between these 2 groups. However, when the BMD values of the groups of patients whose disease was diagnosed in either childhood (1.1 ± 0.06 g/cm^2) or adulthood (0.9 ± 0.09 g/cm^2) were considered separately, the BMD of the latter group was significantly lower than the control value of 1.1 ± 0.09 g/cm^2 ($P < 0.01$). There was also a significant difference in the total daily energy intake of the female patients and control subjects: the patients consumed less total energy and ate a higher percentage of energy as fat ($P < 0.05$) and a lower percentage of energy as carbohydrates ($P < 0.01$).

The weight, height, and BMI of male patients (mean age: 25 y; range: 18–42 y) were significantly lower than those of the male control subjects; 2 male patients were overweight (10%). There was no significant difference in BMD between the male patients and control subjects, but fat mass and lean mass were both lower in the patients than in the control subjects [13.9 ± 6.4 compared with 16.8 ± 4.6% ($P < 0.05$) and 55.5 ± 6.5 compared with 56.7 ± 5.3 kg ($P < 0.03$)]. Male patients consumed less total daily energy than did male control subjects and consumed a higher percentage of energy as fat ($P < 0.05$) and a lower percentage of energy as carbohydrates ($P < 0.01$).

DISCUSSION

Our data show that even in strictly GFD-compliant CD patients in complete clinical, biochemical, and histologic remission, there are differences in body composition and dietary intake between CD patients and healthy control subjects. The results of previously published studies of the nutritional status and body composition of CD patients are equivocal and difficult to compare because they are dependent on several different variables, such as age at diagnosis, the duration of symptoms before diagnosis, the presence of

malabsorption, and compliance with a GFD. Additionally, although compliance with a GFD is often unsatisfactory, it can be only roughly estimated in terms of history and serum antigliadin and antiendomysium antibody concentrations; it is well known that negative results of tests of serologic markers do not correlate with histologic damage (7, 9).

Some of the previously reported abnormalities in nutritional status may have been due to an incorrect GFD or the incomplete normalization of intestinal mucosa, as in the study by Collins et al (6), who found subtotal or partial villous atrophy in 11 of 17 treated CD patients. It is for this reason that we studied only patients in histologic remission and with normal intestinal permeability as determined by the mannitol-lactulose sugar test (10).

Furthermore, the method used to evaluate malnutrition and body composition is also important when comparing the results of nutritional studies (11). In our study, body composition was evaluated by means of dual-energy X-ray absorptiometry, a simple, accurate, and reliable method of estimating body fat, fat-free body mass, and bone mineral content (12–14).

Finally, dietary habits need to be considered because they often depend on age, lifestyles, social status, and place of origin. To avoid these biases, we compared each CD patient with a member of his or her own family as well as with a volunteer of the same age and sex.

We found differences in weight, BMI, fat mass, and lean mass (but not BMD) between CD patients and control subjects. However, given the well-known fact that patients in whom CD is diagnosed in adulthood are frequently osteopenic (3, 15, 16), the larger group of female CD patients was subdivided on the basis of whether CD was diagnosed in childhood or adulthood. The significant difference in BMD between these 2 subgroups confirms that the early diagnosis and treatment of CD may prevent osteoporosis (3, 4, 17).

The observed differences in anthropometric measurements and body composition between the CD patients and the control subjects seem to be justified by the lower daily energy intakes of the CD patients. Smecuol (16) also reported that the energy intake of patients who strictly followed a GFD was significantly lower than that of only partially compliant patients. Moreover, the GFD of the patients in the present study was unbalanced; they consumed a lower percentage of energy as carbohydrates and a higher percentage of energy as fats than did the control subjects, not so much because of the use of commercially available gluten-free foods (whose different components are well balanced), but more because the patients tended to choose the wrong natural foods. CD patients ate less pasta, bread, and pizza (the gluten-free versions of bread and pizza often being considered unpleasant by adults in particular) than did control subjects and tended to prefer eggs, meat, and cheese in an attempt to become satiated while avoiding the inadvertent ingestion of gluten. This finding was also observed previously, and Mariani et al (18) suggested that adherence to a strict GFD worsens the already nutritionally unbalanced diet of adolescents by further increasing protein and fat consumption.

In conclusion, the results of our study showed that CD patients consuming a strict GFD and in complete clinical, biochemical, and histologic remission had a lower BMI, fat mass, and lean mass than did control subjects. Furthermore, when CD was diagnosed in adulthood, CD patients also had lower BMD associated with a lower total daily energy intake. Early diagnosis and treatment, together with regular follow-up visits and dietary advice in terms of the choice and composition of foods, seem necessary to prevent malnutrition in these subjects who require life-long dietetic treatment.

We thank Rossella and Lauretta Valmarana for their help in evaluating the questionnaires and diets.

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