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Review Article

The Gluten-Free Diet: Difficulties Celiac Disease Patients have to Face Daily

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Abstract

Celiac disease (CD) is an autoimmune enteropathy triggered by the ingestion of gluten (the water-insoluble protein of wheat and equivalent proteins of barley, rye and oats). The treatment consists of lifelong adherence to a strict gluten-free diet (GFD). Although it might seem simple, removing gluten from the diet can be a difficult task because wheat and the other cereals that contain gluten are widely consumed around the world. Therefore, the GFD may bring a lot of social compromise to the patient's life. Besides that, the celica's diet demands extreme care in regards to the complete elimination of gluten, since gluten traces may still be able to induce damage to the intestinal mucosa. Moreover, aspects like high cost, poor sensorial and technological quality and unavailability of gluten-free products, cross contamination with gluten-containing cereals and inappropriate food labeling may jeopardize compliance to the treatment. The consequences of maintaining gluten in the diet are well established in the literature and include development of lymphomas and gastrointestinal carcinomas, osteoporosis, spleen atrophy, reproductive disorders, among others and so it is essential to be aware of the obstacles patients must face and come up with viable solutions to overcome those. The aim of this work was to perform a review on difficulties regarding the GFD an attempt to providing basis for possible strategies to contribute to diet compliance.

Gluten and celiac disease

Gluten comprises the water-insoluble protein of wheat, and there are equivalent proteins in barley, rye and oats [1]. It is composed by two polipeptidica fractions: prolamin and glutenin. The prolamin fraction is alcohol-soluble and it is the fragment responsible for toxicity in some individuals. According to the origin cereal, the prolamin receives different names: in wheat, it is called gliadin; in barley, hordein; in rye, secalin; and in oats, avenin [2].

Celiac disease (CD) is described as an autoimmune enteropathy triggered by the ingestion of gluten in genetically susceptible individuals. Gluten's consumption leads to an inflammatory reaction in the intestinal mucosa and villous atrophy and the patient's may present symptoms or not [3]. The most frequent symptoms include diarrhea, abdominal distension/pain, bloating, flatulence, constipation. Besides gastrointestinal manifestations, CD comprises various extra-intestinal symptoms, such as anemia, reduced growth velocity in children, weight loss, fatigue, depression, epilepsy and ataxia, osteopenia/osteoporosis, infertility, dental enamel hypoplasia and arthritis [4,5,6].

The disease affects approximately 1% of the general population and the diagnosis includes serology, intestinal biopsy, presence of typical symptoms and positive response to the removal of gluten from the diet [5]. The GFD is currently the only safe and effective treatment for CD [7].

The gluten-free diet

Gluten containing cereals and derived products are consumed worldwide. Wheat is the most widely grown crop and its availability along with gluten's functional properties justifies its wide use as an ingredient in food processing [5]. Gluten provides adequate sensorial characteristics to bakery products and others, such as elasticity, cohesiveness, firmness, moisture and uniformity [8].

There are available substitutes for CD patients, although none of them provides all the functional and technological characteristics gluten does. Some of these substitutes include: rice, potatoes, soybeans, maize, millet, buckwheat, amaranth, quinoa, green banana flour, sorghum, teff and derived products [8,9,10].

Besides obvious gluten-containing products, like wheat/barley/rye/oats and derived products, naturally gluten-free grains and flours might become contaminated with gluten-containing cereals [9].

According to the WHO/FAO commission *Codex Alimentarius*, 'gluten-free foods' are dietary foods "consisting of or made only from one or more ingredients which do not contain wheat (i.e., all Triticum species, such as durum wheat, spelt, and kamut), rye, barley, oats or their crossbred varieties, and the gluten level does not exceed 20 mg/kg in total, based on the food as sold or distributed to the consumer, and/or consisting of one or more ingredients from wheat (i.e., all Triticum species, such as durum wheat, spelt, and kamut), rye, barley, oats or their crossbred varieties, which have been specially processed to remove gluten, and the gluten level does not exceed 20 mg/kg in total, based on the food as sold or distributed to the consumer"[11].

An observation should be mentioned with respect to oats. While the toxic effect of wheat, barley and rye is well established in CD [12], the safety of oats consumption remains controversial [2,10]. Many *in vivo* and *in vitro* studies have been performed and the conclusions are conflicting [2]. However, in some countries, the inclusion of oats in the GFD is already allowed, as long as the gluten content of the

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product does not exceed 20 ppm [13,14].

As to the nutritional profile, the GFD may be healthy or unhealthy, as any other eating plan, depending on the food choices the patient makes. Removing gluten from the diet may result in low intake of fiber, iron, folate, niacin, phosphorus and zinc possibly because CD individuals usually consume grain foods made primarily from refined gluten-free grains and starch. That is why it is important to recommend that the patient includes whole and enriched gluten-free grains and products in the diet [9].

The diet might also contain high amount of lipids, since adding extra fat is a common procedure in the food industry when gluten is removed from a product formulation in order to obtain similar texture, firmness and other sensorial features as the original gluten-containing version [9].

Prescribing multivitamin and mineral supplement is only advisable when nutritional inadequacies cannot be alleviated through improved eating habits. Even so, nutrient absorption can be impaired in case the patient does not follow a strict diet and presents damaged intestinal mucosa [9,6].

Extreme care in regards to the complete elimination of gluten is necessary in the GFD since gluten traces may still be able to induce damage to the intestinal mucosa [5]. Strict adherence generally leads to symptoms and histological injury remission, with serological parameters normalization. It can reduce the risk for malignant complications and development of other autoimmune diseases, such as diabetes mellitus, hematologic disorders and inflammatory bowel diseases. Furthermore, studies around the world have shown benefits like improvement in growth rate in children, fewer hypoglycemic episodes and diabetes control in diabetic children with CD and recovery of anemia without iron supplementation, when the diet is being properly followed [15].

Difficulties involving the removal of gluten from the diet

As mentioned before, gluten is extensively used in the food industry and other industries due to its viscoelastic properties. It may be surprising to know that gluten might be present in daily use items such as lipsticks, drugs and postage stamps and food items like ice-creams, sweets, confectionary foods spreads and seasonings, soups and sauces, malted beverages and many more [16].

Moreover, wheat breeding over time resulted in changes in the cereal protein profile, mainly an increase in the gluten content, which contributes to higher gluten consumption by the population. Also, gluten fractionated from wheat flour by washing starch granules from dough (sometimes called vital gluten) is often added to food products to achieve improved product characteristics [17].

That is why finding gluten-free food might be difficult. In the study by Araújo and Araújo (2011), CD individuals reported they ingested food with gluten because of lack of alternatives and/or information in food found in public places. The majority of them expressed dissatisfaction regarding the price and availability of gluten-free products [18].

Substitute gluten-free flours are usually more expensive because their demand is lower in the market compared to other flours. In addition to that, when gluten is replaced in a product, it is necessary to modify the fabrication process and add other ingredients that make the cost of the final product higher.

Singh and Whelan (2011) conducted an investigation on availability and cost of gluten-free food and found that there is indeed limited availability of these products and those are generally more expensive than their standard counterparts [19].

These complaints about availability and cost of gluten-free food are common and have been mentioned in several studies [16,19-25]. Leffler et al (2008) found that 51.3% of the patients in the study consider cost was an important issue in living with CD [20].

Inadequate information and education about the disease represent another obstacle to maintain the diet [16]. It has been reported that sufficient knowledge about CD can be associated with diet compliance [25].

Labeling issues also constitute a barrier to the GFD. In the study by Zarcad as et al (2012), more than three-quarters of participants on the diet for over 5 years reported they still experienced difficulties with food labeling [26]. Hall et al (2013) found that clearer and universal product labeling is a factor that could make sticking to the diet easier for CD patients [22].

The dietary restrictions also impact on children and adults' social activities. Chauhan et al (2010) found that children might feel left out of activities at school or friends' home [21] and Whitaker et al (2009) found that 36% of the study adult participants reported less social activity after diagnosis [27].

Another difficulty CD patients must face is gluten contamination. Naturally gluten-free grains and flours might become contaminated with gluten-containing cereals any time they are grown, harvested, transported, or processed in the same area. In a study by Thompson et al, 7 out of 22 analyzed samples of naturally gluten-free grains and flours sold in the United States presented levels of gluten of or above 20 ppm [9].

In Brazil, a study conducted to evaluate the presence of gluten in naturally gluten-free products and products especially produced for CD patients revealed a considerable percentage of gluten contamination above 20 ppm [28].

It has been suggested that an intake of as little as 50 mg of gluten per day for 3 months can be sufficient to cause significant changes in the mucosal histology. Furthermore, a daily intake of gluten lower than10mg is unlikely to produce significant histological abnormalities. The GFD with the threshold at less than 20 ppm of gluten ensures an intake of less than 50 mg/day and provides a sufficient safety margin [16].

Lack of awareness about CD and its strict dietary restriction in the general population also causes problems for patients [16].

Having a meal in a restaurant, for example, constitutes a problem because of lack of knowledge by the restaurant staff regarding the GFD [29].

Oliveira et al (2014) evaluated gluten contamination in beans served in self-service restaurants in Brazil using the ELISA technique. Supposedly, beans are allowed for consumption by celiac in Brazil, since it is a preparation traditionally made with beans, water, salt,

garlic and oil. However, the results showed that 16% of the samples were contaminated with gluten and almost 45% of the restaurants showed at least one day of gluten contamination among three days of evaluation. This might be explained by the fact that chefs are not aware of the risk that represents for CD patients and so they frequently use wheat flour to thicken bean broth in order to prepare beans faster. It is worth mentioning that beans are commonly consumed daily and also out of home in Brazil. Thus, contamination in beans has a considerable impact in CD patients' health [30].

In a study from the United Kingdom, researchers found that less than 20% of the chefs interviewed had ever heard of CD and that 78.6% of the interviewed patients felt restricted eating food not prepared at home [29].

In a similar study conducted in the United States, 77% of the chefs reported having heard of CD. Despite that, some chefs who claimed to having heard of CD made mistakes when classifying gluten-containing or gluten-free food. This situation poses risk for CD individuals. If chefs and restaurant staff have not received formal training on gluten containing foods, patients may be inadvertently exposed to gluten when dining out [31].

Also in this study, questionnaires were administered to CD people and the results pointed out that 63% of them avoid restaurants because of the GFD [31].

In Sweden, CD adolescents were invited to take part in focus group discussions. Data were analyzed for recurrent stigma-related themes across groups and participants reported that restaurant staff was typically not well versed on special diets in relation to the standard menu. The adolescents also affirmed that occasionally they would inform that a dish was gluten-free even if it was obvious to the adolescent that it contained gluten [32].

The participants referred that skilled chefs with knowledge of gluten-free cooking and clear statements on menus in regards to the presence or absence of gluten in the preparation would provide assurance that the food was gluten-free [32].

Avoidance of traveling has also been reported among CD patients. In a health survey from Canada, 38% of participants referred avoiding trips some or most of the time and 94% bring gluten-free food with them when traveling [33].

In children, there are other additional challenges related to the GFD, as participating in birthday parties, sleepovers with friends, summer camp, and eating outside home [25]. Chauhan et al (2010) identified that CD children had problems related to adjustment such as difficulty in maintaining diet at school, restaurants, trips and also that patients complained that their teachers did not understand the nature of their disease [21].

Adolescence is also a critical moment. Children who have long accepted the GFD often rebel during adolescence and interrupt their dietary treatment. Social integration, self-esteem, and school achievements are at risk in teenagers with CD and are likely to generate more problems than clinical complaints [34].

Considering all these difficulties in maintaining the GFD, it becomes clear that adherence requires self-determination from CD patients, as well as their family members [18].

Diet compliance

Adherence to the GFD is important not only for preventing immediate occurrence of gastrointestinal symptoms, but also for reducing the risk for long-term complications, such as malignancies, osteoporosis and infertility [35]. It has been reported that compliance to the GFD ranges between 36% and 96% and it is associated with a variety of demographic, psychological and clinical factors [22].

A dietary interview can be an appropriate tool to assess adherence to the GFD. Biagi et al (2009) developed a fast questionnaire based on four simple questions that can be administered by non-expert personnel. This questionnaire was applied to CD patients and the results were compared to the persistence of villous atrophy and endomysial antibodies while on a GFD. Data obtained showed that the lowest results in the questionnaire score were significantly more frequent among patients with a persistence of both villous atrophy and endomysial antibodies, which shows that this questionnaire might be used as a reliable and simple method to verify compliance with the diet [36].

There are also other forms to evaluate diet compliance, such as assessment of CD related antibodies levels (as anti-endomysium and anti-transglutaminase antibodies and antibodies to deamidatedgliadin peptides) [37-39].

In the study by Machado et al (2013), adherence to treatment was assessed by structural interviews with CD patients and the results were compared to their IgA anti-transglutaminase antibodies' levels. The serological tests showed that 56.5% of the individuals did not follow the GFD, despite the fact that most of them reported complying with the diet [40].

It seems that adherence to the GFD is better if CD diagnosis made earlier in life compared to diagnosis later in life. Patients who display minimal symptoms or those diagnosed on screening comply less well than those who have intense and obvious symptoms. Remission periods can also be a problem because becoming asymptomatic and not displaying acute symptoms after inadvertent or deliberate ingestion of gluten might make the patient more confident and curious about trying gluten in other occasions too [16].

In a review by Hall et al (2009), the most commonly reported correlates of diet adherence were related to the following categories: cognitive (knowledge, attitudes, and illness representations), emotional (anger, depression, and anxiety), and sociocultural influences (public awareness, dining out, travel, and social events), as well as being membership of an advocacy group, and having regular dietetic follow-up [23].

Leffler et al (2008) observed that compliance was influenced by perceptions of the GFD (e.g., positive evaluations), the ability to follow the diet outside home, and the ability to maintain adherence despite changes in emotional state such as mood and stress [20].

In another study, Hall et al (2013) determined the rates of intentional and inadvertent non-adherence in CD individuals and examined the factors associated with both through a self-completion questionnaire. Intentional gluten consumption was reported by 40% of respondents. A total of 54% had made at least one known mistaken lapse over the same period and only 29% reported neither intentional

nor mistaken gluten consumption. Factors like low self-efficacy, perceptions of tolerance to gluten and intention were found to be independently predictive of intentional gluten consumption [22].

On the other hand, the statistical analysis suggested that perceived difficulty was not independently predictive of the odds of self-reported intentional gluten consumption. However, perceived difficulty was associated with the frequency of mistakes made and the confidence in one's ability to stick to the diet (self-efficacy) [22].

Knowledge about the disease and dietary treatment can also be associated with diet adherence. In the study by Roma et al (2010), knowledge was reported as sufficient by only 42.5% of the participants and that fact might be associated to the relatively low compliance found in this study through a questionnaire (58%). On the other hand, among patients with sufficient knowledge, a compliance of 80.6% was observed. The reported reasons for non-compliance were poor palatability (32%), dining outside home (17%), poor availability of products (11%), and asymptomatic disease diagnosed by screening (11%) [25].

Chauhan et al (2010) also performed a study to assess dietary compliance in children with CD. Investigation of diet adherence was based on detailed dietary history and clinical evaluation by a senior consultant. The authors observed a higher percentage of participants with good dietary compliance (75%). The results also pointed out that compliance was higher in younger children compared to adolescents; in children with higher maternal education; in parents having better knowledge and understanding of disease and in children who presented with typical symptoms of CD. Moreover, compliance was better in nuclear families; with less number of siblings and in families with higher per capita income [21].

Considering the importance of a strict GFD, investigating the factors related to diet compliance becomes essential in order to identify potential intervention targets [35].

In the study by Sainsbury and Mullan (2011), a questionnaire designed based on the Theory of Planned Behavior (TPB) was administered to CD individuals with adherence and quality of life measures, a GFD knowledge test, and self-reported psychiatric history. The TPB combined with self-reported depression and anxiety and quality of life explained significant variance in intention (41%) and adherence (33.7%). These findings suggest that the presence of psychiatric conditions represents a potential intervention target to improve adherence and quality of life [35].

According to the Academy of Nutrition and Dietetics Evidence Analysis Library, "medical nutrition therapy provided by a registered dietitian is strongly recommended for individuals with celiac disease." Therefore, consultation with a nutritionist who has expertise in CD is an important step at diagnosis and during follow-up. These patients must be monitored closely in order to assess the healthfulness of the GFD and discuss motivation, quality of life, symptom improvement and barriers to compliance [9].

Possible food substitutes

In the last few years, CD and the GFD have gained more attention worldwide by health care professionals and the population in general. That fact led to studies and instigated the food industry to come up with possible safe and tasty products as options for those patients and other individuals wishing to maintain a GFD [5,41].

Since gluten provides specific desirable characteristics to food products, it is important to find ingredients which could generate a similar structure as gluten by using technology that explores the functional properties of starch in raw materials, or by adding flours that are rich in protein or other ingredients, sometimes combined in order to achieve better results[8].

Thickeners and gums/hydrocolloids derived from seeds, fruits, or plant extracts can be added in formulations to improve water retention, texture and appearance properties. Among different types of flours present on the market and rich in starch, rice and corn flour are the best suited to the gelatinization process [42].

A possibility for creating a physical structure similar to gluten in dough includes using alimentary fibers composed of complex carbohydrates, resistant starch, and lignine [41].

There has been some successful research in development of new gluten-free products using those ingredients. Zandonadi et al (2009) used psyllium as a substitute for gluten in bread. Chemical, nutritional and sensorial evaluations were performed and the data obtained showed that products made with the modified dough had less fat and fewer calories and displayed good acceptance by individuals with or without CD. Moreover, it is worth mentioning that psyllium contributes to gut regulation, serum glucose, and cholesterol control, which are desirable nutritional characteristics [41].

Zandonadi et al (2014) also tested the use of psyllium in pasta. In this study, the modified samples presented great acceptance, reaching 100% for individuals with CD and 94% for individuals without CD. The most affected characteristics were odor and texture; however they did not alter preference or acceptability of modified products in relation to standardized ones. In regards to chemical composition, a reduction of 26.5% was observed for energy value and 85.4% of proportional fat [43].

In another study, green banana flour was used for the production of gluten-free pasta. Pasta sample made from wheat was used as a standard for comparison. Nutritional and sensorial tests were performed and the results showed that the modified sample presented greater acceptance (84.5% for celiac individuals and 61.2% for nonceliac) than standard samples (53.6% for nonceliac individuals). There was no significant difference between the green-banana and standard samples in terms of appearance, aroma, flavor, and overall quality. Besides that, the modified sample presented 98% less lipid [8].

Furthermore, the use of green banana flour improves the nutritional quality of the product because it contains bioactive compounds, such as resistant starch and phenolic acids. The high content of resistant starch might contribute to controlling glycemic indexes, cholesterol, gastric fullness, intestinal regularity, and fermentation by intestinal bacteria, producing short-chain fatty acids that can prevent cancer in intestinal cells [8].

Pumpkin seeds also present a good amount of fiber which can be used in food products. The use of pumpkin seed flour has been tested in combination with corn starch in the production of cake in a study from Brazil. The experimental cakes displayed satisfactory

macroscopic and chemical characteristics, higher soluble fiber content and fewer calories when compared to standard cake. This new formulation proved technological feasibility and it is also a good strategy to improve the nutritional quality of the preparation, since pumpkin seeds contain iron, protein and unsaturated oils [44].

Almond and peanut flour were also used as substitutes for wheat gluten in the study by Granato and Ellendersen (2009). The aim of the study was to formulate two gluten-free cookies, one with peanut flour and the other with almond flour, and to analyze their physicochemical and sensory properties. Both formulations displayed great sensorial acceptance indexes of 80% and 85%, for peanut and almond cookies, respectively. Besides that, physicochemical analyses pointed out that both cookies could be considered sources of iron [45].

In another study, the role of buckwheat and hydroxypropylmethylcellulose (HPMC) on the bread making properties of two commercial gluten-free bread mixtures was evaluated. A dehulled and puffed buckwheat flour were used. High substitution levels were tested, with the aim of improving the nutritional value of the final gluten-free breads without decreasing their technological quality. The results pointed out that the inclusion of 40% dehulled buckwheat flour improved the baking performances of the commercial gluten-free mixtures. Moreover, the presence of a small amount of puffed buckwheat flour, as well as of HPMC, was useful in limiting the diffusion and the loss of water from the bread crumb and the interactions between starch and protein macromolecules, resulting in a softer bread crumb and reduced staling kinetics during storage [46].

Beyond that, buckwheat's consumption may generate health benefits, since it presents high content of high biological value proteins, fibers, minerals, flavonoids and polyphenols. Moreover, it is associated with improvement in glucose tolerance in diabetic individuals and with lower serum cholesterol and higher ratio of high-density lipoprotein cholesterol to total cholesterol [46].

Blanco et al (2011) investigated the effects of adding acidic food additives (acetic acid, lactic acid, citric acid and monosodium phosphate) in the formulation of gluten-free bread made with rice flour and HPMC. The influence of those compounds on sensorial aspects was determined and results suggested that monosodium phosphate increases the volume of the gluten-free bread, improving appearance, odor, taste and texture, which might be another strategy to improve gluten-free dough [47].

Quinoa and amaranth have also been tested in the production of bread, pasta and crackers, and displayed good results. These grains are rich in proteins with high biological value (albumins and globulins) and contain carbohydrates that can be considered nutraceuticals, as they have cholesterol and glycemic-lowering effects, and induce a reduction of free fatty acids [42].

When removing gluten from a preparation, it is common to technologically compensate its absence by adding great quantities of fat. Thus, it is essential to explore alternative healthier solutions, such as using resistant starch and fibers, to produce food with better nutritional composition [41].

Although there are viable options to replace gluten in the market, it is urgent to investigate the potential of ingredients, additives and technological aids, to develop high-quality gluten-free products at a reasonable price [47].

Strategies to deal with the GFD

Consultation with a nutritionist is an important strategy to help CD patients to maintain the GFD [9,16]. Typical dietary intake assessment must be thorough. It is advisable to review all food and beverages consumed on weekdays and weekends, including name brands of products and frequency of food eaten away from home (restaurants, social events, other people's homes, travelling). Patients should be questioned about compliance to the diet and frequency of gluten ingestion (purposely or inadvertently) [9].

Patients' knowledge and understanding of the diet is crucial to achieving good dietary compliance. In order to assess that, the nutritionist must review their label-reading skills, how they order food in restaurants and what cross-contamination procedures are used in shared kitchens [9].

Consumers must be educated as to read labels carefully and look for sources of gluten. The ingredients list should be read for words such as "wheat", "rye", "barley", "oats", "malt", "brewer's yeast", "modified food starch", "dextrin" and "starch" [9].

It is also important to alert patients to investigate the possible presence of gluten in medications, vitamins and other dietary supplements [9].

As to contamination problems, a few topics must be discussed with the patient when buying food. It is necessary to investigate what types of grains are eaten, what specific brands are purchased and if there are any grains or flours purchased from bulk bins (which may be contaminated because of use of shared scoops) [9].

In regards to specific attitudes at home, the patient must be advised to store gluten-free food separately (in case there is gluten-containing food in the house), use separate cooking and serving utensils to prepare gluten-free and gluten-containing food, clean well shared plates, pots and so after use with gluten-containing food, keep microwaves, toaster ovens, counter tops, silverware drawers, and so forth clean and free of wheat-containing crumbs, use separate and exclusive pop-up toaster for gluten-free food, and separate products such as peanut butter, jelly, and mayonnaise for gluten-free products to prevent contamination with gluten-containing crumbs due to "double-dipping" [9].

When eating out, the patient should investigate if wait staff is well-informed about the need for the meal to be gluten-free and free of cross-contamination. Moreover, CD individuals should avoid French fries, tortilla chips and other fried food (these foods may be cooked in oil previously used to prepare breaded foods) and soups (soup may be thickened with wheat flour or contain a wheat-based commercial broth/bouillon). Besides that, patients should be careful with preparations containing sauces and dressings, which might also contain wheat or barley ingredients [9].

Another possibility is recommending that the patient prepare his own food. Araújo and Araújo observed that 77.7% of the patients enrolled in their study reported they prepared their meals by themselves or that this task was assumed by their caregivers [18].

Table 1: Difficulties related to the gluten-free diet and possible strategies to overcome those.

Difficulties	Strategies
Presence of gluten in many food products due to its viscoelastic properties	Development of healthier, less expensive, tastier gluten-free products
High cost of gluten-free products	Increasing provision of gluten-free food within supermarkets
Low availability of gluten-free products	Increasing awareness within the catering/food industry about CD, GFD and gluten-free products
Eating outside home (restaurants, social events, family and friends' houses)	Improvement in food labeling
Lack of gluten-free alternatives and/or information in public places	Regular consultation with a nutritionist
Labeling issues	Educating the patient about the disease and diet (how to read labels, prevent contamination issues…)
Inadequate information/education about the disease among the general population and CD patients	Developing and promoting gluten-free cooking classes and workshops
Compromise to social activities	Social support from family and friends
Travelling	Recommending that the patient prepares his own food
Gluten contamination	Encouragement to join/maintain membership of a local support society
	Assistance with the social and emotional adaptation after CD diagnosis
	Governmental actions (implementing effective regulations and control measures like analytical tests to prevent contamination)

Developing and promoting gluten-free cooking classes and workshops can be interesting so that CD patients can learn how to prepare their own food. This could bring more variety in their diet. Moreover, social events like those create the opportunity for CD patients to socialize, share experiences, exchange information, and discuss problems regarding the GFD and strategies to cope with them.

Another essential tool to help CD individuals consists of social support from family and friends [16]. Dietary gluten avoidance requires a lot of effort from the patient and family [48] and so education about the disease and dietary treatment is of immense importance [16].

Support from CD supporting groups and associations are also very important. It may provide opportunities for the patients to share information about gluten-free products and their availability and increase diet compliance. Moreover, these associations can advocate for gluten labeling and other issues to the government and regulatory agencies [16]. Therefore, encouragement to join and maintain membership of a local support society for people with CD is an interesting strategy [25].

In order to promote dietary self-management in CD, some efforts which extend individual and health care setting are necessary, such as continued improvement in food labeling, increasing provision of gluten-free food within supermarkets and increased awareness within the catering and food manufacturing industry [22].

There is a demand for the food industry to search for less expensive and healthier gluten-free ingredients and improve and develop other food options that would expand product supply and encourage greater acceptance of new food standards by people with CD [8].

Governmental actions such as implementing effective regulations and control measures including analytical tests to prevent contamination and enforcement activities are necessary to guarantee consistent labeling and availability of safe products which will ultimately lead to an effective avoidance of gluten by families affected by CD [49].

Achieving a successful management of the GFD demands a team approach, including the patient, family, physician and dietitian. Diet education, meal planning and assistance with the social and emotional adaptation to the imposed lifestyle are essential and periodic monitoring prevents obtaining inaccurate information from the Internet, health food stores, family, friends, and other sources, which may cause confusion and frustration [16].

Conclusion

The diagnosis of CD leads to the mandatory need of adopting a GFD, since that is currently the only safe treatment for the disease. The GFD restrictions bring a lot of changes into the patient's life and dealing with those is not easy.

Although there are some available gluten-free food substitutes, these are usually more expensive, difficult to find and not so adequate in regards to sensorial characteristics.

Studies around the world show that compliance to the diet can vary a lot and it depends on several aspects. Medical and nutritional monitoring constitutes the first approach to dealing with the treatment in the best possible way.

Self-determination by the CD individual also plays a key role for maintaining the diet, but there are necessary efforts which extend individual setting, such as actions by the food industry to develop healthier, less expensive and desirable products. Furthermore, governmental measures to ensure availability of safe non-contaminated products through analytical control and adequate labeling are extremely important to enable strict adherence to the diet.

Considering all the short and long-term negative repercussions of maintaining gluten in the diet of CD patients, dedication of health care professionals, the food industry, government, patient and family should be directed to coming up with strategies to facilitate diet adherence.

References

1. Hollén E, Högberg L, Stenhammar L, Fälth-Magnusson K, Magnusson KE. Antibodies to oat prolamines (avenins) in children with coeliac disease. Scand J Gastroenterol. 2003; 7: 742-746.

2. Haboubi NY, Taylor S, Jones S. Coeliac disease and oats: a systematic review. Post grad Med J. 2006; 82: 672-678.

3. Fasano A, Araya M, Bhatnagar S, Cameron D, Catassi C, Dirks M, et al. Federation of International Societies of Pediatric Gastroenterology, Hepatology, and Nutrition Consensus Report on Celiac Disease. J PediatrGastroenterolNutr. 2008; 47: 214-219.

4. Barker JM, Liu E. Celiac disease: pathophysiology, clinical manifestations,

and associated autoimmune conditions. Advances in Pediatrics. 2008; 55: 349-365.

5. Sapone A, Bai JC, Ciacci C, Dolinsek J, Green PHR, Hadjivassiliou M, et al. Spectrum of gluten-related disorders: consensus on new nomenclature and classification. BMC Medicine. 2012; 10: 1-12.

6. Woodward J. Coeliac disease. Medicine. 2007; 35: 226-230.

7. Lerner A. New therapeutic strategies for celiac disease. Autoimmunity Reviews. 2010; 9: 144-147.

8. Zandonadi RP, Botelho RBA, Gandolfi L, Ginani JS, Montenegro FM, Pratesi R. Green banana pasta: an alternative for gluten-free diets. Journal of the Academy of Nutrition and Dietetics. 2012; 112: 1068-1072.

9. Simpson S, Thompson T. Nutrition assessment in celiac disease. Gastrointest Endoscopy Clin N Am. 2012; 22: 797-809.

10. Fric P, Gabrovska D, Nevoral J. Celiac disease, gluten-free diet, and oats. Nutr Rev. 2011; 69: 107-115.

11. Codex Alimentarius Commission. Standard for Gluten-free Foods (Stan 118) Revised 2008.

12. Guttormsen V, Løvik A, Bye A, Bratlie J, Mørkrid L, Lundin KEA. No induction of anti-avenin IgA by oats in adult, diet-treated celiac disease. Scand J Gastroenterol. 2008; 43: 161-165.

13. Ballabioa C, Ubertia F, Manferdellib S, Vaccab E, Bogginic G, Redaellid R, et al. Molecular characterization of 36 oat varieties and in vitro assessment of their suitability for coeliacs' diet. Journal of Cereal Science, 2011; 54: 110-115.

14. Comino I, Real A, Lorenzo L, Cornell H, López-Casado MA, Barro F, et al. Diversity in oat potential immunogenicity: basis for the selection of oat varieties with no toxicity in celiac disease. Gut. 2011; 60: 915-922.

15. Barada K, Daya HA, Rostami K, Catassi C. Celiac disease in the developing world. GastrointestEndoscopyClin N Am. 2012; 22: 773-796.

16. Rajpoot P, Makharia GK. Problems and challenges to adaptation of gluten-free diet by Indian patients with celiac disease. Nutrients. 2013; 5: 4869-4879.

17. Kasarda DD. can an increase in celiac disease be attributed to an increase in the gluten content of wheat as a consequence of wheat breeding? J Agric Food Chem. 2013; 61: 1155-1159.

18. Araújo HM, Araújo WM. Coeliac disease. Following the diet and eating habits of participating individuals in the Federal District, Brazil. Appetite. 2011; 57: 105-109.

19. Singh J, Whelan K. Limited availability and higher cost of gluten-free foods. Journal of Human Nutrition and Dietetics. 2011; 24: 479-486.

20. Leffler DA, Edwards-George J, Dennis M, Schuppan D, Cook F, Franko DL, et al. Factors that influence adherence to a gluten-free diet in adults with celiac disease. Digestive Diseases and Sciences. 2008; 53: 1573-1581.

21. Chauhan JC, Kumar P, Dutta AK, Basu S, Kumar A. Assessment of dietary compliance to gluten-free diet and psychosocial problems in indian children with celiac disease. Indian Journal of Pediatrics. 2010; 77: 649-654.

22. Hall NJ, Rubin GP, Charnock A. Intentional and inadvertent non-adherence in adult coeliac disease. A cross-sectional survey. Appetite. 2013; 68: 56-62.

23. Hall NJ, Rubin GP, Charnock A. Systematic review: adherence to a gluten-free diet in adult patients with coeliac disease. Aliment PharmacolTher. 2009; 30: 315-330.

24. Biagetti C, Naspi G, Catassi C. Health-related quality of life in children with celiac disease: a study based on the critical incident technique. Nutrients. 2013; 5: 4476-4485.

25. Roma E, Roubani A, Kolia E, Panayiotou J, Zellos A, Syriopoulou VP. Dietary compliance and life style of children with coeliac disease. Journal of Human Nutrition and Dietetics. 2010; 23: 176-182.

26. Zarkadas M, Dubois S, MacIsaac K, Cantin I, Rashid M, Roberts KC, et al. Living with celiac disease and a gluten-free diet: a Canadian perspective. Journal of Human Nutrition and Dietetics. 2012; 26: 10-23.

27. Whitaker JK, West J, Holmes GK, Logan RF. Patient perceptions of the burden of coeliac disease and its treatment in the UK. Aliment PharmacolTher. 2009; 29: 1131-1136.

28. Silva RP, Lordello MLL, Nishitokukado I, Ortiz-Agostinho CL, Santos FM, André Z. Leite, et al. Detection and quantification of gluten in processed food by ELISA in Brazil. Gastroenterology. 2010; 138: s306-s306.

29. Karajeh MA, Hurlstone DP, Patel TM, Sanders DS. Chefs' knowledge of coeliac disease (compared to the public): a questionnaire survey from the United Kingdom. Clinical Nutrition. 2005; 24: 206-210.

30. Oliveira OMV, Zandonadi RP, Gandolfi L, Almeida RC, Almeida LM, Pratesi R. Evaluation of the presence of gluten in beans served at self-service restaurants: a problem for celiac disease carriers. Journal of Culinary Science & Technology. 2014; 12: 22-33.

31. Simpson S, Lebwohl B, Lewis SK, Tennyson CA, Sanders DS, Green PH. Awareness of gluten-related disorders: a survey of the general public, chefs and patients. e-SPEN, the European e-Journal of Clinical Nutrition and Metabolism. 2011; 6: e227-e231.

32. Olsson C, Lyon P, Hörnell A, Ivarsson A, Sydner YM. Food that makes you different: the stigma experienced by adolescents with celiac disease. Qualitative Health Research. 2009; 19: 976-984.

33. Cranney A, Zarkadas M, Graham ID, Butzner JD, Rashid M, Warren R, et al. The Canadian Celiac Health Survey. Dig Dis Sci. 2007; 52: 1087-1095.

34. Errichiello S, Esposito O, Mase R, Camarca ME, Natale C, Limongelli MG. Celiac disease: predictors of compliance with a gluten-free diet in adolescents and young adults. JPGN. 2010; 50: 54-60.

35. Sainsbury K, Mullan B. Measuring beliefs about gluten free diet adherence in adult coeliac disease using the theory of planned behavior. Appetite. 2011; 56: 476-483.

36. Biagi F, Andrealli A, Bianchi PI, Marchese A, Klersy C, Corazza GR. A gluten-free diet score to evaluate dietary compliance in patients with coeliac disease. Br J Nutr. 2009; 102: 882-887.

37. Sugai E, Nachman F, Váquez H, González A, Andrenacci P, Czech A. Dynamics of celiac disease-specific serology after initiation of a gluten-free diet and use in the assessment of compliance with treatment. Dig Liver Dis. 2010; 42: 352-358.

38. Nachman F, Sugai E, Vázquez H, González A, Andrenacci P, Niveloni S. Serological tests for celiac disease as indicators of long-term compliance with the gluten-free diet. Eur J Gastroenterol Hepatol. 2011; 23: 473-480.

39. Monzani A, Rapa A, Fonio P, Tognato E, Panigati L, Oderda G. Use of deamidated gliadin peptide antibodies to monitor diet compliance in childhood celiac disease. J Pediatr Gastroenterol Nutr. 2011; 53: 55-60.

40. Machado J, Gandolfi L, Almeida FC, Almeida LM, Zandonadi RP, Pratesi R. Gluten-free dietary compliance in Brazilian celiac patients: questionnaire versus serological test. Nutr. clin. diet. hosp. 2013; 33: 46-49.

41. Zandonadi RP, Botelho RB, Araújo WM. Psyllium as a substitute for gluten in bread. J Am Diet Assoc. 2009; 109: 1781-1784.

42. Lamacchia C, Camarca A, Picascia S, Di Luccia A, Gianfrani C . Cereal-based gluten-free food: how to reconcile nutritional and technological properties of wheat proteins with safety for celiac disease patients. Nutrients. 2014; 6: 575-590.

43. Zandonadi RP, Botelho RBA, Araújo WMC. Psyllium as a substitute for gluten in pastas. Journal of Culinary Science & Technology. 2014; 12: 181-190.

44. Gorgônio CMS, Pumar M, Mothe CG. Macrocospic and physiochemical characterization of a sugarless and gluten-free cake enriched with fibers made from pumpkin seed (Cucurbita maxima, L.) flour and cornstarch. Cienc. Tecnol. Aliment. 2011; 31: 109-118.

45. Granato D, Ellendersen LSN. Almond and peanut flours supplemented with iron as potential ingredients to develop gluten-free cookies. Ciênc. Tecnol. Aliment. 2009; 29: 395-400.

46. Mariotti M, Pagani MA, Lucisano M. The role of buckwheat and HPMC on the breadmaking properties of some commercial gluten-free bread mixtures.

Food Hydrocolloids. 2013; 30: 393-400.

47. Blanco CA, Ronda F, Pérez B, Pando V. Improving gluten-free bread quality by enrichment with acidic food additives. Food Chemistry. 2011; 127: 1204-1209.

48. Tanpowpong P, Broder-Fingert S, Katz AJ, Camargo CA Jr. Predictors of gluten avoidance and implementation of a gluten-free diet in children and adolescents without confirmed celiac disease. J Pediatr. 2012; 161: 471-475.

49. Diaz-Amigo C, Popping B. Gluten and gluten-free: issues and considerations of labeling regulations, detection methods, and assay validation. J AOAC Int. 2012; 95: 337-348.

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