
VIEWPOINT

Understanding the gluten-free diet for teaching in Australia

Sue SHEPHERD¹ and Peter R. GIBSON²¹Monash University, Department of Medicine and ²Department of Gastroenterology, Box Hill Hospital, Box Hill, Victoria, Australia**Abstract**

Diagnosis of coeliac disease in Australia is increasing. The only recognised treatment is a gluten-free diet. It is essential that dietitians, who offer a critical role in the management of patients with coeliac disease, are up-to-date for the current teachings of a gluten-free diet. The present article provides background to the condition, rationale for dietary restriction of gluten, practical education strategies, suggestions for managing associated conditions and long-term management issues, in the Australian context.

Key words: coeliac disease, diet, gluten-free diet, nutrition.

INTRODUCTION

Coeliac disease is a medical condition characterised by an intolerance to dietary gluten. It is a common condition, now estimated to affect about one in 100 Australians.¹ With raised awareness and improvements in blood test screening, diagnosis of coeliac disease is increasing. It is logical that this will generate a growing demand for gluten-free (GF) dietary education. It is essential that dietitians, who offer a critical role in the management of patients with coeliac disease, are up-to-date for the current teachings of a GF diet. The aims of the present paper are to provide practical information regarding the medical condition, definition of a GF diet and education strategies, and to address important management issues. As dietary recommendations can differ around the world, the present article is written for application in Australia, but may be useful in other settings.

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Conflicts of interest: S. S. has published three cookbooks directed towards issues of coeliac disease (the second and third books also address fructose malabsorption). S. S. is Director of Irresistible Group Australia, an event organising company for Gluten Free Wheat Free Food Show.

THE CLINICAL PROBLEM

Gluten is the main protein component of wheat (and varieties including spelt, dinkel and kumut), rye, barley, triticale, and possibly oats (see later). In people with coeliac disease, gluten induces an immune response that damages the lining of the small bowel.² The resulting villous atrophy reduces the body's nutritional absorptive surface area, with the consequent potential for the development of malnutrition.^{3–5} The chronic inflammation in the intestinal wall with the release of cytokines and other inflammatory mediators can in itself induce problems such as fatigue and bone loss.^{6,7}

The classical clinical presentation of a child with failure to thrive and steatorrhoea is now very uncommon among those diagnosed with coeliac disease. The most common symptoms are 'tired all the time' and gastrointestinal symptoms identical to those seen in irritable bowel syndrome.^{3,4,8} Some have no symptoms. The change in presenting symptoms is likely to represent an increased rate of diagnosis due to increasing awareness of the association of coeliac disease with these symptoms and with other common conditions (such as type 1 diabetes, thyroid disease, migraines and infertility),^{8,9} and the increasing application of serological screening tests.

Serological tests that are currently used comprise tissue transglutaminase (IgA) and anti endomysial (IgA),

both of which have a high specificity for coeliac disease (95% or greater),^{3,6} and anti gliadin (IgA, IgG) antibodies, which have a much higher false-positive rate (up to 27%).¹⁰ As most of these antibodies are IgA in type, a serum total IgA should also be performed, as the tests may be falsely negative in the 2% of patients with coeliac disease who have IgA deficiency.¹¹ Although screening tests suggest a high likelihood of coeliac disease being present, they should not be used as a diagnostic test as false positives and negatives do occur and the consequences of an incorrect diagnosis are major. Therefore, the gold standard for diagnosis remains the demonstration of abnormalities typical of coeliac disease on small bowel biopsy,^{12,13} usually performed by taking multiple biopsies of the duodenum at gastroscopy. As exclusion of gluten from the diet can lead to healing of the villous abnormalities, normal histology can be misinterpreted in this situation. For that reason, it is highly recommended that a GF diet be instituted after the diagnosis is made. Alternatively, gluten should be consumed for a few weeks prior to the endoscopy for those already on the diet ('gluten challenge'). The amount of gluten ingestion required for a gluten challenge is not clearly defined; however, the equivalent of four serves of wheat bread or equivalent per day for approximately six weeks prior to biopsy is recommended.¹⁰

With the clinically milder presentations commonly seen now, the question arises whether all patients in whom the diagnosis is made require treatment. The consequences of untreated coeliac disease are typically lethargy and easy fatigue, gastrointestinal symptoms, specific nutritional deficiencies (particularly of iron, vitamin D, folate and zinc), and progressive bone loss leading to osteoporosis and the risk of bone fractures. Other consequences include an increased risk of infertility and miscarriage,^{4,5} and of lymphoma and cancer of the small intestine. Most symptoms improve and complications are usually prevented by long-term adherence to a GF diet.¹⁴

Therefore, the only treatment currently recommended for coeliac disease is a strict, life-long GF diet.⁴ This is the requirement for all people diagnosed with coeliac disease, irrespective of severity of symptoms and villous abnormality described in the histology report.³

DEFINITION OF GLUTEN-FREE FOODS

Prior to 1995, the Codex Alimentarius Standard was used across the world to define 'gluten free' as foods containing <0.3% protein from a gluten-containing grain.¹⁵ The sensitivity of methodologies to measure gluten has markedly improved, with the most recent assays being able to detect a concentration of two to five parts per million

(p.p.m.), more than 500 times more sensitive than the Codex Standard. There has been no international agreement on how much gluten a person with coeliac disease can tolerate. Consequently, considerable heterogeneity has developed across countries; for example, many European countries follow the Codex Standard, whereas, in Canada¹⁶ and most areas of the USA,^{17,18} GF applies only to foods or ingredients derived from naturally GF grains. Food Standards Australia New Zealand (FSANZ) has defined a GF food as having no detectable gluten using the universally accepted most sensitive and specific testing method,¹⁹ and must also not contain oats or malt as the current testing methods cannot consistently or accurately detect the presence of gluten in these grains and their derivatives. The FSANZ Code also has provision for a low-gluten standard, similar to Codex Standard, so that health professionals can apply either to their GF practice. However, the range of low-gluten foods available in Australia is extremely limited.

Which style of GF diet—from low levels of exposure (i.e. Codex Alimentarius) to zero tolerance of gluten—offers the best outcome for patients has not been resolved. The spectrum of dietary approaches and arguments are presented in Table 1. In a cohort of Australian patients with coeliac disease, two of three reduced or resolved ongoing gastrointestinal symptoms by converting from a Codex diet to a no-detectable gluten diet, suggesting an advantage for the latter approach.²¹ However, the same investigators found no association between the type of diet used and healing of the villous lesion.²² An alternative approach is to perform gluten challenge experiments in patients with healed small bowel mucosa to determine at what trace amount lesions will redevelop. A recent report (in abstract only) indicated that, in a small group of coeliac patients, up to 10 mg/day might be tolerated.²³ Extrapolation of such data suggests that 20–100 p.p.m. in foods might be acceptable—500 g of a 20 p.p.m. gluten-detectable food, or 100 g of a 100 p.p.m. gluten-detectable food would equate to 10 mg intake gluten. However, the apparent heterogeneity of sensitivity to gluten among patients renders any such conclusion tenuous.

With further technological developments and the availability of high-level evidence based upon clinical outcomes, standards and practices are likely to evolve. For example, the Association of European Coeliac Societies has recently approved <20 p.p.m. as an acceptable level of detection in foods, and are negotiating the replacement of this into the Codex Standard. Such developments underline the importance of health professional actively involved with the therapy of coeliac disease keeping up-to-date with developments and current recommendations.

Table 1 Comparison of strategies of gluten-free diet according to the acceptable limits of gluten intake

<i>Dietary approach</i>	<i>Principles of the diet</i>	<i>Advantages</i>	<i>Disadvantages</i>	<i>Currently practised</i>
Limited detectable gluten	Minute gluten intake (e.g. that associated with a Codex Standard diet, approximately 34 mg/day; range 5–150 mg/day) can be tolerated. ²⁰ Foods containing gluten up to the tolerated level permitted (e.g. chocolate-flavoured drink powder containing wheat-maltodextrin)	Liberalises dietary restrictions with an improvement in quality of the eating experience	Boundaries of safety very low, as it assumes no background or accidental exposure to gluten. Suboptimal control of gastrointestinal symptoms ²¹	UK Some areas of Europe New Zealand (some)
No detectable gluten	Foods with no detectable gluten content (including those processed to remove gluten content) will lead to minimal exposure to gluten and minimal chance of intestinal injury. Foods that are naturally gluten-free, or determined to have no ingredient containing detectable gluten (to 10 p.p.m.) permitted	Permits inclusion of gluten-free wheat-derived ingredients. Greater food variety with improvement of eating experience. Background gluten intake minimal—minor indiscretions better tolerated. Better symptom control ²¹	Some limitation of food choice. Greater knowledge needed to interpret food contents	Australia New Zealand
Zero tolerance gluten free	Assumed that the intestine is exquisitely sensitive to gluten, so that even trace gluten exposure may induce intestinal injury with/without symptoms. Only ingredients derived from naturally gluten-free grains permitted even if gluten free on sensitive assay	No chance of any background exposure if source/ingredients of food known. May lead to higher chance of complete healing. Better symptom control ²¹	Strictly limits food choice. Engenders sense of fear over effects of inadvertent gluten ingestion. Negative teachings might lead to negative attitudes	Canada USA (most)

In Australia, the FSANZ Code permits the application of any of the GF diet approaches outlined in Table 1. As both the Coeliac Society of Australia²⁴ and the Gastroenterological Society of Australia^{12,13} support the 'no detectable gluten diet' as the method of choice, implementation of this diet will be further discussed.

GLUTEN-FREE FOODS

The cornerstone of a GF diet is the knowledge to be able to choose confidently foods that do not contain gluten. There are three broad types of food:

- 1 Foods that occur GF in their natural, unadulterated state. Examples include unprocessed fruit, vegetables, meat, fish, poultry, shellfish, legumes, milk, eggs, rice, nuts, seeds, sugar, butter and oils.
- 2 Foods clearly labelled as 'GF' on the package. Such foods must comply with the definition of no detectable gluten, described earlier. Any product making a GF claim must indicate gluten content within the nutrition information panel on the package. GF products may list gluten as 'nil', 'not detected' or describing the limits under which it was not detected (e.g. '<0.005%').
- 3 Foods determined to be GF by interpreting ingredients. Foods that do not make a GF claim on the packaging may still be suitable for inclusion in a GF diet. Such products are identified by confirming the gluten status of individual ingredients making up the whole food (see later).

IDENTIFYING GLUTEN IN FOODS

Reading food labels

Reading and correcting interpretations of food labels are essential skills for people diagnosed with coeliac disease, and require understanding of food labelling laws, food sources and processing. The gluten status of many foods and ingredients made from grains and starches are listed in Tables 2 and 3. These Tables provide background information but are not suitable as stand-alone patient education material.

Food labelling laws

In Australia these dictate that 'allergens' must be declared on the food package.²⁵ Gluten-containing grains (wheat, rye, oats, barley and their hybrids) are defined allergens. Ingredients derived from wheat, rye, oats or barley must also be declared on the food package. The source of the ingredient *not* derived from an allergen does not require listing. Therefore, if an ingredient does NOT specify that it has come from a gluten-containing grain, it is GF. The allergy declaration can also be made as a general comment on the label, not necessarily listed alongside a specific ingredient (e.g. 'contains ingredients derived from wheat'). A 'contains gluten' statement is also permissible on the label, without declaring which ingredient(s) came from a gluten-containing grain. Compound ingredients (e.g. mayonnaise as an ingredient within a dip) are not

Table 2 Foods and ingredients made from grains and starches, classified according to whether gluten free or not

<i>Definitely contain gluten</i>		<i>Definitely gluten free</i>	
Wheat:	Flour including wholemeal, white, self-raising, spelt, graham, atta, durum, wheat starch, wheaten cornflour Forms wheatmeal, germ, bran, flakes, puffed, kibbled, cracked wheat/bulgar (burghul) Pasta macaroni, spaghetti, all regular varieties Noodles hokkien, udon, egg Bread white, wholemeal, spelt, multigrain Other breakfast cereals, biscuits, pastry, batter, breadcrumbs, semolina, couscous, stuffing, Communion hosts	Rice:	All rice types, including 'glutinous', rice bran, rice flour, puffed rice, ^(a) rice pasta, rice noodles, rice cakes, ^(b) rice biscuits, rice crackers ^(b)
Rye:	Rye flour, rye meal, rye breads, rye cereals	Corn:	Pure cornflour (maize flour), polenta (maize meal), corn cakes, ^(b) corn crispbreads, corn chips, ^(b) puffed corn, corn flakes (without malt extract)
Triticale:		Other:	Soy flour, besan (pea flour), lentil flour (urid, gram flour), potato flour, arrowroot, sago, tapioca, buckwheat, sorghum, millet, amaranth, lupin, taro, yam, psyllium
Barley	Barley flakes, pearl barley, malt, malt flavouring, malt extract, malt vinegar, beer, stout, ale, lager, Guinness		
Oats	Oatmeal, oat-bran, rolled oats, porridge		

^(a) Check no malt.

^(b) Check flavoured varieties.

Table 3 Interpreting status of ingredients on food products purchased in Australia

	<i>Gluten free (no detectable gluten)</i>	<i>Not gluten free</i>
Starch-derived		
Starch	Starch Starch (maize, potato, tapioca, rice) Modified starch Modified starch (maize, potato, tapioca, rice) Pregel starch	Wheat starch Modified wheat starch Modified starch (wheat) Pregel wheat starch
Thickeners	Thickener (1400–1450) Thickener (1400–1450) (maize, potato, tapioca, rice)	Wheat thickener (1400–1450) Thickener wheat (1400–1450) Thickener (1400–1450) wheat
Maltodextrin	Maltodextrin Maltodextrin (maize, potato, tapioca, rice)	Wheat maltodextrin ^(a) Maltodextrin (wheat) ^(a)
Dextrin	Dextrin Dextrin (maize)	Wheat dextrin Dextrin (wheat)
Dextrose	Dextrose Dextrose (wheat) Wheat dextrose	
Glucose	Glucose Glucose syrup Wheat glucose Wheat glucose syrup Glucose syrup from wheat	
Caramel colour	Colour caramel Caramel 150 Colour caramel from wheat Colour 150 (wheat)	
Protein-derived		
HVP	Hydrolysed vegetable protein Hydrolysed vegetable protein (maize, soy) Hydrolysed plant protein Hydrolysed plant protein (maize, soy)	Hydrolysed vegetable protein (wheat) Hydrolysed wheat protein
TVP	Textured vegetable protein Textured vegetable protein (soy)	Textured vegetable protein (wheat) Textured wheat protein
Miscellaneous		
Vegetable extract	Vegetable extract	Vegetable extract (wheat, barley, malt)
Yeast extract	Yeast extract	Yeast extract (malt, barley)
Vinegar	Vinegar Vinegar (white, wine, cider, balsamic)	Malt vinegar
Malt	Malt (rice)	Malt (barley)
Cornflour	Cornflour Cornflour (maize)	Cornflour (wheat) Wheaten cornflour
Icing sugar	Icing sugar	Icing sugar mixture (wheat)
Bran	Bran (rice)	Bran (wheat, oat, barley)
Vegetable fibre	Vegetable fibre Vegetable fibre (inulin, lupin, soy)	Vegetable fibre (wheat)
Food additives	Acidity regulators, anti-caking agents, antifoaming agent, antioxidants, bulking agents, colourings, colour fixatives, emulsifiers, enzymes, firming agents, flavours, ^(b) flavour enhancers, foaming agents, gelling agents, glazing agents, humectants, mineral salts, preservatives, propellants, raising agents, sequestrants, stabilisers, sweeteners, thickeners ^(c)	Thickeners (1400–1450) wheat Flavours (wheat) ^(d)
Other	Unprocessed fruit, vegetables, meat, fish, poultry, shellfish, and legumes, milk, eggs, rice, nuts, seeds, sugar, butter and oils	

^(a) Some wheat maltodextrin can be gluten free—unless known with certainty, avoid.^(b) Flavours may contain wheat-derived ingredients. If so, these would be indicated on the ingredients list.^(c) Thickeners contain gluten if derived from gluten-containing grains. If so, these would be indicated on the ingredients list.^(d) At the time of writing, generally flavours used in 'sweet' foods contain dextrose as the wheat-derived ingredient.

HVP = hydrolysed vegetable protein; TVP = textured vegetable protein.

exempt from the food labelling laws, where the presence of any ingredient derived from an allergen, no matter how small, must be declared. Processing aids, often used to assist in the manufacturing of foods (e.g. starch dusted on confectionary moulds to prevent sticking) must also be declared on the food package when an allergen is present.

Food sources and processing

Foods and ingredients derived from GF grains are GF. Most, but not all, ingredients derived from gluten-containing grains contain gluten. It depends upon which component of the grain is used and how it is processed (Figure 1). Any ingredient derived from the *protein component* (e.g. textured vegetable protein) of a gluten-containing grain will contain gluten. The *fibre component*, used to make processed and unprocessed bran and fibre food products, contains gluten as processing cannot completely separate this from the fibre. In contrast, some ingredients manufactured from the *carbohydrate component* of the grain may be GF. Although the starting carbohydrate component of wheat contains residual protein (gluten), its content decreases as the ingredient is more highly processed (i.e. hydrolysed). Highly processed ingredients, particularly dextrose, glucose, glucose syrup and colour caramel (150), have no detectable gluten.²¹ This enables many packaged foods to be included in the 'no-detectable gluten' diet and is the major contrast point with the 'zero tolerance' GF diets (Table 1).

Oats

The safety of oats in coeliac disease is under review. Australia's Food Standard Code currently states that a product cannot be labelled GF if the product contains oats. There is good evidence that small amounts of oats (50 g/day) may be tolerated by people with coeliac disease,^{26,27} but the results may not be applicable to the Australian population.²⁷ Australia oats are grown in rotation with wheat and often barley crops, and are likely to be contaminated with gluten from these sources.²⁶ Furthermore, oats contain a peptide sequence that induces an immunological response in some people with coeliac disease.²⁸ There is only limited availability to commercially available oats free of wheat contamination. Therefore, at least for the present, oats should continue to be excluded from the GF diet in Australia.

Cross-contamination

Although a food may be GF by ingredients, it may be gluten-contaminated by the way it is prepared and/or

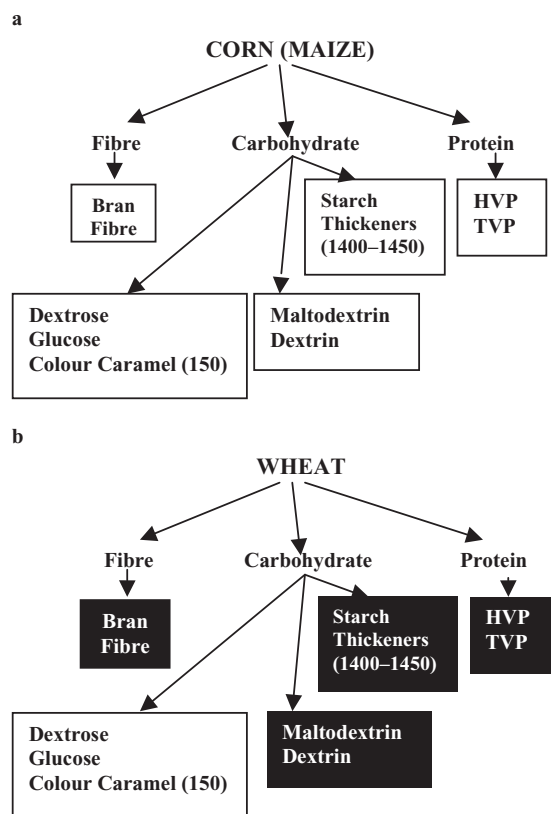


Figure 1 Status of ingredients derived from cereals. (a) Maize: all ingredients derived from a gluten-free food such as maize will be gluten free (white box). (b) Wheat: ingredients derived from a gluten-containing food such as wheat will be gluten free if from the carbohydrate component of the grain and highly processed (hydrolysed). Gluten-free ingredients are indicated with white box. Gluten-containing ingredients are indicated with black box. HVP, hydrolysed vegetable protein; TVP, textured vegetable protein.

stored. Simple rules and practices that should be followed in the home, in commercial food preparation and by food manufacturers are outlined in Table 4.

Hidden sources of gluten

Gluten can often be present in foods that may be less obvious sources. Some common examples are outlined in Table 5.

Eating away from home

The GF diet is complex and it cannot be assumed that chefs and other caterers (including friends and family) are fully aware of all potential sources. A thorough investigation of all ingredients and food

Table 4 Suggested practices for minimising cross-contamination while preparing food

- Prepare gluten-free food first. Use separate working areas if preparing gluten-free and gluten-containing foods at the same time, or for convenience, choose gluten-free brands to minimise the need to cook separate meals.
- Clearly label all foods in the pantry, refrigerator and freezer.
- Use different utensils when preparing gluten-free and gluten-containing foods at the same time; for example, a separate colander should be used for draining gluten-free pasta, or the gluten-free pasta should be drained first.
- Check margarine and spreads for residual crumbs in the container.
- Check dips for crumbs if wheat-based biscuits have been used.
- Wash utensils thoroughly to remove all traces of gluten. This especially applies to sifters, colanders and chopping boards.
- Ensure the grills and barbecues are clean before use, and use separate tongs if all food is not gluten free.
- Care should be taken when using a toaster for both regular and gluten-free bread: be wary of contamination with ordinary breadcrumbs.
- If purchasing gluten-free bread from a regular bakery, do not have the loaf sliced. The slicer is unlikely to be sufficiently cleaned of regular crumbs.

Table 5 Examples of less obvious sources of gluten in foods

<i>Food</i>	<i>Less obvious source(s) of gluten</i>
Hot chips	Oil: Often unsuitable as the oil that is also used to fry wheat-based crumbed/battered foods can be a source of gluten, even though the potato chip may itself be gluten free. Chips should be cooked in oil cleaned of batter/crumb debris. Coating: Check chips have not been coated in flour prior to cooking (this makes chips 'crispier').
Hot roast chickens	Salt: If using salt, ensure it is plain salt as often chicken/seasoned salts contain gluten. If prepared with stuffing, simply removing the stuffing will not sufficiently remove gluten, as it is cooked through the chicken. Only chicken that has not been stuffed (or stuffed with gluten-free stuffing) is suitable. Also check seasonings used on the skin.
Small goods and processed meats	These can often contain cereal binders. Check these for the presence of gluten.
Icing sugar	Icing mixture often contains wheaten cornflour. Pure icing sugar must be used.
Soy sauce	Often contains gluten.
Soy products (milk, ice cream, yoghurt)	Often contain gluten. This is of particular relevance for patients who have coexisting lactose intolerance.
Malted cereal beverages	These drink powders also contain gluten.
Communion wafers	These are made from wheat. Low gluten (<200 p.p.m.) wafers are available.
Hot chocolate drinks	Chocolate drink powders may contain wheat starch. Check. The powders may also be used as a dusting on cappuccinos.
Seafood extender (imitation crab meat)	This often contains gluten. Check in seafood salad, marinara mix and as a sushi or California roll filling.
Yeast extract spreads	These have traditionally contained gluten, but many new gluten-free varieties are now available
Corn and rice-based breakfast cereals	These may contain malt. Check food labels
Medications and nutritional supplements	Whether prescribed or purchased over the counter, many of these contain gluten. The labelling requirement for medications in relation to gluten is identical to those applied to packaged food (effective 1 July 2004). Medications should be checked for gluten. If an equally efficacious gluten-free alternative is not available, then the patient should continue with the medication as per health priority goals. The amount of gluten present, if any, will be minimal. Patient tolerance and health should be monitored.

preparation is required to ensure GF status. People with coeliac disease may benefit from keeping a card in their wallet or purse summarising common sources of gluten, GF alternatives and appropriate food preparation practices.

PROMOTING NUTRITIONALLY ADEQUATE DIET

Any restrictive diet has the potential for nutritional inadequacy and the GF diet is no exception. However,

meeting nutritional goals is readily achieved in a well planned GF diet. Important aspects to address are shown in Tables 6 and 7.

RELATED HEALTH ISSUES

Confirming the diagnosis

If a GF diet is being taught for coeliac disease, it is essential that the diagnosis be well supported. After all, the institution of a GF diet for coeliac disease is a long-term, life-changing event with potential nutritional and social implications (especially in dining out experiences). Furthermore, the diet does compromise subsequent ability to confirm a diagnosis of coeliac disease because of its

effects of serological markers and duodenal histology. Although duodenal biopsy is highly desirable in the majority of patients, many people may be diagnosed with reasonable confidence on coeliac serology alone.²⁹ Therefore, in the setting of elevated tissue transglutaminase and/or positive endomysial antibodies where duodenal biopsy is not possible, the GF diet may be confidently delivered. However, the diagnosis of coeliac disease from elevated antigliadin antibodies alone should never be made as these have a low specificity and are frequently seen in patients with irritable bowel syndrome (personal observations, 2000–2006). It is recommended that diagnostic uncertainty be discussed with the referring medical practitioner, or indeed the patient if appropriate.

Table 6 Some important issues to be addressed in ensuring the nutritional adequacy of a gluten-free diet

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- Any deficiencies in micronutrients identified at the time of diagnosis may be treated with nutritional supplements. Follow-up blood tests are recommended to assess the need for continued supplementation.
 - Promote adequate calcium, iron, folate and zinc intake.
 - Promote adequate fibre intake. Many high-fibre foods are not permitted in the gluten-free diet as they are wheat-based. Encourage gluten-free fibre-rich food sources such as wholegrain breads (or addition of seeds and gluten-free grains to bread mix (e.g. psyllium husks, sesame, sunflower, linseed)), brown rice in preference to white, legumes, and fruits and vegetables (preferably with skins left on). Also encourage adequate fluid intake to assist in preventing constipation.
 - Ensure any other food aversions/allergies/intolerances do not result in a nutritionally inadequate diet. Encourage patients only to restrict additional foods if they cause a problem; suggest suitable gluten-free alternatives to ensure nutritional adequacy.
 - Encourage variety in the diet.
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Table 7 Checklist for a gluten-free dietary education

Pre-education	Does the dietitian understand the rationale for the gluten-free diet?	<input type="checkbox"/>
Initial consultation		
Motivation	<ul style="list-style-type: none"> • Does the client understand why a gluten-free diet is required? • Does the client understand the mechanism of symptoms? 	<input type="checkbox"/> <input type="checkbox"/>
Education	<ul style="list-style-type: none"> • Broad dietary principles—does the client understand <ul style="list-style-type: none"> • food sources that contain gluten? • alternative gluten-free food sources? • Advanced dietary principles—does the client understand <ul style="list-style-type: none"> • how to interpret gluten-free status of ingredients? • hidden sources of gluten (including medications)? • cross-contamination? 	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Support	• Has the client been encouraged to join the Coeliac Society?	<input type="checkbox"/>
Knowledge	• Does the client show good understanding of gluten-free diet?	<input type="checkbox"/>
Review consultations		
Implementation	• Does the client show gluten-free compliance?	<input type="checkbox"/>
Education	<ul style="list-style-type: none"> • Have fibre, micronutritional adequacy, food variety and weight issues been addressed? • Have coexisting conditions (such as diabetes, lactose intolerance, fructose malabsorption) been addressed and incorporated as appropriate in dietary management? 	<input type="checkbox"/> <input type="checkbox"/>
Wider issues	<ul style="list-style-type: none"> • Has bone density test been recommended? • Has blood test screening of family members been recommended? • Have blood tests to monitor dietary compliance been recommended? 	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Diabetes

Approximately 5–8% of people with type 1 diabetes have coeliac disease.³⁰ Many type 2 diabetics may also have coeliac disease, as common illnesses occur frequently together. Although coeliac disease and diabetes independently rely on dietary manipulation for optimal management, good glycaemic control can still be attained, but does require individual tailoring.

Coexisting malabsorptive conditions

Many people with newly diagnosed coeliac disease can suffer from other malabsorptive conditions, which may be secondary to the coeliac disease, or independent of it. The most common are lactose⁴ and/or fructose malabsorption, affecting up to 40% of untreated patients, but resolving in at least half with effective management by a GF diet (unpublished data, 2006). The clinical importance of lactose and fructose malabsorption is that they can induce gastrointestinal symptoms that are similar to coeliac disease. When such symptoms persist despite adherence to the GF diet, attention should be directed towards the dietary intake of these and identification of other food intolerances if necessary.

FOLLOW UP

Number and frequency of consultations

Patients should receive initial education and review consultation. The need for subsequent review consultations

should be individually assessed. Children should be reviewed regularly to ensure appropriate growth and development is being achieved, and to adequately address childhood-specific food issues. Factors such as coexisting food intolerances, reduced capacity for understanding of, or reduced ability to implement dietary requirements will warrant further review.

Monitoring of dietary adherence

Being able to assess adherence to the GF diet is an important and necessary skill for a dietitian. Patients need and desire feedback on their performance, and doctors require expert assessment of adherence particularly in situations where apparent response to dietary measures is suboptimal or new symptoms emerge. Adherence is monitored by taking a focused dietary history, by the judicious use of coeliac serology,^{31–33} and, in a minority of situations, by the use of histological assessment of duodenal biopsies. Specific details of the techniques are shown in Table 8.

Medical monitoring

Follow up by a gastroenterologist is recommended, where several issues are usually addressed. Although not recommended by all gastroenterologists, repeat duodenal biopsy, performed after at least 12 months on the GF diet, will define the degree to which the mucosa has healed. This provides useful feedback to the patient and attending health professionals, and baseline information that may be critical in the evaluation of problems that

Table 8 Monitoring dietary adherence in patients with coeliac disease

Technique	How to assess
Dietary history	<input type="checkbox"/> Does the patient ever deliberately eat gluten? <input type="checkbox"/> Does accidental gluten intake occur, and, if so, how often? <input type="checkbox"/> Enquire as to brand names of foods consumed. <input type="checkbox"/> Are labels read on every food product for every purchase? <input type="checkbox"/> Assess knowledge of hidden sources of gluten (see Table 5). <input type="checkbox"/> Enquire as to frequency of eating away from home and the approach the patient takes to ensure food consumed is gluten free.
Coeliac serology	<input type="checkbox"/> In patients with elevated pretreatment levels of antigliadin and/or tissue transglutaminase antibodies, the levels progressively return to normal ranges over the first 12 months of commencing a strict GF diet. ^{3,30} <input type="checkbox"/> Following normalisation of levels, they can be used as indicators of subsequent gluten-free dietary adherence. ^{9,30–33} <input type="checkbox"/> Note: Antibody levels can be normal with insufficient gluten restriction and occasionally remain elevated in adherent patients. ³²
Duodenal biopsy	<input type="checkbox"/> When there is clinical concern about the status of a patient in whom dietary adherence appears excellent, duodenal histology can confirm or deny the dietitian's assessment and lead to appropriate management. ³

might arise in the future. Routine assessment involves evaluation of bone density, as osteopenia and osteoporosis are common in people with coeliac disease,^{4,34} micronutrients (calcium, iron, folate, zinc, vitamin D), thyroid function and blood glucose¹² (association of coeliac disease with thyroid problems and diabetes). Follow up should include yearly monitoring of micronutrients, thyroid function, blood glucose and coeliac serology (if initially abnormal). Intensity of follow up will depend upon initial findings and clinical response.

Family screening

Although it is primarily the responsibility of the attending medical practitioner to advise immediate family members (first-degree relatives) be screened for coeliac disease,^{12,13} it is appropriate for the dietitian to also raise this issue during dietary education. Recommended screening is by serology, but it is important that family members continue eating gluten in their diet prior to testing in order to avoid false-negative screening results.

Involvement of patient advocacy groups

Patients should be encouraged to join a patient advocacy group for ongoing support. In Australia, the Coeliac Society provides members with educational resources (including detailed dietary information, and brochures discussing diabetes, osteoporosis and children's issues) and ongoing information through their regular magazine. Other services might include a drop-in centre, cooking demonstrations, camps and social outings.

CONCLUSION

As the only specific treatment of coeliac disease is dietary therapy, the dietitian has a significant role in the patient's health. It is therefore essential that the health professional is up-to-date with their understanding of GF dietary requirements. The diagnosis of coeliac disease may at first seem distressing as the GF diet can be quite overwhelming. The mandatory food labelling laws have provided the consumer with greater information to determine foods that can suitably be included in a GF diet. With thorough, supportive and positive education, the patient can implement the GF diet and continue to enjoy the eating experience, together with significant improvements in health.

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