

# Evidence of high fat and sugar intake, and low fibre and selected minerals intake in adult female coeliac patients

Joanna Myszkowska-Ryckiak, Justyna Szymańska, Anna Harton, Danuta Gajewska

Department of Dietetics, Faculty of Human Nutrition and Consumer Sciences, Warsaw University of Life Sciences, Warsaw, Poland

**Abstract:** A strict gluten free diet (GFD) is the only treatment of coeliac disease (CD). However, compliance with such a diet has an impact on the quality of life of individuals with CD, and, possibly, on their nutritional status. The aim of the study was to assess the dietary intake of female coeliacs and to determine if they are meeting the current dietary reference values. Volunteers were recruited through advertisements placed in coeliac disease support groups, and from the Section of Dietary Counseling at the Department of Dietetics at WUL-S. Forty-two volunteers met all criteria for participation and completed the 3-day food records. The following parameters were evaluated: body height, weight, mass index, and fat and muscle masses (bioimpedance – BIA, Akern). The total daily energy and selected nutrients intake were calculated using *Dietetyk 1* software, and the obtained values were compared to current recommendations. The results showed an inadequate intake of complex carbohydrates, fibre, calcium, potassium and iron, and high consumption of fat, sugar, and phosphorus. Although most of the individuals (79%) had normal weight, the BIA results showed excessive amount of fat tissue. Female CD patients are at risk of having an unbalanced diet; therefore, the nutritional therapy for CD patients cannot be focused only on the avoidance of gluten on a GFD. Emphasis should be on the nutrients contents of a gluten-free foods, especially fat, sugar, fibre, calcium, potassium, and iron.

**Key words:** coeliac disease, high fat diet, high sugar intake

## INTRODUCTION

Coeliac disease (CD) is a life-long autoimmune condition of the gastrointestinal tract, affecting the small intestine of genetically susceptible individuals. The only treatment for CD is life-long avoidance of gluten proteins [1] found in wheat, rye, and barley, whereas the exclusion of oats is controversial [2]. Many studies have shown that compliance with a gluten-free diet reduced the risk of complications such as osteoporosis or small bowel lymphoma [3]. However, compliance with such a diet has an impact on the quality of life of individuals with CD, and possibly, on their nutritional status. In practice, nutritional treatment of patients with a gluten-free diet allows them to choose appropriate foods by omitting and substituting gluten-containing products [4]. The diet and gluten-free products often have low vitamin B, vitamin D, calcium, iron, zinc, magnesium, and fibre content. The minority of gluten-free products are enriched or fortified, adding to the risk of nutrient deficiencies [2]. Considering the increasing number of adults diagnosed with CD, only a few studies, particularly in Poland, have investigated whether the composition of a strict gluten-free diet is nutritionally balanced [4]. Therefore, the aim of the study was to assess the dietary intake of coeliac female patients and to determine if they are meeting the current dietary reference values.

## METHOD

The research was carried out in 42 female coeliac patients aged 19-30 (mean age 26.5), residing in Warsaw and suburbs, in the years 2007-2009. Volunteers were recruited through advertisements placed in coeliac disease support groups, and from the Section of Dietary Counseling at the Department of Dietetics at Warsaw University of Life Sciences (WUL-S). All participants had histologically-confirmed CD and on a strict gluten-free diet (GFD) for at least 5 months. Pregnant, lactating women or individuals on alternative diets, e.g. vegetarian, macrobiotic, were excluded from the study. Written informed consent was previously obtained from all volunteers who received detailed written instructions and invited to fill in 3-day food records (2 consecutive weekdays and 1 day at the weekend). The emphasis was placed on eating as usual. The completed food records were clarified and validated during the visit by a dietician using colour photographs for estimating the sizes of food portions [5]. Participants were also asked to complete a short questionnaire eliciting information on age at diagnosis, years on a GFD, economic situation, physical activity, and problems with adherence to a diet. Nutrients provided by supplements were not included in the nutritional analysis. The height and weight of each individual were measured, and body mass index (BMI) calculated (BMI between 18.5-24.9 kg/m<sup>2</sup> assumed to be correct; BMI < 18.5 kg/m<sup>2</sup> – underweight, and BMI ≥ 25 kg/m<sup>2</sup> – overweight). The body composition (fat mass, muscle mass, total body water) was assessed using the bioimpedance method (BIA 101/S Akern – RJL Systems). Measurements were conducted in the mornings in a supine position after an overnight fast. Energy and nutritional value

Corresponding author: Joanna Myszkowska-Ryckiak, PhD, Department of Dietetics, Faculty of Human Nutrition and Consumer Sciences, University of Life Sciences, Nowoursynowska 159C, 02-776 Warsaw, Poland.  
Tel.: +48 22 59 370 22. Fax: +48 22 59 370 18.  
E-mail: joanna\_myszkowska\_ryckiak@sggw.pl

Received: 15 November 2010; accepted: 15 December 2010

of diets were calculated using *Dietetyk 1©* software with a database containing gluten-free products [6]. In the case of specific commercial gluten-free products not included in nutrient databases, the nutrition labelling information was used for analysis. Calculated values for vitamins A, B<sub>1</sub>, B<sub>2</sub>, C were reduced for non-avoidable technological losses [7]. The obtained values were compared with the current nutritional recommendations to estimated average requirement (EAR), or for nutrients without EAR to adequate intake (AI) [8]. Individual energy requirement was estimated based on individual physical activity levels (PAL): for sedentary or light activity lifestyle PAL = 1.4, and for active or moderately active lifestyle PAL = 1.7 [9], and basal metabolic rate (BMR), calculated with Harris-Benedict equations [10].

## RESULTS

The total of 42 adult women with diagnosed CD were recruited into the study, the majority of whom came from Warsaw (86%). Almost all individuals (95%) reported a good or average economic situation, whereas only 2 stated that their economic situation was unsatisfactory. More detailed characteristics of the participants are presented in Table 1.

**Table 1** Characteristics of the participants.

Characteristics	Women (n = 42)
Mean age ± SD (years)	26.5 ± 2.9
Mean duration of GFD ± SD (years)	6.1 ± 9.0
BMI range [kg/m <sup>2</sup> ]	16.8-29.9
BMI 18.5 – 24.9 (% of group)	79%
BMI < 18.5 (% of group)	7%
BMI ≥ 25 (% of group)	14%
Mean body fat mass [%] ± SD	25.0 ± 6.81
Mean body muscle mass [%] ± SD	44.4 ± 6.1
Mean total body water [%] ± SD	54.9 ± 5.02

<sup>1</sup> recommendations for women aged 18-30: 16-20% (BIA 101/S Akern)  
<sup>2</sup> recommendations for women aged 18-30: 62% (BIA 101/S Akern)

The average duration of adherence to a GFD was about 6 years, but the range was from 5 months to 26 years, with a median of 2 years. Based on height and weight measurements, 79% of the women had a BMI in the healthy range, 7% were in a underweight range (< 18.5 kg/m<sup>2</sup>), and 14% in the overweight range (25-29.9 kg/m<sup>2</sup>). Although most of the subjects had normal weight, the amount of fat tissue in more than one third of them exceeded the recommended values (16-20%). The average amount of total body water (54.9 ± 5.0) was below the recommended value for women aged 18-30 (62%).

The average energy intake was 1,888 kcal/d and in 96% covered the energy needs of the patients. Almost one third of subjects did not meet the recommended energy intake. The highest reported intake was about 25% above the individual requirement, and the lowest reported intake was about 38% below the individually estimated energy requirement. Mean intake of carbohydrates and protein as percentage of energy (% E) met the recommended values. However, the intakes of fat and sucrose were higher, and the intake of fibre was lower than the recommendations. More than a half of the individuals exceeded the recommended levels of fat and sucrose, whereas only 4 women consumed insufficient amount of protein (< 10% E). The average intake of selected vitamins A, B<sub>1</sub>, B<sub>2</sub>, C was at the acceptable level, according to

recommendations. Only less than 10% of participants did not consume recommended amounts of vitamins A and B<sub>2</sub>; in the case of vitamins B<sub>1</sub> and C – about 25 and 30%, respectively, of women did not meet the recommended levels. Estimated intake of magnesium met the average requirements, whereas the intake of phosphorus even exceeded the estimated average requirement. Although the average iron intake was above the estimated average requirement for the examined group, almost 71% of participants consumed less than 8 mg per day. Similarly, the intakes of calcium and potassium were too low, with only 6 women consuming the recommended amount of the former and 3 subjects of the latter.

Detailed data on nutrients intake in the examined group are given in Table 2.

**Table 2** Average daily energy and nutrient intake in 42 subjects consuming a GFD.

Nutrient	Recommendations [8]	Present study	
		Mean ± SD	Min – max
Energy [kcal] <sup>1</sup>		1,888 ± 353	1,280-2,495
Protein [% E]	10-15	16.0 ± 5.0	8.0-24.0
Fat [% E]	< 30	34 ± 8.2	17.9-51.0
Carbohydrates [% E]	55-75	59 ± 15.1	38.2-79.8
Sucrose [% E]	< 10	15 ± 7.6	3.9-30.3
Fibre [g]	20-40	16 ± 5.2	8.0-31.3
Vitamin A [µg]	500 <sup>2</sup>	977 ± 462	335-1,933
Vitamin B1 [mg]	0.9 <sup>2</sup>	1.0 ± 0.3	0.4-1.3
Vitamin B2 [mg]	0.9 <sup>2</sup>	1.0 ± 0.5	0.9-2.9
Vitamin C [mg]	60.0 <sup>2</sup>	67.0 ± 31.4	21.4-135
Calcium [mg]	1,000 <sup>3</sup>	789 ± 307	213-1,421
Iron [mg]	8.0 <sup>2</sup>	10.0 ± 3.2	6.4-17.3
Magnesium [mg]	255 <sup>2</sup>	278 ± 95.9	134-489
Potassium [mg]	4,700 <sup>3</sup>	2,899 ± 846	1,737-5,304
Phosphorus [mg]	580 <sup>2</sup>	1,204 ± 362,8	579-1,998

<sup>1</sup> energy requirement was estimated individually by multiplying values for BMR and PAL  
<sup>2</sup> EAR  
<sup>3</sup> AI

## DISCUSSION

Although in Polish literature there is very little data on the nutrition of adults with CD, a major finding of the present study is that women with CD on GFD appear to follow the same principal trends as healthy women regarding too high intakes of fat and sucrose, whereas too low intakes of calcium, potassium, iron and fibre. The dietary intakes examined in the presented study were inadequate regarding the quality and quantity of macronutrients, especially complex carbohydrates vs sucrose, and the quantity of vitamins and minerals.

In this study, despite the average energy intake being 1,888 kcal/d, the intake of almost one third of the subjects fell below their calculated needs. Similar results obtained Thompson *et al* [11] in women with CD reported a consumption of 1,900 calories a day, with the energy from carbohydrates accounting for 52%. Duda *et al* [12] showed sufficient energy intake (95.6%) among girls aged 16-18 years with CD. Analysis of the percentage of energy from macronutrients showed that although the supply of protein and carbohydrates was adequate, the amount of fat was too high. Bardella *et al* [13] reported that women with CD, strictly adhering to GFD, consumed significantly less energy than healthy women, but with a higher share of energy from fat and less from carbohydrates. According to the results of the WOBASZ [14], Polish women consume an average of 1,681 kcal/day, which

is below their needs. However, it is worrying that too much energy in their diets came from fat (35%), while according to the recommendations this should not exceed 30%. Similarly, the inadequate energy intake and inadequate proportions between macronutrients among young women have been reported in many studies [15, 16].

Despite the relatively inadequate energy intake in about 30% of the examined group, the majority of them had normal body weight, with only 7% of participants at risk of malnutrition. Moreover, the mean body fat mass in the examined group exceeded recommended values and, as a consequence, a small amount of water in fat tissues (10-15%); the total body water content was below the recommendations. On the other hand, Ciacci *et al* [17] observed significantly lower body mass index, and fat and lean body mass in adult patients following a strict GFD, compared with healthy controls. On the contrary, Mariani *et al* [18] showed the diet of children on a strict GFD to be unbalanced; these children were therefore more likely to be overweight or obese comparing with healthy controls. Haller *et al* [4] and Wild *et al* [19] suggested that adult patients underestimated their energy intake by about 25-20%, which could explain our results.

The high amount of fat in the diet is typical not only for people with CD, but also for the healthy Polish population, and is the consequence of a high consumption of meat and meat products. Among those on the GFD, important sources of this macronutrient are also milk, milk products, and gluten-free snacks. A high fat intake was reported in several studies of CD patients [12,13,17,18], but there is also some evidence for a lower fat consumption in patients on GFD diet, compared to the general population [20]. The high intake of fat, especially saturated fatty acids found in meat, milk products and snacks, might be a risk factor for obesity and cardiovascular diseases.

A major problem among people on GFD is an adequate intake of carbohydrates, with special regard to proportion between their different types. In the present study, very unfavourably high amounts of sucrose in the diets of about half of the participants was observed, exceeding the recommended 10%. The consumption of dietary fibre was also far below the recommended 20-40 g per day (average  $16 \pm 5,2$  g/day). This is comparable with similar studies. Thompson *et al* [11] noted a sufficient intake of dietary fibre in less than a half of adult respondents (46%). Studies on children with CD showed that the majority of diets did not cover the demand for dietary fibre, whereas the intake sucrose was too high [21]. Similarly, Duda *et al* [12] reported that the consumption of sucrose among children and adolescents with CD exceeded 10% of energy, and an inadequate amount of dietary fibre. In a very recent study on 62 female coeliac patients, a significantly lower intake of fibre and a high amount of sucrose were observed, compared with the general population. The authors suggested that women were more likely to choose sugary snack food in their diets [19]. In a population of healthy Polish women, Biezanowska-Kopec *et al* [22] noted a slight over-consumption of sucrose, while Charkiewicz *et al* [15] found a sucrose intake below the recommended 10% of energy. With regard to dietary fibre consumption, many studies confirmed its low intake by young women [15,22,23]. Our results and literature data confirm that patients on a GFD do not consume sufficient complex carbohydrates. This insufficient intake of complex carbohydrates and dietary fibre by the participants is a consequence of the exclusion from the diet of cereal

products containing gluten, which is the main source of these compounds. Naturally gluten-free cereal products rich in fibre and other nutrients, such as millet or buckwheat, were chosen rather rarely by the individuals. An excessive amount of sucrose and an inadequate amount of fibre was attributed to too frequent consumption of sweets, and too low intake of vegetables and fruits.

It should be emphasized that commercial gluten-free products, without enrichment, are lower not only in fibre, but also in iron, folate, thiamin, riboflavin, and niacin [24,25]. Hallert *et al* [4] observed poor vitamin status in a half of examined CD patients who had been on GFD for 8-12 years. In our study, the intake of selected vitamins was at least adequate or higher. It should be noted that large standard deviations indicated a significant diversity of consumption of these nutrients within the group. Wojtasik and Kunachowicz [21] observed among children on GFD an adequate intake of thiamine and vitamins A, E, and B<sub>2</sub>, but an insufficient level of niacin. The WOBASZ results showed that the average Polish diet had proper levels of vitamin C, but vitamin B<sub>1</sub> was below the recommendation [14].

The consumption of selected minerals in the studied group was rather diverse. There were significant deficiencies in potassium and calcium intake, and the intake of iron was also inadequate in about 71% of participants. The real intake of minerals and vitamins in the examined group might be underestimated in some cases; this is because in the nutritional analysis, nutrients provided by supplements were not included. However, insufficient intake of calcium and iron is very common, not only in CD patients, but also in the general population. Wojtasik and Kunachowicz [21] reported very low intakes of calcium, iron and magnesium in children with CD. Thompson *et al* [11] observed adequate intakes of iron and calcium in only 44% and 31% of women on GFD, respectively. Similarly, lower amounts of calcium and iron in diets in women on GFD, compared to general population, were found in other surveys [19,20]. Results from the WOBASZ study indicated major deficiencies in calcium and magnesium in Polish diets [14], and Przysięga and Wasilewska [26] also showed inadequate intakes of dietary potassium, with an excessive amount of phosphorus in the diets of young women. An insufficient intake of iron is a consequence of exclusion of cereal products from the diet which, in a typical Polish food ration, supply one third of the total quantity of this nutrient. Commercial low-protein and gluten-free bread usually contains less calcium, iron, magnesium, zinc and copper than 'typical' bread. The highest content of these nutrients can be found in soy flour, buckwheat and millet [21]. The recommended consumption of calcium on GFD might also be difficult due to lactose intolerance, often observed in patients at the time of diagnosis, or in individuals not adhering strictly to GFD, as a result of damage to the villi and reduced production of lactase [27]. These might result in the need for periodic exclusion of milk and milk products from the diet.

A strict GFD for life is the only treatment for CD. Compliance with such a diet has been shown to influence the quality of life and, possibly, nutritional status. For adults especially, changing lifelong eating habits and adapting to the new gluten-free products might be a challenge. Because of the nutritional inadequacies and potential health concerns caused by CD it is essential for newly-diagnosed patients to be referred to a dietitian [28]. Our work highlights the importance for all patients with CD to have the opportunity for regular dietary

review with a qualified dietitian for advice on foods, and to achieve a balanced diet.

## CONCLUSION

Based on the results of the present study, females on GFD might be at risk through an unbalanced diet. Therefore, nutritional therapy for CD patients on a GFD cannot be focused only on the avoidance of gluten. Emphasis should be placed on the nutrient content of gluten-free foods, especially fat, sugar, fibre, calcium and iron. Our data strongly suggest that the constant supervision of a dietician might be essential for correcting the intake of nutrients, and prevent possible deficiencies among patients with CD.

## REFERENCES

- Lerner A: New therapeutic strategies for celiac disease. *Autoimmun Rev* 2010, **9**(3), 144-147.
- Kupper C: Dietary guidelines and implementation for celiac disease. *Gastroenterology* 2005, **128**, 121-127.
- Stuckey C, Lowdon J, Howdle P: Symposium 1: Joint BAPEN and British Society of Gastroenterology Symposium on 'Coeliac disease: basics and controversies' Dietitians are better than clinicians in following up coeliac disease. Proceedings of the Nutrition Society 2009, **68**, 249-251.
- Hallert C, Grant C, Grehn S, Granno C, Hulten S et al.: Evidence of poor vitamin status in celiac patients on a gluten-free diet for 10 years. *Aliment Pharmacol Ther* 2002, **16**, 1333-1339.
- Szponar L, Wolnicka K, Rychlik E: Album fotografii produktów i potraw (in Polish). Album of photographs, products and dishes. Instytut Żywności i Żywienia, Warsaw 2000.
- Kunachowicz H, Nadolna I, Przygoda B, Iwanow K: Tabele składu i wartości odżywczej żywności (in Polish). Tables of composition and nutritional value of food. Wydawnictwo Lekarskie PZWL, Warsaw 2005.
- Szczygieł A, Nowicka L, Bułhak-Jachymczyk B, Szostak W: Normy żywienia i wyżywienia. Cz. II Normy wyżywienia modele racji pokarmowych (in Polish). Standards of nutrition and nourishment. Part II. Standards of nourishment – models of food portions. Instytut Żywności i Żywienia, Warsaw 1987.
- Jarosz M, Bułhak-Jachymczyk B (Eds.): Normy żywienia człowieka. Podstawy prewencji otyłości i chorób niezakaźnych (in Polish). Standards of human nutrition. Essentials for prevention of obesity and non-contagious diseases. Wydawnictwo Lekarskie PZWL, Warsaw 2008.
- FAO. Human energy requirements. Report of a Joint FAO/WHO/UNU Expert Consultation. Food and Nutrition Technical Report Series 1, Rome 2004.
- Frankenfield DC, Muth ER, Rowe WA: The Harris-Benedict studies of human basal metabolism: history and limitations. *J Am Diet Assn* 1998, **98**, 439-445.
- Thompson T, Dennis M, Higgins LA, Lee AR, Sharrett MK: Gluten-free diet survey: are Americans with celiac disease consuming recommended amounts of fibre, iron, calcium and grain foods? *J Hum Nutr Dietet* 2005, **18**, 163-169.
- Duda G, Maruszewska M, Walkowiak J, Przysławski J, Różycka-Cała K: Wartość odżywcza całodziennych racji pokarmowych dzieci chorych na celiakię. Część I. Wartość energetyczna i składniki podstawowe (in Polish). Nutritional values of daily food portions for children with coeliac disease. Part I. Energetic value and basic components. *Nowiny Lekarskie* 2000, **69**(9), 760-770.
- Bardella MT, Fredella C, Prampolini L, Molteni N, Giunta AM, A Bianchi P: Body composition and dietary intakes in adult celiac disease patients consuming a strict gluten-free diet. *Am J Clin Nutr* 2000; **72**:937-939.
- Sygnowska E, Waśkiewicz A, Głuszek J, Kwaśniewska M, Biela U et al.: Spożycie produktów spożywczych przez dorosłą populację Polski. Wyniki programu WOBASZ (in Polish). Consumption of food products by adult Polish population. Results of WOBASZ project. *Kardiologia Polska* 2005: 63-66.
- Charkiewicz WJ, Markiewicz R, Borawska MH: Ocena spożycia podstawowych składników odżywczych w dietach studentów Uniwersytetu Medycznego w Białymstoku (in Polish). Evaluation of consumption of basic nutrients in diets of students from the Medical University in Białystok. *Bromat Chem Toksykol* 2008; **XLI**, **3**, 735-739.
- Dybowska E, Świdorski F, Waszkiewicz-Robak B: Ocena poziomu spożycia wybranych składników odżywczych przez mieszkańców Warszawy. In: Gutkowska K, Narojek L (Eds.): Konsument żywności i jego zachowania w warunkach polskiego członkostwa w Unii Europejskiej (in Polish). Evaluation of the level of consumption of selected nutrients by Warsaw inhabitants. In: Gutkowska K, Narojek L (Eds.): Food consumers and their behaviour in conditions of Poland's membership in the European Union. Wydawnictwo SGGW, Warsaw 2005: 32-36.
- Ciacchi C, Cirillo M, Cavallaro R, Mazzacca G: Long-term follow-up of celiac adults on gluten-free diet: prevalence and correlates of intestinal damage. *Digestion* 2002, **66**, 178-185.
- Mariani P, Viti MG, Montuori M, La Vecchia A, Cipolletta E, et al.: The gluten-free diet: a nutritional risk factor for adolescents with celiac disease? *J Pediatr Gastroenterol Nutr* 1998, **27**, 519-523.
- Wild D, Robins GG, Burley VJ, Howdle PD: Evidence of high sugar intake and low fibre and mineral intake in the gluten-free diet. *Aliment Pharmacol Ther* 2010, **32**, 573-581.
- Kinsey L, Burden ST, Bannerman E A: dietary survey to determine if patients with coeliac disease are meeting current healthy eating guidelines and how their diet compares to that of the British general population. *Eur J Clin Nutr* 2008, **62**, 1333-1342.
- Wojtasik A., Kunachowicz H. Wartość odżywcza produktów bezglutenowych i ocena sposobu żywienia chorych na celiakię. In: Kunachowicz H. (Ed.): Dieta bezglutenowa. Co wybrać? (in Polish). Nutritional value of gluten-free products and evaluation of the mode of nutrition of patients with coeliac disease. In: Kunachowicz H. (Ed.): Gluten-free diet. What to choose? Wydawnictwo Lekarskie PZWL, Warsaw 2001:30-41.
- Bieżanowska-Kopec R, Kopec A, Wilk M: Ocena sposobu żywienia kobiet w wieku 20-25 lat z okolic Krakowa (in Polish). Evaluation of the mode of nutrition among women aged 20-25 from the Cracow area. *Żyw Człow Metab* 2007; **XXXIV**, ½:678-683.
- Bronkowska M: Żywnienie kobiet o małej aktywności fizycznej (in Polish). Nutrition of women with low physical activity. *Roczniki PZH* 2007; **58**(1), 177-183.
- Thompson T: Thiamin, riboflavin, and niacin contents of the gluten-free diet: Is there cause for concern? *J Am Dietetic Assoc* 1999, **99**, 858-862.
- Thompson T: Folate, iron, and dietary fiber contents of the glutenfree diet. *J Am Dietetic Assoc* 2000, **100**, 1389-1396.
- Przysięga E, Wasilewska A: Realizacja norm żywieniowych na wybrane składniki mineralne i grupy produktów spożywczych w dietach studentów Akademii Ekonomicznej we Wrocławiu (in Polish). Performance of nutritional standards for selected mineral components and groups of food products in diets of students from the Academy of Economics in Wrocław. *Bromatol Chem Toksykol* 2008; **XLI**(2), 151-159.
- Case S, Kaplan CR: Gluten Free Guidance: Practical tips for dietitians and their celiac patients. *Today's Dietitian* 2003, 44-49.
- Case S: The gluten-free diet: How to provide effective education and resources. *Gastroenterology* 2005, **128**, 128-134.