

Nutritional implications of food allergies

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Abstract

Food allergy is becoming an increasing problem worldwide, with an estimated 6–8% of children affected at some point in their childhood. It is important to recognise that the nutritional implications encompass not only the elimination of essential food(s) from the diet (and the consequent attendant lack of energy, protein or other macro or micro constituents, including vitamins), but that undiagnosed or poorly managed conditions such as severe hayfever or asthma may result in decreased activity, and/or increased or decreased food intake, which in turn may cause either negative effects on growth, or obesity. Clinical awareness is required among health professionals as to the clinical characteristics, epidemiology, investigation, and management of food allergic disorders, as is the inclusion of a dietitian as part of the allergy team. Good dietary intervention in children (and adults) with single or multiple food allergies should be seen as an integral part of the allergy consultation. It remains an essential part of holistic care.

S Afr J Clin Nutr 2010;23(1) Supplement:S37-S41

Food allergy is becoming an increasing problem worldwide, with an estimated 6–8% of children affected at some point in their childhood. However, consumer surveys indicate that the perceived prevalence of food allergy is even higher; 20–30% of the people interviewed consider that they or a family member have an allergy to a food product, and around 22% implement some form of an elimination diet, which may or may not be required, on the mere possibility that the food may contain an allergen.^{1,2} For example, milk elimination diets are frequently adopted in the treatment of atopic dermatitis when the actual prevalence of cow's milk allergy in patients on milk elimination diets may be significantly lower than the number of patients prescribed such diets.² Elimination of any major food, without considering its nutritional implications, has the potential to

result in harm. In fact there are a number of scenarios which may impact adversely on the diet of an individual and/or other family members (Table I).

It is important to recognise that the nutritional implications encompass not only the elimination of essential food(s) from the diet (and the consequent attendant lack of energy, protein or other macro or micro constituents, including vitamins), but that undiagnosed or poorly managed conditions such as severe hayfever or asthma may result in decreased activity, and/or increased or decreased food intake, which in turn may cause either negative effects on growth, or obesity. Alternative concepts of health, as published in the media, may result in diets self-selected by children with behavioural disorders, or parent-selected from nutrition misinformation, cultural preferences, alternative nutrition therapies, or misconceptions about food tolerance.³ For example, the author was referred a 6-week-old infant fed rooibos tea alone, as a result of misinformation regarding the infant's first feeding.

Behavioural conditions may also play a role, with feeding refusal and protein-energy malnutrition secondary to food allergies having been described.⁴ A South African study highlighted the higher incidence of allergies among tactile-defensive children compared to the norm. Tactile-defensive children eat only a limited range of foods.⁵

Importantly, lack or removal of a responsible food allergen may result in the exacerbation or manifestation of other atopic conditions, such as asthma, allergic rhinitis, atopic dermatitis, and other food allergies.⁶

Table I: Scenarios of presumed food allergy with nutritional implications

- Poorly managed condition
- Undiagnosed condition
- No elimination diet implemented
- Excessively restrictive diet implemented
- Cross-reactive foods not eliminated
- Non-relevant but potential cross-reactive foods removed
- Hidden allergens involved
- Behaviour or psychological factors
- Tactile-defensive children
- Significant social chaos
- Nutrition misinformation
- Food faddism
- Cultural preferences
- Alternative nutrition therapies
- Alternative diagnostic allergy tests
- Misconceptions

Accurate diagnosis is essential to prevent the imposition of unnecessarily restrictive diets, particularly on young children, although our adult patients should also be considered. However, there are a number of difficulties in making the correct diagnosis, including that not all allergies to food are IgE-mediated, with approximately 30% being delayed non-IgE-mediated.^{7,8} This is particularly problematic when children present with possible multiple food allergies, and is exacerbated where the presenting pathology is a mixture of IgE-mediated and non-IgE-mediated disease. Even with double-blind placebo-controlled challenges, isolated delayed responses may occur in over 12% of challenge tests.^{9,10} A further difficulty is the poor understanding of test interpretation, with diets being implemented based on sensitisation to foods that may in fact not result in the elicitation of symptoms.^{11,12}

It is also relevant to remember that food proteins may be encountered directly, through oral consumption, or indirectly, via either transmission in breast milk or through inhalational or epicutaneous skin contact.^{13,14}

Poorly managed condition or undiagnosed condition

It is self-evident that an undiagnosed food allergy may result in poor absorption of energy, protein, or other essential nutrients. For example, chronic diarrhoea may result in villus-flattening, directly affecting the absorption of these vital substances. Not always appreciated is that poorly-managed conditions or other undiagnosed allergies may affect appetite, with consequent attendant adverse effects. For example, poorly-managed asthma, severe hay fever or eczema may result in tiredness, apathy, and decreased appetite, with consequent weight loss, failure to thrive, or height retardation. Alternately, though appetite is not affected, exercise may be decreased, which may result in a child who is overweight or obese.

Lactating women restricting allergens

Although the elimination of allergens from the diet of women with babies at high risk for allergies is no longer recommended, many lactating mothers choose to restrict the intake of various allergens during lactation. For example, mothers may restrict milk intake, to assist their breastfed milk-allergic infants. However, this may have unintended consequences that become clinically significant; particularly if a mother's mean levels of calcium and vitamin D intake are below the adequate intake level. Milk restriction has been shown to compromise protein and the intake of other nutrients in lactating women who restricted milk to < 250 ml per day, affecting vitamin D, calcium, thiamin, riboflavin and zinc intake.

Vitamin D levels in breast milk vary between 20 and 60 IU/l,¹⁵ which is well below the recommended intake of 200 IU/l for all breastfed and bottlefed infants.¹⁶ Higher quantities of vitamin D might be required by dark-skinned infants, or mothers wearing traditional modest dress, due to the poor formation of vitamin D by the skin.¹⁶

Some experts suggest that milk restriction should not be recommended during lactation; and where this is unavoidable, nutrients provided by milk should be compensated for by other foods or supplements, practice that should not be followed without expert advice.¹⁷

Restrictive food diets

The institution of un-monitored dietary restrictions, as a result of misdiagnosis or over-zealous management, may also impact on growth and nutrient intake.^{18,19} Dietary limitations secondary to food allergy may lead to failure to thrive, and/or deficiencies in specific macro- and micronutrients.²⁰ Elimination diets in particular are potentially hazardous to children, with cases of rickets, kwashiorkor, and vitamin and mineral deficiency having been reported in the literature.^{18,21,22,23} Lack of parental education and basic health knowledge may influence the correct implementation of restrictive diets.

Cows' milk allergy is one of the most common allergies in infancy, real or assumed. Approximately 2–3% of young children develop allergy or intolerance to cow's milk. The only available treatment is elimination of milk from the diet, but a milk-free diet may not meet the child's nutritional needs adequately. Children on milk-free diets have been reported to have significantly lower intake of energy, fat, protein, calcium, riboflavin and niacin.²⁰ Use of milk substitutes improved the nutritional content of the cow's milk-free diets; however, the recommendations for riboflavin and calcium were still not met, and supplements with calcium, vitamin D and riboflavin were indicated.²⁰

Other studies have reported retardation of height in cow's milk-allergic children, low serum zinc values, and low serum iron concentration. Dietary intake of energy may be below the recommendation in some children, even though protein intake is high. Some children had low intakes of riboflavin.²⁴ Children with cow's milk allergy who experienced relative length or height decrease after the onset of symptoms of food allergy experienced no catch-up growth by 24 months of age.^{6,24,25}

Children with two or more food allergies have been shown to be shorter and to consume less calcium and vitamins, particularly vitamins D and E, than those with one food allergy or age-matched controls.^{21,26} This effect was lessened if the child received dietetic support.²¹ However, growth impairment is also reported in children with other allergic conditions, such as asthma and atopic dermatitis.^{27,28,29} Standing height retardation and delayed skeletal maturity scores may be significant.²⁷

Both vitamin D-deficient rickets and calcium-deficient rickets are well-described, separate entities, and have been reported in children with cows' milk allergy who are not receiving adequate supplementation.^{6,30,31,32,33} Seizures secondary to hypocalcaemia have been reported.⁷ There is a strong correlation between iron-deficient anaemia and vitamin D deficiency³⁴; therefore, if one is present, the potential lack of the other should be investigated. It has also been shown that treatment with iron alone leads to rising levels of vitamin D, suggesting that iron deficiency might be a factor in vitamin D deficiency.^{35,36}

Whole-body bone mineral content (BMC) and bone mineral density (BMD) have been shown to be reduced for age in children with cow's milk allergy by more than four years. Reduced bone mineralisation also occurred. Bone age was retarded by a mean 1.4 years.³⁷ Dietary calcium deficiency may increase fracture risk, though it is uncertain whether the association was due to the illness, calcium deficit or a deficit in other milk nutrients.³⁸

Although uncommon, scurvy and pellagra have been documented as consequences of food allergy.³⁹ Scurvy (vitamin C deficiency) was reported in a 34-year-old man with a history of rhinitis and severe oral allergy syndrome for multiple fruits and vegetables. He had restricted his diet to milk, beef and oats. Scurvy developed nine years after onset of his allergy.⁴⁰ Although most individuals with oral allergy syndrome (OAS) are not allergic to all fruits and vegetables, it is important to assess whether these patients are at risk of any vitamin deficiencies.

Although rare, cases of kwashiorkor unrelated to chronic illness have been reported in affluent families. In 12 children with kwashiorkor evaluated in seven tertiary referral centres in the United States, most cases were due to nutritional ignorance, perceived milk intolerance, or food faddism. Half were the result of a deliberate deviation to a protein-deficient diet because of a perceived intolerance to formula or milk. Homes with significant social chaos were a factor in a few.²² Kwashiorkor was described in a 22-month-old child who had been weaned onto a rice beverage at 13 months of age. The rice beverage, fallaciously referred to as rice milk, was extremely low in protein content. Kwashiorkor resulting from the use of a non-dairy creamer as a milk alternative has been described.⁴¹

Nutritional deficiency may also occur in adults, in particular with sensitisation to multiple foods and if a restrictive diet is self-imposed.⁴² Importantly, specific food-restrictive diets may have specific attendant risks; for example, children with peanut or tree nut allergy may need to find other sources of potassium, children with wheat allergy need to ensure satisfactory iron intake, and soybean allergy requires consideration of zinc intake. Egg allergy may require attention to vitamin B12 intake.

Family and parental beliefs

Parental beliefs about food allergies may lead to dietary restrictions severe enough to cause failure to thrive in their children, in particular if the health care provider collaborates with these unsubstantiated parental beliefs.⁴³ Significantly, parental misconceptions and health beliefs concerning what constitutes a normal diet for infants may in themselves be a cause of failure to thrive. In one study, seven patients (aged 7 to 22 months) evaluated for poor weight gain and linear growth were found to be consuming only 60% to 94% of the recommended energy intake, because of parental restriction. Parents were concerned that their children would become obese, develop atherosclerosis, become junk food dependent, and/or develop unhealthy eating habits.⁴⁴

Psychology

One cannot consider the nutritional implications of food allergies without considering the psychological effects of the disease on the child, siblings and parents, particularly in the setting of very restrictive diets, or if the individual is at risk of anaphylaxis. Not only will the psychological sequelae encompass the whole family, but the dietary requirements for the affected individual will affect the whole family: avoiding peanuts will require full family participation. Restrictive diets may also have an impact on the quality of life and anxiety of the allergic child, the parents and siblings.⁴⁵ In older children, risk-taking behaviour may occur; precautionary labelling of

the presence of hidden allergens may be ignored, with the attendant effects on the parents.

Lactose/sucrose/fructose

As a result of an allergy diagnosis (particularly asthma), health care providers may restrict the intake of additives and preservatives, in particular when associated with soft drinks. A consequence of this has been the replacement of these drinks with fruit juice. However, excess fruit juice consumption may result in chronic diarrhoea and be a contributing factor in nonorganic failure to thrive. Iron deficiency may also be a consequence.⁴⁶

Milk substitutes

A number of products are marketed as suitable replacements for cow's milk, including extensively-hydrolysed milk, soy milk, rice milk, and goat's milk. Occasionally parents may regard non-dairy creamers as suitable replacements. These are not without risks.

For example, vitamin D or calcium deficiency, resulting in rickets, may be caused by the replacement of milk with non-dairy creamer, or soy milks that are not adequately fortified. This is exemplified by a case report of a 17-month-old male, breastfed until 10 months of age, when he was weaned to a soy health food beverage. The soy beverage was not fortified with vitamin D or calcium. Intake of solid foods was good, but included no animal products. Although total daily energy intake was 114% of the recommended dietary allowance, dietary vitamin D intake was essentially absent because of the lack of vitamin D-fortified milk. He had limited sun exposure, and his dark complexion further reduced endogenous skin synthesis of vitamin D. At around 10 months, he had an almost complete growth arrest of both height and weight, and regression in gross motor milestones. Clinical features of rickets were present.⁴¹

Extensively-hydrolysed hypoallergenic formulae are designed to be tolerated by infants with cow's milk allergy, yet around 10% of infants will not tolerate these products; if health professionals continue not to take this important consideration into account, adverse nutritional effects are likely.⁴⁷ Furthermore, it is suggested that in children with IgE-mediated cow's milk allergy, the first ingestion of extensively-hydrolysed cow's milk protein formulas should require strict medical supervision, because of the potential of immediate reactions.⁴⁸

Similarly, 20–40% of children with IgE-mediated cow's milk allergy, and up to 60% of infants with non-IgE-mediated cow's milk allergy, will not tolerate soya milk.⁴⁹

Rice and oat milk have poor energy and protein content (rice milk 0.4 g/100 ml and oat milk 1.0 g/100 ml protein) compared to cow's milk-based infant formulae (1.9 g/100 ml).⁵⁰ However, rice and oat milk may be used as a suitable alternative to cow's milk in older children, with adequate growth, on diets which are otherwise nutritionally sound.

Companies have marketed goat's milk as a suitable alternative for cow's milk-allergic individuals, but as with other mammalian milks including mare, buffalo, and ewe, the majority of such milks cross-react with cow's milk protein and hence are not suitable for children with cow's milk protein allergy.^{51,52,53,54} Up to 90% of children with cow's milk allergy will be cross-reactive to goat's milk.⁵⁵ Allergy may

occur to goat's milk and sheep's milk without concomitant allergy to cow's milk.⁵⁶ However, for the 10% of patients that tolerate goat's protein, goat's milk may be an excellent substitute in children older than two years.⁵⁷

Undiagnosed conditions

Undiagnosed or inadequately-managed allergic conditions may have severe nutritional implications for the patient. Particularly hazardous are conditions such as eosinophilic oesophagitis, which has become increasingly prevalent over the past decade.⁵⁸ Unfortunately, gastrointestinal manifestations of food allergy are varied, with well-described clinical entities being recognised, many of which are not initially attributed to food.⁵⁹ Protein-losing enteropathy is a feature of both non-IgE-mediated allergic enteropathy disorders as well as of the eosinophilic gastroenteritis disorders (mixed IgE and non-IgE). In food protein-induced enteropathy, failure to thrive, iron deficiency anaemia and hypoproteinaemia is common.⁵⁹ In eosinophilic gastroenteritis, growth retardation, protein-losing enteropathy, and growth failure occurs. Serum-specific IgE is present in approximately 50%.⁶⁰

Multiple food protein intolerance is a severe form of immune reaction. One of the cardinal features of this spectrum is a failure to tolerate extensively-hydrolysed formula or soya-based formula. Infants may react to a wide range of foods, including proteins within breast milk and other foods normally considered of 'low allergenic potential', such as rice.⁶¹ An amino acid formula is the formula of choice in such cases, as up to 10% of these infants will react to the extensively-hydrolysed casein or whey formulae.^{62,63,64,65}

Although eczema is a multifactorial disease, IgE and non-IgE food reactions may play an important role. Avoidance of specific foods is often based on belief, and proper diagnosis should be implemented.⁶⁶

Celiac disease, although not an allergy, is immune-mediated. It is a very under-diagnosed condition, as symptoms may be latent. In these individuals, failure to thrive is the major feature. All children with failure to thrive with no obvious cause should be evaluated for this condition.⁶⁷

Although uncommon, biotin deficiency has been encountered in infants weaning from breast- and formula feeding.^{68,69} Biotin deficiency has been described in an infant fed with amino acid formula and hypoallergenic rice. The amino acid formula was not supplemented with biotin, since biotin was not permitted as a food additive in that country.⁷⁰

Alternative diagnostic allergy tests

A number of unproven or scam allergy tests are being marketed, including the ALCAT, IgG, Vega (BEST) testing, hair analysis, and many others which may lead to nutritional implications as a result of misdiagnosis.^{71,72,73,74} Dietary recommendations implemented may result in responsible foods for allergic reactions not being removed from the diet; or more commonly, the implementation of unnecessarily restrictive diets. In a study, double-blind placebo-controlled, food challenge (DBPCFC) was only rarely in agreement with the alternative test, and many patients did not have any food

allergy.⁷⁵ Alternative health practitioners may implement blanket recommendations that may be unnecessary, e.g. removing wheat, milk, sugar, and other foods without adequate confirmation of a cause and effect relationship, which may result in unintended nutritional deficiencies.

Conclusions

Good dietary intervention in children (and adults) with single or multiple food allergies should be seen as an integral part of the allergy consultation. It remains an essential part of holistic care.^{7,76}

Children diagnosed with food allergies need an annual nutrition assessment to prevent growth disorders or inadequate nutrient intake. Children with milk allergies or multiple food allergies are at greater risk.²¹ In the management of an infant with cow's milk allergy, ideally breastfeeding should continue (if tolerated) for as long as possible, under the supervision of a dietitian to ensure nutritional adequacy, with supplementation and weaning onto other solids from six months of age (World Health Organization recommendation).⁷⁷

Both new and old patients need to be reviewed. A clear strategy regarding allergy re-assessment, testing, and challenge needs to be implemented, with close follow-up and dietary supervision. The dietary recommendations need to be tailored to the individual child, taking into account the overall nutritional requirements, the risk of reaction on re-exposure, and the natural history of the specific food allergy in question as regards the likelihood of persistence versus outgrowing. Timing of food challenge tests will depend on the clinical history, type of food allergen, and demonstration of declining specific IgE levels. Cross-reactivity with other foods needs to be carefully evaluated, and only cross-reactive foods clearly resulting in adverse clinical effects should be removed.

It is recommended that a few-foods diet is followed for no more than 10–14 days, as it is not nutritionally adequate. Elimination diets should be supervised and monitored to a degree similar to that for drug treatment, and the need for continued dietary elimination should be reviewed on a regular basis and food re-challenges should be considered.⁷⁸ Health care providers must be vigilant in monitoring both growth and feeding patterns to identify inappropriate dietary changes that may result in nutritional deficiencies.

Clinical awareness is required among health professionals as to the clinical characteristics, epidemiology, investigation, and management of food allergic disorders, as is the inclusion of a dietitian as part of the allergy team.

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