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CHAPTER 4

Nutritional management of the gluten-free diet in young people with celiac disease in the Netherlands

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ABSTRACT

Background: For young people with celiac disease, adherence to the gluten-free diet may be difficult to achieve and gluten restriction may lead to insufficient nutrient intake and unbalanced food intake resulting in overweight. In the Netherlands, no nutritional information is available. Therefore, we evaluated the nutritional management and nutritional state in young celiac patients.

Methods: The Dutch Celiac Society invited all its members aged 12 to 25 years to complete a food record and a questionnaire. Nutrient intakes were compared with the recommendations and the intake in the general population. Total immunoglobulin A, endomysial antibody, tissue transglutaminase and IgA gliadin were determined and height and weight were assessed.

Results: Strict dietary compliance was reported by 75%. The fiber and iron intakes were significantly lower, and the saturated fat intake significantly higher than recommended, but comparable with the general population. Most of the patients (61%) found the diet easy to follow. Regular medical controls were reported by 86%, but regular dietary controls by only 7% of the patients. Mean and SD scores for height and body mass index were -0.3 ± 1.1 and -0.3 ± 0.8 , respectively.

Conclusions: The dietary compliance in this group is high, the nutritional state is adequate, but the nutrient intake is not. Better medical and dietary support is necessary to prevent long-term complications and to achieve an ongoing satisfying management in this group of young patients with a chronic disorder.

INTRODUCTION

The treatment of celiac disease (CD) consists in a life long strict gluten-free diet (GFD). Nonadherence to the GFD may lead to complications such as diarrhoea, abdominal pain, anaemia, osteoporosis, infertility and cancer (1).

For many patients, adherence to the diet may be difficult to achieve (2-5). This seems to be particularly true among adolescent celiacs. In Europe, the compliance with the GFD by young people varies between 52% and 81% (6-11).

In addition, adherence to a GFD may have negative nutritional consequences (12,13).

Mariani et al., (11) reported that 72% of the Italian adolescents with CD adhering strictly to the diet were overweight and consumed an unbalanced diet rich in fat and protein, poor in carbohydrate and deficient in calcium, iron and fiber.

In the Netherlands, there is no information on the nutritional intake and dietary compliance by young people with CD. Therefore, we evaluated the nutritional management of the GFD and the nutritional state in celiac patients aged 12 to 25 years, an age group with an expected poor compliance.

MATERIALS AND METHODS

In January 2000, the Dutch Celiac Society invited all its 395 members in the age category 12 to 25 years to participate in the study. Inclusion criteria were diagnosis of CD based on at least one small-intestinal biopsy showing histological abnormalities characteristic of CD (14) and a good knowledge of the Dutch language. Nonresponders (age and sex known) were sent a reminder after 2 months.

We used anonymous information from the nationwide network and registry of histopathology and cytopathology in the Netherlands (PALGA) to check the total number of CD patients in the Netherlands aged 12 to 25 years at the start of the study. The reported diagnosis of CD of the responders was cross-checked by means of the information provided by PALGA. Only confirmed CD patients were included in the study.

Nonparticipants were asked some additional questions concerning body weight, height and educational level.

A 34-item questionnaire was composed in collaboration with the Dutch Nutrition Centre. This questionnaire was based on a 2-hour focus group interview with 10 CD patients in the target age category. Under the direction of a trained facilitator (MH), the focus group members were encouraged to express their perceptions and opinions about living with CD and adhering to a GFD. The questionnaire was pretested individually by 4 celiac patients (one aged 12 years, two aged 14 years and one aged 19 years) in presence of the investigator (EGDH).

Patients were asked to fill in a 3-day food record (two weekdays and one weekend day) in household measures and to precisely note the name of the manufacturer of the product used. The food records were analysed for total energy and macronutrient intake, saturated fat, vitamins B1, B2, B6, iron, calcium and fiber intake, according to the Dutch Food Composition Table 1996, (15) using the computerised nutrition calculating program (BECEL 5, the Netherlands).

The data were compared with both the Dutch (DRDA) (16) and American recommendations (ARDA) (17,18) and the General Dutch Population (GDP) (19) for which the total group had to be divided in the age categories less than 13, 13 to 16, 16 to 19, 19 to 22 and 22 to 25 years. For comparison, the sex distribution in the different age categories was taken into account.

Because there are no data on gluten content of food products, the gluten intake reported by the patients in their questionnaires was approximately estimated using the information in the Draft Revised Standard for gluten-free foods of the Codex Alimentarius Commission from the year 2000, (20) that stated that the total content of gluten in wheat-starch based gluten-free products should not exceed 200 ppm (20 mg gluten per 100 g). For the gluten-containing products, we used the estimation method from Overbeek et al., (21) that consists on multiplying the grams of vegetable protein by 0.8. For products of which is known that they may contain gluten, but the amount of gluten could not be estimated because of a rounded number of zero grams protein in the food composition table, the 20 mg gluten per 100 g was used for calculations.

Participants had blood punctures at either our hospital or at their family doctor's. All determinations were done at the laboratory for clinical immunology of the Free University Hospital, Amsterdam. Patients with a total immunoglobulin A (IgA) concentration less than 0.06 g/L were considered as IgA deficient. The serum titers of IgA gliadin (AGA) and tissue transglutaminase (tTGA) antibodies were measured using enzyme-linked immunosorbent assay techniques (22,23). Serum IgA endomysium antibodies (EMA) were detected by indirect immunofluorescence on monkey oesophagus (22).

We also estimated the gluten intake from the food record from 15 randomly selected patients: 6 with positive EMA and/or tTGA and 9 without these antibodies.

Patients performed the measurement of their own height and weight at home according to standardized instructions and of 26 patients visiting the LUMC for blood puncture the measurements were repeated by one of us (EGDH). Height was measured using a wall-mounted stadiometer. Height and body mass index (BMI) were expressed as SD scores (SDS) (24).

All analyses were carried out using the software of the Statistical Package for the Social Sciences release 10 (1999, SPSS Inc, Chicago IL). The Student *t* test was used to compare the characteristics of the participating and nonparticipating patients. We checked whether

the 95% confidence interval of the energy and nutrient intakes contained the values of the DRDA and the ARDA and the values of the intakes of the GDP. For differences between medians, the Mann-Whitney *U* test was performed. The reliability of the self-reported height and weight was assessed by paired *t* test and Bland-Altman analysis by comparing these measurements with the ones assessed at the LUMC. Percentages were compared using the Chi-square test. We divided the total group into the age categories of 12 to 16 years and 17 to 25 years.

ETHICAL CONSIDERATIONS

The study was approved by the Medical Ethics Committee of the LUMC.

RESULTS

Figure 1 shows the patient flow and participation rates of the patients invited for the study. The 395 members of the Celiac Society represented 61% of the patients in this age category in the Netherlands as checked through PALGA. The responders were significantly younger compared with the nonresponders: 16.9 ± 4.3 years versus 18.1 ± 3.8 years ($P=0.005$), and there were more female responders in the age category of 17 to 25 years (74% versus 57%; $P=0.049$). There were no significant differences between participants and nonparticipants concerning sex distribution, mean age and height SDS, but the nonparticipants had a significantly lower BMI SDS (-0.9 ± 0.7 ; $P=0.016$). Without the 33 participants and 3 nonparticipants still attending primary school, 50% of the nonparticipants had a low educational level compared with 38% of the participants, but this difference did not reach statistical significance. The characteristics of the participating patients are shown in Table 1. Of the participants, 8% had an associated disease. Dividing the total group into the age categories of 12 to 16 years ($n=80$) and 17 to 25 years ($n=52$), there were significant differences in the median age at diagnosis (2.8 years [0.8-14.7] versus 7.3 years [0.3-23.6; $P=0.003$]), and the mean duration of the GFD (8.5 ± 3.9 years versus 11.2 ± 8.2 years; $P=0.03$).

The anthropometric measurements of the 26 patients (20%) visiting the outpatient department were higher than the ones they performed at home: 1.3 cm ($-1.2 - 3.8$; $P<0.0001$) for height and 1.6 kg ($-1.9 - 5.1$; $P<0.0001$) for weight, resulting in a higher BMI (19.1 ± 2.2 versus 18.7 ± 2.2 ; $P<0.05$). Eighty-four percent of the patients (111) returned the completed food record. The nutritional data from all the patients were analysed and as an example, the data of the patients aged 13 to 16 years are presented in Table 2.

Figure 1. Patient flow and participation rates.

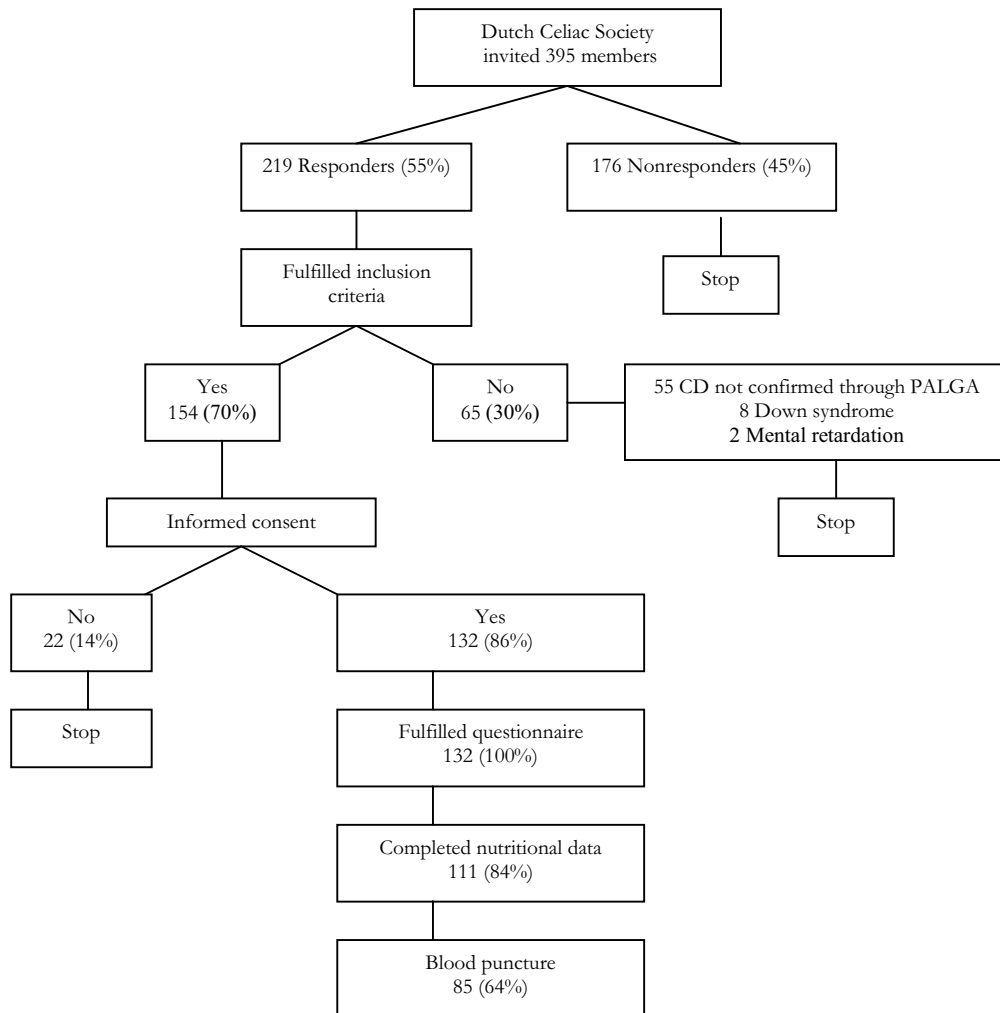


Table 1. Characteristics of 132 Dutch patients with celiac disease aged 12 to 25 years.

Females, n (%)	87 (66)
Age, y (mean±SD)	16.6±4.4
Age at diagnosis, y median (range)	4.3 (0.3-23.6)
Duration of GFD, y (mean±SD)	9.6±6.0
Height, SDS (mean±SD)	-0.3±1.1
BMI, SDS (mean±SD)	-0.3±0.8
Associated diseases, n (%)	
Thyroid dysfunction	5 (4)
IDDM	2 (2)
Thyroid dysfunction + IDDM	2 (2)
Ulcerative Colitis	1 (1)
Psychiatric Disorder	1 (1)
Low education*, n (%)	50 (38)

*With a maximum level of (senior) secondary vocational education.

IDDM, insulin-dependent diabetes mellitus.

Table 2. Nutritional intakes of 37 patients with celiac disease aged 13 to 16 years, presented as means (95% CI), compared with the intakes in the same age category by the GDP, the DRDA and the ARDA.

	Celiac patients	GDP	DRDA	ARDA§
Energy (kcal)	2264 (2097-2432)*	2280	2486	2320
Protein (%)	12 (11.7-12.8)†	14	10-15	10-30
Fat (%)	34 (32-36)	36	30-35	25-35
Saturated fat (%)	12 (11.6-13.2)*,†	14	Max. 10	¶
CH (%)	54 (52-56)†	51	55	45-65
Fiber (g)	17 (15-19)*,†,‡	20	31	28
Vit. B1 (mg)	1.0 (0.9-1.1)‡	1.1	1.0	1.2
Vit. B2 (mg)	1.7 (1.5-1.9)*,†,‡	1.4	1.4	1.4
Vit. B6 (mg)	1.5 (1.4-1.7)*	1.5	1.3	1.5
Calcium (mg)	1082 (960-1204)‡	960	780-1080	1300
Iron (mg)	10 (9-11)*,‡	10	13	14

* $P < 0.05$ CD patients compared with DRDA; † $P < 0.05$ CD patients compared with GDP; ‡ $P < 0.05$ CD patients compared with ARDA.

§For the ARDA, the age category of 11 to 14 years was used for the RDA of energy, vitamins and iron and that of 9 to 13 years for the RDA of protein, total fat, saturated fat, carbohydrates, fiber and calcium;

¶ Indicates as low as possible; %, energy percentage; CH, carbohydrates.

CD patients of all age categories had an intake of fiber and iron significantly lower than both the RDAs and an energy percentage saturated fat significantly higher than the DRDA. In addition, the intake of calcium by the patients younger than 19 years did not reach the ARDA, which are higher than the DRDA for all ages. Concerning the B vitamins, the intake in all ages reached or exceeded the RDAs.

Compared with the GDP, a significantly lower intake was found in the patients aged 13 to 16 years and 22 to 25 years for protein and saturated fat, in the patients younger than 19 for fiber, and in the patients aged 16 to 19 years for iron. Only the patients in the oldest age category (22-25 years) had a significantly higher calcium intake than the GDP (tables presented on the internet).

Most of the patients (64%) used vitamin- and mineral-enriched gluten-free food products, and 35% of these patients also used vitamin and mineral supplementation. Of the patients who did not use enriched food products, 47% used vitamin and mineral supplementation, which is significantly higher than in the GDP (17%) ($P<0.0001$).

Reasons for using supplementation were “just as an addition to the GFD” (17%), “in case of tiredness” (11%), “concern about having less resistance” or “prevention of becoming ill” (19%) and “advised by the doctor or the dietician” (6%). Comparing the intake of those using enriched gluten-free products and those who do not use them, the latter had a significant lower intake of B vitamins, calcium, fiber and iron (table presented on the internet). However, the intake of B vitamins and calcium by the last group still reached the DRDA but not the ARDA for vitamin B1 and calcium. In addition, patients with CD consuming enriched products still not reach the RDAs for fiber and iron and the ARDA for calcium.

Seventy-five percent of the patients reported a strict adherence to the GFD, of whom 10% added that it might be possible that they consume gluten only by accident.

Occasional consumption of gluten-containing food was admitted by 23% of the patients (estimated median gluten intake: 153 mg/d [2-6382 mg]). Two patients (2%) did not adhere to the GFD. Most of the patients (61%) found that the GFD was easy to follow. From the 85 patients who had serologic antibodies determination, 2 (2%) were found to be IgA deficient. The patients who did not have blood puncture were significantly older (18.0 ± 4.1 years versus 15.8 ± 4.3 years, $P=0.006$), had a lower educational level 38% versus 21%, $P=0.034$), less often completed the food record (66% versus 94%, $P<0.0001$) but were not different in self-reported strictness in following the GFD (74.5% versus 75.3%) compared with the ones who did have blood punctures. Positive EMA and tTGA were found in 7% to 17% of the patients (6/83-14/83). There was no difference in the self-reported compliance between the patients who did and who did not have detectable antibodies in serum, neither was there any difference between the group categories aged 12 to 16 years and aged 17 to 25 years. There was no difference in the percentage of patients with high serum antibodies between the 2 groups (17% versus

15%) (Table 3). However, considering the duration of the diet, a higher percentage of the patients after a GFD for shorter period (less than 5 years) had high serum antibodies (33% versus 14%; $P=0.058$).

Table 3. IgA serum antibodies in 83 patients aged 12 to 25 years with celiac disease, reporting to follow a strict GFD or a GFD with gluten consumption from time to time.

Positive IgA serum antibodies	GFD n=63 (%)	GC n=20 (%)
AGA	0	0
EMA	9 (14)	3 (15)
tTGA	6 (10)	0
At least one positive antibody (AGA, EMA or tTGA)	11 (18)	3 (15)
EMA and/or tTGA	10 (16)	3 (15)
No positive antibodies	52 (83)	17 (85)

GC, GFD with gluten consumption from time to time.

The gluten intake estimated from the food records were compared with the self-reported adherence to the GFD. The median daily gluten intake of the 6 patients with high serum antibodies was 29 mg (17-40 mg), whereas that of the 9 patients with CD without antibodies was 47 mg (8-1394 mg). This is however much lower than the intake in the GDP, which is approximately 10 to 15 g/d. Seven of the 15 patients admitted that they consumed gluten-containing food from time to time, but only one of them had high antibodies. Three patients with the highest gluten intake stated that they sometimes got complaints after gluten ingestion (table presented on the internet).

The most frequent sources of gluten were candies (53%), chocolates or crisps (47%) and fast food (31%). This last product group was significantly more often consumed by the older patients (43% versus 18%; $P<0.05$). The gluten-containing food products were mostly consumed at special occasions (60%) or at home (49%). A high percentage of the patients (65%) reported symptoms after gluten consumption, especially abdominal pain (83%), diarrhoea (73%) and lassitude (52%).

Reported strategies to find out whether or not a food product was suitable for the GFD were “reading the ingredients on the food label” (94%), followed by “checking the list of gluten-free products” (72%). A less reported strategy was to “just eat it and see whether it gives problems” (6%), but this was used significantly more often by the older group (12% versus 3%; $P<0.05$). As expected, “asking my parents” was a strategy mostly used by the younger group (66% versus 15%; $P<0.01$).

The most frequent answer to the question of “what the long-term consequences of not adhering to the GFD can be” was cancer: in the first place, gastrointestinal cancer (46%), particularly among the older group of patients (65% versus 33%; $P<0.01$), but also other types of cancer (15%).

Most of the patients reported regular medical controls (86%; median duration 8.4 years; 0-23 years), with a significantly higher frequency in the younger group (95% versus 71%; $P<0.0001$). The physicians consulted usually were paediatricians or internists (61%), and only 38% reported controls by the (pediatric-) gastroenterologist. Sixty-two percent of the patients undergoing regular medical controls thought that it was important to be controlled, an opinion shared by 32% of the patients without medical controls.

Only 7% of the patients had regular dietary controls by a dietician. A great number of the patients (47%) reported that the GFD is instructed during a single visit. However, 16% thinks that it is important to have these dietary controls (11% in the younger and 23% in the older group). Of the patients who have regular dietetic control, 33% think that the controls are important. About 84% think their knowledge about CD and the GFD is sufficient.

DISCUSSION

In this study among young patients with CD in the Netherlands, we have found a self-reported compliance with the GFD of 75%, which is within the range of the one found by other European investigators (6-11). The mean duration of the GFD was significantly longer in the oldest group, although the age at diagnosis was significantly higher compared with the younger group, indicating a trend of earlier recognition of CD by the Dutch pediatricians (25,26).

Determination of celiac antibodies in serum has been reported as a reliable way to monitor the compliance with the GFD (27). Interestingly, we did not find a correlation between the self-reported compliance with the diet and the results of the celiac antibodies in serum. Neither did we find a relation between the estimated amount of gluten consumed and the presence of antibodies, but presumable, there is a role for the duration of the GFD. One possible explanation is that our patients overestimated their gluten intake. It is also possible that the determination of the antibodies in serum is not an adequate method to detect adherence to the GFD, both in adults and in adolescents, as has been suggested by others (28-31). Another reason for a lack of rise in AGA upon gluten intake could be the fact that the diagnosis of CD was established before AGA had developed, so treatment was started before an immunological memory for AGA production had been formed, and no up-regulation of AGA levels occurred upon gluten consumption.

The high compliance in our group of patients may be explained by the fact that all of them were members of the Dutch Celiac Society, and they may have a higher awareness of the importance of adhering to the GFD. It is also possible that especially the most compliant patients were willing to participate. However, our rates of response (55%) and participation (42%) are within the range of those in other studies among celiac patients (2,32). It is also possible that the higher level of education, which may have influenced their willingness to fill in the questionnaire and the food record, may have influenced their compliance with the diet as well. On the other hand, the CD diagnosis of 51% of the nonparticipants was not confirmed, so it is also possible that an important number of them did not participate because they did not have CD.

In contrast to the report from Italy (11), we found a good nutritional state among the young people with CD, both males and females, although we used the home measurements for height and weight for analyses, which were significantly lower than the ones performed at the outpatient department.

The data on the nutrient intakes of the patients were compared with the DRDA and the ARDA. A problem was that the age categories of the ARDA were not similar to those of the DRDA, so the most suitable age category of the ARDA had to be chosen to make a comparison. However, this did not change the evaluation of the adequacy of the nutrient intake, except for the patients up to 19 years with respect to the calcium intake, the ARDA of which is higher than the DRDA.

We have found that the nutritional intake of young people with CD in the Netherlands is comparable with their peer groups in the GDP, which means a higher saturated fat intake and a lower fiber and iron intake than is recommended. In some age categories, however, the intakes of protein and saturated fat are lower than in the GDP, but still higher than the RDA. However, for fiber and iron, the intakes are lower than in the GDP, which means much more deficient with regard to the RDA. In these cases, adhering to the GFD does have consequences for the adequacy of the nutritional intake, as has been shown before (11,12).

Approximately 45% of the patients reported an intake for saturated fat over 125% of the RDA. Seventy percent and 65% reported intakes, for respectively, fiber and iron less than 75% of the RDA. Because we did not measure the fat and iron levels of the celiac patients in serum, we do not know whether their self-reported inadequate intakes also had biological consequences for them.

Compared with the general population, a significantly higher percentage of the celiac patients used vitamin and mineral supplementation, either by enriched food products or tablets or by both. In almost all cases, this supplementation was taken on their own initiative. Apparently, the patients themselves thought that CD or the GFD formed risk factors for nutrient deficiencies.

Most young people with CD thought that avoiding cancer was the most important reason to adhere to the GFD. It has been found that when patients with CD adhere to a GFD for 5 consecutive years or more, their risk of malignancy is not increased compared with that of the general population (33,34). On the other hand, over the last years it has become clear that, although CD patients have a higher risk of developing cancer than the general population, the risk is much lower than previously presumed (35-37).

At present, the GFD is the only effective treatment for CD, and it is prudent to recommend strict adherence to the diet to all celiac patients. However, the fear of developing malignancy is not necessarily the most important reason for advising a strict diet to CD patients. Physicians should, arguably, mainly stress the advantages of the diet with regard to the prevention of other complications of CD, such as osteoporosis (38) and autoimmune disorders (39). They should also point out the relation between adherence to the GFD and improvement of fertility and birth outcomes (40-42). These facts support the necessity of regular medical and dietary controls, subscribed by the patients themselves but not brought into practice.

In conclusion, we have found that the dietary compliance of young people with CD is high in the Netherlands, and that their nutritional state is adequate. Their nutritional intake is inadequate, albeit similar to the one of the GDP. A suitable medical and dietary treatment is necessary, with special attention to the intakes of saturated fat, fiber and iron to prevent long-term complications and to guarantee ongoing satisfying management of CD and the GFD in this group of young patients with a chronic disorder.

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