Celiac Disease: Evaluation of the Diagnosis and Dietary Compliance in Canadian Children

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ABSTRACT. *Objectives.* **We sought to characterize the clinical features at presentation as well as the associated disorders, family history, and evaluation of compliance with a gluten-free diet in children with celiac disease from across Canada.**

Study Design. **All members (n = 5240) of the Canadian Celiac Association were surveyed with a questionnaire. Of the 2849 respondents with biopsy-confirmed celiac disease, 168 who were <16 years old provided the data reported here.**

Results. **The mean age when surveyed was 9.1 ± 4.1 years, and 58% were female. Median age at diagnosis was 3.0 years with a range of 1 to 15 years. Presenting symptoms included abdominal pain (90%), weight loss (71%), diarrhea (65%), weakness (64%), nausea/vomiting (53%), anemia (40%), mood swings (37%), and constipation (30%). Almost one third of families consulted ≥2 pediatricians before confirmation of the diagnosis. Before the recognition of celiac disease, other diagnoses received by these children included anemia (15%), irritable bowel syndrome (11%), gastroesophageal reflux (8%), stress (8%), and peptic ulcer disease (4%). A serological test was performed to screen for celiac disease in 70% of those in this population. Eight percent had either type 1 diabetes mellitus or a first-degree relative with celiac disease. Almost all respondents (95%) reported strict adherence to a gluten-free diet, and 89% noted improved health. Reactions after accidental gluten ingestion developed in 54% of the children between 0.5 and 60 hours after ingestion with a median of 2.0 hours. Reactions included abdominal discomfort (87%), diarrhea (64%), bloating (57%), fatigue (37%), headache (24%), and constipation (8%), and most displayed >1 symptom. Although most adjusted well to their disease and diet, 10% to 20% reported major disruptions in lifestyle. Twenty-three percent felt angry all or most of the time about following a gluten-free diet. Only 15% avoided traveling all or most of the time, and during travel, 83% brought gluten-free food with them all of the time. More than half of the families avoided restaurants all or most of the time. Twenty-eight percent of the respondents found it extremely difficult to locate stores with gluten-free foods, and 27% reported extreme difficulty in finding gluten-free foods or determining if foods were free of gluten. Sixty-three percent of the respondents felt that the information supplied by the Canadian Celiac Association was excellent. Gastroenterologists provided excellent information to 44%, dietitians to 36%, and the family physician to 11.5%. When asked to select 2 items that would improve their quality of life, better labeling of gluten-containing ingredients was selected by 63%, more gluten-free foods in the supermarket by 49%, gluten-free choices on restaurant menus by 49%, earlier diagnosis of celiac disease by 34%, and better dietary counseling by 7%.**

Conclusions. **In Canada, children with celiac disease present at all ages with a variety of symptoms and associated conditions. Delays in diagnosis are common. Most children are compliant with a gluten-free diet. A minority of these children experience difficulties in modifying their lifestyles, and gluten-free foods remain difficult to obtain.** *Pediatrics* **2005;116:e754–e759. URL: www.pediatrics.org/cgi/doi/10.1542/peds.2005-0904;** ***celiac, gluten, survey.***

ABBREVIATIONS. IgA, immunoglobulin A; CCA, Canadian Celiac Association.

Celiac disease, or gluten-sensitive enteropathy, is a permanent intolerance to gluten, which causes damage to the small bowel mucosa by an autoimmune mechanism in genetically susceptible individuals. It can present with a variety of intestinal and nonintestinal symptoms in children. Celiac disease was considered to be rare in North America until a recent large epidemiologic study demonstrated the many manifestations and underrecognition of this chronic autoimmune disorder.[1,2] Celiac disease may affect as many as 1 in 104 children in the United States[3] and 1 in 99 children in Europe.[4] Such a high prevalence makes celiac disease one of the most common chronic disorders in children.

Individuals with celiac disease may present with only mild and/or atypical symptoms. Medical

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awareness of these multiple presentations and diseases associated with gluten-sensitive enteropathy is not high and often leads to a delay in diagnosis and increased risk of complications.[5] This delay in diagnosis may cause serious nutritional complications including growth failure, delayed puberty, iron-deficiency anemia, and impaired bone health.[1,6] Celiac disease is also associated with several other disorders of childhood, including type 1 diabetes mellitus, autoimmune thyroiditis, Down syndrome, Turner syndrome, and selective immunoglobulin A (IgA) deficiency.[6] Although it is controversial, some investigators suggest that the early diagnosis and treatment of celiac disease may prevent the occurrence of autoimmune disorders that are associated with celiac disease, such as diabetes and thyroiditis.[7,8]

The treatment of celiac disease requires strict adherence to a gluten-free diet for life, which can be challenging for the patient. This can be even more problematic for children; the strict restrictions of a gluten-free diet may affect their psychosocial well-being. Few data exist about the effects of celiac disease on the well-being and lifestyle of the child and the family.

This study examines the clinical presentation, associated disorders, family history, and difficulties in making the diagnosis of celiac disease in children from across Canada. In addition, it evaluates the impact of celiac disease and the gluten-free diet on the lifestyles and well-being of children with celiac disease and their families.

METHODS

The Professional Advisory Board of the Canadian Celiac Association (CCA) in collaboration with the Department of Epidemiology and Medicine, University of Ottawa, developed the questionnaire for the Canadian Celiac Health Survey. The survey included 76 questions on demographics, clinical symptoms before diagnosis, diagnoses considered before diagnosis of celiac disease, associated disorders, and family history. Also, a series of celiac disease–specific questions about the well-being and lifestyles of children and families of children with celiac disease were included. Members of the CCA Professional Advisory Board and 2 international experts on celiac disease, one of whom is a pediatric gastroenterologist, reviewed the content of the survey. It was pretested by 14 CCA members (including 4 children) for readability and face validity. A pilot of the questionnaire was administered to 414 members, including 14 children, of the Ottawa chapter of the CCA to confirm its feasibility.[9]

Ethics approval for the study was received from Queen's University, Kingston, Ontario, Canada, and informed consent was obtained from all participants. The questionnaire was mailed to all members (n = 5240) of the CCA in October 2002, and 3408 (65%) were completed and returned. Of the 3408 respondents, 194 were children younger than 16 years. Of these, 168 (86%) had biopsy-confirmed celiac disease, and only data from these children were analyzed. Children accounted for 6% of the total biopsy-confirmed survey respondents. The adult data will be reported elsewhere. The membership had broad representation from all 10 Canadian provinces. Strict anonymity of the participants was maintained. When parents completed the questionnaire, they were encouraged to involve the child in answering the questions. Only 1 family member with celiac disease per household completed the questionnaire. The data were analyzed by using SPSS 10 for Windows (SPSS Inc, Chicago, IL).

RESULTS

The mean age of these 168 participants was 9.1 ± 4.1 years (range: 2–15 years), and 58% were female. There were 19 (11%) children aged 2 to 3 years, 46 (27%) aged 4 to 7 years, 43 (26%) aged 8 to 11 years, and 60 (36%) aged 12 to 15 years. The median age at diagnosis of celiac disease was 3.0 years (mean: 4.8 ± 4.0 years; range: 1–15 years).

Table 1 lists the clinical symptoms reported before the diagnosis of celiac disease. Abdominal pain was the most common symptom, present in 90% of the respondents. Other prominent gastrointestinal symptoms included weight loss, diarrhea, nausea and vomiting, and constipation. Major nongastrointestinal symptoms included growth failure, extreme weakness, anemia, and mood swings or depression. Most children (96.4%) displayed >1 symptom. Thirty (18%) children had short stature, 25 (15%) had dental enamel defects, and 13 (8%) had type 1 diabetes. Eight percent of the children had a first-degree relative with biopsy-confirmed celiac disease. A serological test of some type was performed to screen for celiac disease in 118 (70%) of those in this population.

Physicians Consulted Before Final Diagnosis

One quarter (24%) of the families consulted ≥2 family physicians, 30% consulted at least 2 pediatricians, and 6% consulted ≥2 gastroenterologists before establishing the diagnosis of celiac disease. Before the recognition of celiac disease, other diagnoses received by these children included anemia (15%), irritable bowel syndrome (11%), gastroesophageal reflux (8%), stress (8%), and peptic ulcer disease (4%). The median time between the onset of symptoms and the diagnosis of celiac disease was 1 year (range: 0–12 years).

Treatment and Gluten-Free Diet

All participants (100%) were advised to follow a gluten-free diet for life. Families were members of the CCA, and all received information on celiac disease and the gluten-free diet from the association. In addition, dietitians provided information to 90%, gastroenterologists to 80%, and family physicians to 32% of the patients and families. The perceived quality of information received varied depending on the source. Sixty-three percent of individuals who responded felt that the information supplied by the CCA was excellent. Gastroenterologists provided ex-

TABLE 1. Clinical Symptoms or Signs Prior to Diagnosis of Celiac Disease

	%
Abdominal pain, gas, bloating	90
Weight loss	71
Poor growth	70
Diarrhea	65
Extreme weakness	64
Nausea, vomiting	53
Anemia	40
Mood swings/depression	37
Constipation	30
Eczema	24
Bone/joint pain	21
Mouth ulcers	16
Muscle cramps	14
Easy bruising	11

cellent information to 44%, dietitians to 36%, and the family physician to 11.5% of the respondents.

Almost all (95%) of the respondents adhered to a strict gluten-free diet, and only 4% felt that they could be healthy without their gluten-free diet (Table 2). After starting the gluten-free diet, 89% noted a significant improvement in health. The accidental consumption of gluten triggered reactions in 91 (54%) children. Reactions reported include abdominal discomfort (87%), diarrhea (64%), bloating (57%), fatigue (37%), headache (24%), and constipation (8%), and most displayed >1 symptom. The reaction time from ingestion of gluten to development of the first symptom ranged from 25 minutes to 60 hours (median: 2.0 hours).

The participants were questioned about how they felt during the past year and how the gluten-free diet affected them and their family. The responses are listed in Tables 2 and 3. Although 63% of the children felt left out of social activities to some degree, only 13% considered celiac disease to be a major disruption in their social life, and 11% felt all or most of the time that teachers and friends did not understand their disease. Twenty-three percent felt angry all or most of the time about following a gluten-free diet. Restaurants were avoided all or most of the time by 54%. Only 15% avoided traveling all or most of the time, and during travel, 83% brought gluten-free food with them all of the time. Twenty-eight percent of the respondents found it extremely difficult to locate stores with gluten-free foods, and 27% reported that all or most of the time they found it difficult to determine if a food was free of gluten by reading the label.

The participants were asked to select 2 items from the questionnaire that they felt would improve their quality of life. Better labeling of gluten-containing ingredients was selected by 63% of the respondents, more gluten-free foods in the supermarket by 49%, and gluten-free choices on restaurant menus by 49%. Earlier diagnosis of celiac disease was selected by 34%, and better dietary counseling by 7%.

DISCUSSION

The pediatric data of the CCA's Health Survey examined the presenting symptoms, family's experience with diagnosis, dietary compliance, and the child's and family's perceptions about coping with celiac disease and the gluten-free diet. Children from 168 families from across Canada participated in this retrospective endeavor. This evaluation is the largest of its type to be completed on Canadian and perhaps North American children with celiac disease. The data on the clinical presentation of children at diagnosis are compared with the only previous Canadian data obtained >35 years ago in a single-center study from Toronto, Ontario.[10] The evaluation of the child and family's experiences in complying with a gluten-free diet, to our knowledge, has not been reported previously in a North American population.

The mean age of presentation in this study, 4.8 years, is almost twice that observed in the Toronto study (2.6 years).[10] In the current study, 89% of the children were diagnosed after 3 years of age, whereas in the previous study only 17% were diagnosed after the age of 3. In the Toronto study 75% of the children presented with the "classical gastrointestinal" presentation of celiac disease.[6] The frequency of symptoms associated with this presentation (weight loss, poor growth, diarrhea, nausea/vomiting, and irritability) occurred at similar rates in the 2 studies. However, in our study, children presented with these symptoms at an older age. In addition, a much higher percentage of children presented with abdominal pain compared with the previous study (90% vs 19%). The presenting symptoms and signs of fatigue, constipation, bone/joint pain, mouth ulcers, muscle cramps, and anemia were not recognized in the previous study. These data mirror similar trends summarized by Walker-Smith and Murch[11] that demonstrate an increasing age of presentation of children with celiac disease throughout Europe. Although the reasons for this are not known, authors speculate that this trend is caused by several factors. These factors may include breastfeeding to an older age, delayed introduction of gluten-containing foods into the infant's diet, and the use of screening tests in high-risk populations.[11] Because older children are presenting with a wide variety of atypical symptoms, the indications for celiac disease screening have been broadened.[1,6,11] Atypical signs and symptoms observed in this study include constipation, anemia, extreme weakness, and mood swings or depression. Most children displayed >1 symptom or sign. Other symptoms not observed in this study that should lead to screening include unexplained hypertransaminasemia, osteopenia/osteoporosis, and neurologic symptoms including epi-

TABLE 2. Feelings of Children With Celiac Disease

	All of the Time, %	Most of the Time, %	Some of the Time, %	Never, %	Not Answered, %
Felt left out of activities at school or friends' homes	4	9	48	37	2
Felt different from other kids because of celiac disease	7	11	51	29	2
Felt embarrassed to bring gluten-free foods to parties	10	13	30	45	2
Felt angry about having to follow a special diet	15	8	49	26	2
Felt that their teachers and friends did not understand	5	6	42	45	2
Felt that they can be healthy without following a special diet	2	2	22	71	2

TABLE 3. Effect of Celiac Disease on Eating Out, Shopping for Food, and Travel

	All of the Time, %	Most of the Time, %	Some of the Time, %	Never, %	Not Known/ Not Applicable, %
Avoided restaurants	6	48	41	5	—
Avoided traveling	2	13	31	54	—
Found it difficult to buy gluten-free foods at stores	6	22	62	10	—
Found it difficult to determine if the food was gluten free from label	8	19	65	8	—
Felt that they were not invited out for meals because of celiac disease	1	9	35	53	2*
Worried about staying in hospital because of celiac disease	8	5	13	69	5†

* Not known.
† Not applicable.

lepsy with occipital calcifications, ataxia, and peripheral neuropathy, as well as delayed puberty.[1,6,11]

Celiac disease is now recognized with other associated conditions and syndromes. High-risk populations in which the use of screening has demonstrated a 5% to 12% prevalence of celiac disease include children with type 1 diabetes mellitus, autoimmune thyroiditis, dermatitis herpetiformis, short stature, dental enamel defects, Trisomy 21, Turner's syndrome, selective IgA deficiency, and those with first-degree relatives with celiac disease.[1,6,11–13] Similar to the observations of others, this study demonstrated celiac disease to be associated with short stature, dental enamel defects, and type 1 diabetes mellitus, and 8% of the children had at least 1 first-degree relative with celiac disease.[1,6]

The lack of awareness about atypical or mild presentations of celiac disease among health professionals has contributed to delayed diagnosis.[1,6,14] At least one quarter of these children had consulted ≥2 family physicians or pediatricians and received multiple alternative diagnoses before the diagnosis of celiac disease. Screening tests for celiac disease only recently became available in Canada and are still not available in all provinces. Despite this, serological screening of some type was used as a diagnostic aid by physicians, as evidenced by the 70% screening rate reported by families. Recent guidelines on the screening and diagnosis of celiac disease published by the North American Society of Pediatric Gastroenterology, Hepatology and Nutrition and the National Institutes of Health provide excellent resources to educate physicians about the myriad of presentations of celiac disease and appropriate diagnostic strategies.[1,15]

The 95% rate of "strict dietary compliance to a gluten-free diet" observed in this study, compared with the lower rates of 32% to 81% reported in several European studies, is likely due to a combination of factors.[16–22] Some may argue that the high rate reported here is simply because of the retrospective method of this study. However, data from the European studies suggest several alternative explanations. The mean age (9 years) of the participants in this study is less than that of all the European studies, in which mean ages ranged from 14 years to "young adults." A Swedish study demonstrated a comparable compliance rate of 93% in 12- to 14-year-olds that fell to 76% by the ages of 15 to 17 years.[19] The majority of children in this study were diagnosed with symptomatic celiac disease rather than by screening alone. All were diagnosed with intestinal biopsy, and 89% reported improvement in health after starting a gluten-free diet. Italian studies report decreased compliance over time in asymptomatic children diagnosed through adolescent population screening initiatives compared with those who presented with typical symptoms of celiac disease.[20,21] Compliance is higher in children when the diagnosis is confirmed with intestinal biopsy compared with those who are diagnosed by clinical suspicion of celiac disease, initial response to a gluten-free diet, and no biopsy.[22] Also, in this study, 54% of the children reported a symptomatic reaction within 0.5 to 60 hours after the ingestion of a gluten-containing product. This negative reinforcement after the ingestion of gluten likely contributed to the high level of compliance observed. In a study that examined symptoms of older noncompliant adolescents, 65% ignored celiac disease–associated symptoms.[18] Finally, dietary compliance is higher in families in which knowledge about celiac disease is better and in families that belong to a celiac association.[16] In this study, all families belonged to the CCA, and all were informed that celiac disease required lifelong adherence to a strict gluten-free diet. Almost all were referred to a dietitian. These families identified the CCA as the best source of information about the gluten-free diet. Gastroenterologists, dietitians, and family physicians provided excellent information to <50% of those instructed. These data reinforce the importance of obtaining a biopsy to diagnose celiac disease. Factors such as providing excellent education about the disease and a gluten-free diet will encourage optimal dietary compliance. Better strategies to ensure compliance in screening-detected children with celiac disease need to be developed, and education of health care professionals about the treatment of celiac disease and the gluten-free diet needs to be improved. It should be pointed out that the data regarding dietary compliance in our study were reported primarily by parents. The parents were encouraged to have the child involved in answering the questions. However, there were several young children <7 years of age included, in which

case the information would be wholly parent reported. The CCA requested complete anonymity of all respondents. The questionnaire only allowed for 1 response per household, and the CCA does not record the age of members. Thus, we could not estimate or evaluate children and families who did not complete the questionnaire.

Little information is available on the impact of following a gluten-free diet on the psychosocial functioning of children with celiac disease and their families. Kolsteren et al[23] reported the overall quality of life in a small number of European children with celiac disease to be no different from the general population. A few celiac disease–specific questions were included in the European study as a supplement to generic quality of life, and these questions were not control matched. This Canadian survey examined the impact of celiac disease on the child's well-being and family activities. The purpose of disease-specific questions rather than those addressing generic quality of life was to identify areas of concern and hence formulate strategies to address those problems. To our knowledge, this is the first study to address these specific concerns in a large number of North American children with celiac disease.

Although a well-planned gluten-free diet may provide adequate nutrition, it is restrictive. Dietary restriction may impact the child's social activities including school and extracurricular events as well as family activities including dining out, travel, and shopping. Most children adjusted well to the diet, and almost all recognized the importance to their health of eating a gluten-free diet. However, approximately one quarter of them felt angry all or most of the time about having to follow it, one quarter felt different or embarrassed about their disease, and 13% felt left out of activities at school or a friend's home. Enjoyable social activities such as birthday parties, sleepovers, summer camp, and eating out provide additional challenges to the child who eats a gluten-free diet. The majority of families avoided going to a restaurant all or most of the time. Despite this, almost all traveled, and most carried gluten-free food on their travels. Most families had some difficulty in finding gluten-free foods at grocery stores and determining if a food was free of gluten. The majority of families identified better labeling and increased availability of gluten-free foods as changes that would most improve their quality of life.

It has been demonstrated that increased awareness and education about celiac disease as well as better availability of gluten-free foods helps to improve the child's and family's adjustment to this chronic disease.[16,24] Because physical symptoms usually resolve once a gluten-free diet is initiated, health professionals need to appreciate the emotional and psychosocial hurdles faced by children with celiac disease. Children who develop difficulties in adapting to their disease need to be identified so that well-trained volunteers and professionals who are familiar with the complexities of celiac disease and the gluten-free diet may provide support. The food industry must make gluten-free foods more available in restaurants and stores. Finally, governments need to pass legislation that mandates improved labeling to identify hidden sources of gluten in foods.

CONCLUSIONS

Recent prevalence data suggest that celiac disease is one of the most common chronic diseases affecting North American children.[2] It is a true clinical chameleon, and children present with a myriad of symptoms at a variety of ages.[25] Although excellent celiac disease screening tests are available, such as the IgA tissue transglutaminase or IgA endomysial antibody tests, some family physicians and pediatricians continue to experience difficulty in making the diagnosis. Until better definitive tests become available, intestinal biopsy remains necessary to confirm the diagnosis.[1,15] Compliance with a gluten-free diet is essential to prevent the complications that occur later in life. These complications include chronic nonspecific gastrointestinal complaints, refractory iron-deficiency anemia, infertility, osteoporosis, intestinal lymphoma, and possibly the development of other autoimmune diseases. Keys to improve compliance include the provision of ongoing education and support to children with celiac disease and their families. Volunteers with celiac associations and health professionals must be properly trained to provide appropriate education and support. The availability of gluten-free foods needs to increase, and legislation to identify hidden sources of gluten must be improved.

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