

Impact of elimination diets on growth and nutritional status in children with multiple food allergies

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Abstract

Background: Impairment of growth has been reported in food-allergic children. It is not known whether this is related to the extent of food allergies. We sought to compare growth, nutritional status, and nutrient intake in children with food allergy either avoiding cow's milk or avoiding cow's milk and wheat, which are staples of the diet in young children.

Methods: Infants and young children with challenge-proven allergy were recruited to this prospective study. They were strictly avoiding their allergic food triggers, either cow's milk, or cow's milk and wheat. They were counseled by a dietitian specialized in food allergies on food avoidance diets and nutritionally adequate supplementation at regular intervals. A 3-day food diary was kept. Children's height, weight, and laboratory data for nutritional parameters were monitored at 8-month intervals.

Results: A total of 18 patients avoiding milk and 28 patients avoiding milk and wheat were evaluated at an average of 12, 21, and 28 months of age. During the follow-up, the markers of nutritional status, nutrient intake or height for age, and weight for height were comparable between the two groups, although the means for anthropometric measures were below the average for age in both groups.

Conclusions: The extent of food elimination diet has no impact on growth or nutritional status of food-allergic children, when diet is adequately supplemented. Close physician and dietitian follow-up are essential for food-allergic children when avoiding one or more foods, which are staples of the diet.

Food allergy is a common chronic disease in childhood, affecting up to 8% of children in the United States (1–3). Among food-allergic children in the USA, 30% have multiple food allergies, the most common being milk, peanut, and shellfish (4). In a Finnish study, food allergies were reported in 1.3% to cow's milk, 1.5% to hen's egg, 0.7% to wheat, 0.7% to fish, and 1.8% to nuts (5). Worldwide, allergic diseases have risen in prevalence over the past 50 yrs (6). Because strict allergen avoidance is the mainstay of management (7), food-allergic patients may require supplementation as depending on the food, supplementation or replacement foods are not always necessary.

Many studies have shown that food-allergic children tend to be smaller than their non-food-allergic peers (8–14). Extensive elimination diets limiting the options for food sources,

decreased absorption of nutrients due to increased intestinal permeability (15, 16), increased nutrient needs, or other intrinsic factors related to food allergy are possible causes. Therefore, the proper dietetic treatment of food allergy to eliminate food allergens is essential to preserve the intestinal integrity. We have recently shown that food-allergic patients with increased intestinal permeability following a strict avoidance diet were shorter than those with normal intestinal permeability (17). Children with food allergies can also have inadequate nutrient intakes and decreased growth, which was shown to be more likely in children with cow's milk allergy (18, 19). It was shown that children, aged 31–37 months who were avoiding cow's milk had decreased intakes of energy, fat, protein, calcium, riboflavin, and niacin (18). Children with cow's milk allergy and atopic dermatitis also have been shown

to have lower serum albumin levels than healthy controls, despite having similar protein intakes in their diets (8). In addition, frequent comorbidities seen in food allergy such as eczema and asthma are further associated with increased energy needs and are associated with increased intestinal permeability (20). Even limited cases of kwashiorkor have been reported with cow's milk elimination diets (21) as well as some cases of protein-energy malnutrition (22).

Despite the reports indicating poorer growth in children with food allergy, there are few studies focusing on more or less extensive food elimination diets, to determine whether this impacts their nutritional status and growth. In this study, we assessed children with food allergy on two different elimination diets to see whether the extent of the elimination impacts their nutritional status and growth. We found that cow's milk-allergic children and those with cow's milk and wheat allergy had comparable growth, nutritional status, and nutrient intake, while under close supervision of a dietitian. This underlines the importance of close follow-up of these patients with both, a medical provider and dietitian to monitor their nutrient intake while on restrictive elimination diets (23, 24).

Subjects and methods

Subjects

All together, 46 children <3.5 yrs of age at recruitment were enrolled in this prospective study during their office visits at the Skin and Allergy Hospital of Helsinki University Central Hospital. They had food allergy to staples of the diet of an infant and toddler, including cow's milk or cereals (rye, wheat, oats, and barley) diagnosed by positive skin prick, positive atopy patch test (25), food challenge and/or they had a strong suspicion due to resolution of their symptoms during their elimination diet. When food allergy was diagnosed, the children were put on an elimination diet for their specific food allergies. Group M children were on a cow's milk elimination diet, while Group MW eliminated both cow's milk and wheat. In addition, many children had not been yet introduced to egg, fish, and nuts due to their young age and concerns regarding other food allergies as per the national guidelines at the time. Some of the children in the MW group had very limited diets and tolerated <10 foods. Data were collected regarding demographics and presence of eczema. Children with chronic diseases other than allergic diseases and those on long-term oral corticosteroid therapy were excluded.

Informed consent was obtained from the parent. The initial cohort study was approved by the ethics committees of the Skin and Allergy Hospital of the Helsinki University Central Hospital. Internal Review Board of the Albany Medical College, Albany, NY approved the use of clinical and laboratory data.

Anthropometry

Height was assessed during office visits, and weight was measured to the nearest 0.1 kg in light indoor clothing. Height values were plotted for age, and weight was plotted against

height (i.e., 'relative weight', shown as % deviation of weight from the mean weight for height) utilizing age appropriate growth charts approved by the Finnish Board of Health and widely used in Finland (26).

Blood samples and analyses

EDTA samples were used for assessment of blood cell count. Serum immediately frozen at -70°C for subsequent determination of osteocalcin by CAP system FEIA (Pharmacia AB, Uppsala, Sweden), and collagen type I C-terminal cross-linked telopeptide (ICTP), collagen type I C-terminal propeptide (PICP), and collagen type III N-terminal propeptide (PIIINP) by RIA (Orion Diagnostica, Espoo, Finland). Routine laboratory assessments were used for determination of serum levels of iron, transferrin and its saturation, ferritin, albumin, pre-albumin, urea, creatinine, calcium, magnesium, zinc, phosphate, insulin-like growth factor-1, alkaline phosphatase, quantitative IgA, IgM, IgG, and IgG subclasses.

Dietary intake

The adequacy of the diet was monitored and confirmed by a dietitian. If cow's milk was eliminated from the diet, a tolerated formula such as soy (NutriSoy, Prosobee), protein hydrolysate (Profylac, Nutramigen), or amino acid-based formula (Neocate, NutriJr) was substituted in infants <2 yrs of age. Calcium, vitamin D, multivitamin, and trace element supplementation was added to each participant's regimen when dietary intake fell short of meeting the Nordic Nutrition Recommendations. Four children received breastmilk. Mothers of breastfed children on a cow's milk elimination diet were supplemented with calcium. During cereal elimination, gluten-containing cereals were excluded from the diet and replaced with gluten-free rice, corn, millet, and buckwheat. Parents of food-allergic children were instructed by the dietitian to increase the amount of meat in their child's diet, as well as adding plant-based oils and milk-free margarines to the diet to increase calorie and fat intake. A three-consecutive day food record was kept by the parents. The portion sizes were estimated in household measures. The data were analyzed using the MICRO-NUTRICA computer program developed at the Research Centre of Social Insurance Institution, Turku, Finland.

Statistical analysis

Repeated measures analysis of variance was applied to assess the similarity of the two groups with respect to continuous variables measured over time. The analysis of variance included a main between effect of diet group, a repeated measures effect of visit (age), and their interaction effect. A significant interaction effect would indicate that the diet group has an effect on the time course of the measure from visit one to visit three. Multiple comparisons were by Tukey's honest significant difference test. The Mann-Whitney test was employed to determine the statistical significance of differences between groups at the same time intervals for parameters that were not normally distributed. Fisher's exact test was used to

assess significance for categorical variables between groups. The results are expressed as means with $\pm$ s.d. or interquartile range (IQR). The analyses were carried out using Statistica (v 6; StatSoft Inc, Tulsa, OK) and MiniTab (v 14; MiniTab Statistical Software State College, PA, USA).

Results

Demographics

A total of 18 food-allergic children ages 5–42 months avoided milk (Group M), while 28 children ages 6–41 months avoided milk and wheat (Group MW, Table 1). Because the study occurred in a tertiary referral center, the proportion of milk and wheat allergic patients was higher than milk-allergic ones. During the follow-up period, no significant changes were implemented in the subjects' diets unless proven tolerance development: One subject in Group M and 2 subjects in group MW did experience development of spontaneous cow's milk tolerance. Children of comparable age and gender were evaluated during three visits, about 8 months apart. The majority of subjects had atopic dermatitis and/or hives, with or without gastrointestinal symptoms. One-quarter presented with only gastrointestinal symptoms, such as vomiting or diarrhea. There was a trend for an increased rate of eczema in

the children with wheat allergy, when compared to the children that were not avoiding wheat ($p = 0.053$). However, the severity of eczema as assessed by the SCORAD index was comparable between the groups.

Anthropometric measurements

Upon enrollment in this study, height for age and relative weight for height were comparable on each follow-up visit in the children on milk elimination and in those on milk and wheat elimination (Fig. 1). However, in both groups these parameters were below the average compared to healthy Finnish children. There were two subjects in M group and five subjects in MW group who were <1 s.d. for height for age; only one subject in the MW group had his height <2 s.d. for age. This subject had a history of faltering growth prior to enrollment. There were two subjects in the M group and six subjects in the MW group who were $<-10\%$ for relative weight and none were $<-20\%$.

Nutritional status

We compared the markers of nutritional status during three visits of children in Group M and Group MW. There were a few significant effects of diet although differences were small. The levels of iron ($p = 0.045$, main effect of diet), serum IgG ($p = 0.02$, main effect of diet), and phosphorus were lower in the MW group ($p = 0.046$) (Table 2). After Bonferroni correction for multiple comparisons, these differences were not statistically significant. Several variables changed with time (age) between the 1st and 3rd visit (hemoglobin, hematocrit, MCV, Phosphorus, PICP, PIINP, IgA, IgG, IgM). However, in none of the measured variables was there any evidence that the diet groups were different in their time course. There were no significant statistical differences between the two diet groups in regards to markers of iron metabolism, trace minerals, protein metabolism, immunoglobulins, bone metabolism, or insulin-like growth factor.

Nutrient intake

Of the 18 children in Group M, eight were maintained on a hydrolyzed formula, three on a soy-based formula or soy milk, and one breastfed and supplementing with hydrolyzed formula,

Table 1 Demographic information comparing food-allergic children who are avoiding milk and wheat (Group MW) and those who are avoiding milk (Group M)

Characteristic	Group MW N = 28	Group M N = 18	p-Value*
Age (mo) visit 1 (mean $\pm$ s.d.)	16.3 $\pm$ 8.7	16.8 $\pm$ 7.6	0.95
Age (mo) visit 2 (mean $\pm$ s.d.)	24.9 $\pm$ 8.8	26.0 $\pm$ 7.7	0.94
Age (mo) visit 3 (mean $\pm$ s.d.)	32.3 $\pm$ 8.3	33.7 $\pm$ 7.6	0.98
Male	17 (61%)	8 (44%)	0.37
SCORAD	16.8 $\pm$ 15.5	15.3 $\pm$ 12.1	0.74
Eczema	19 (68%)	7 (39%)	0.07

*ANOVA with Tukey's test for continuous variables and Fisher's exact test for categorical.

Figure 1 Height for age (a) and weight for height (b) in food-allergic children with either milk or milk and wheat elimination diets during a follow-up of three visits. Shown is mean (box) with s.d. There is no significant difference between the groups.

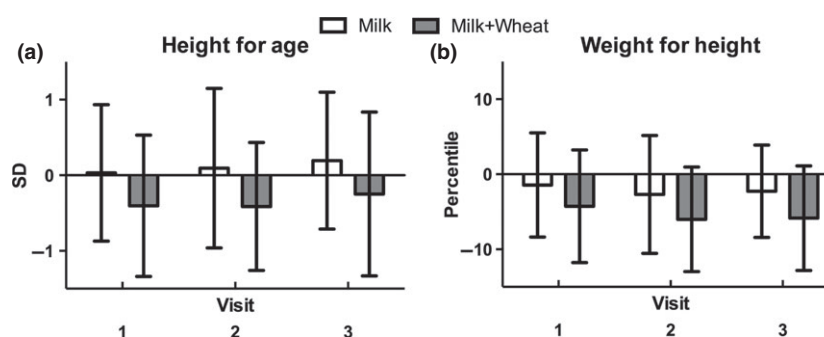


Table 2 Comparison of laboratory data p-values between food-allergic children either avoiding milk (M) or avoiding milk and wheat (MW)

	Visit 1			Visit 3		
	MW	M	p-Value*	MW	M	p-Value*
Hb	117.4 ± 7.9	118.3 ± 5.4	0.69	127.2 ± 10.3	124.9 ± 8.2	0.48
HKR	35.7 ± 2.19	35.8 ± 1.6	0.76	38.3 ± 2.69	37.69 ± 2.5	0.44
MCH	36.4 ± 52.7	26.4 ± 1.29	0.42	27.2 ± 1.75	26.6 ± 1.25	0.32
MCHC	328.1 ± 7.19	328.4 ± 5.8	0.87	330.6 ± 9.8	330.4 ± 5.8	0.94
MCV	80.3 ± 4.95	80.3 ± 3.7	0.96	82.1 ± 3.7	81.0 ± 3.6	0.34
Fe	12.2 ± 4.5	14.0 ± 5.4	0.23	12.8 ± 5.9	16.0 ± 9.3	0.19
Transf	2.7 ± 0.4	2.8 ± 0.4	0.65	2.7 ± 0.4	2.6 ± 0.3	0.67
Ferrit	26.1 ± 28.0	24.1 ± 8.9	0.78	25.9 ± 11.8	23.3 ± 10.4	0.50
Trfesat	17.7 ± 7.14	19.3 ± 7.7	0.49	18.6 ± 9.5	23.7 ± 15.5	0.20
Ca	2.56 ± 0.1	2.50 ± 0.08	0.41	2.51 ± 0.10	2.40 ± 0.04	0.62
Zn	11.6 ± 1.7	12.2 ± 2.4	0.36	12.4 ± 1.8	12.6 ± 2.5	0.78
Mg	0.88 ± 0.04	0.88 ± 0.07	0.78	0.87 ± 0.06	0.84 ± 0.05	0.14
Pi	1.75 ± 0.20	1.83 ± 0.14	0.19	1.61 ± 0.12	1.70 ± 0.09	0.028**
Osteo-2	31.8 ± 18.4	33.0 ± 9.7	0.84	32.3 ± 11.8	29.8 ± 6.9	0.48
PICP	667.6 ± 283.2	769.5 ± 316.2	0.37	505.3 ± 145.3	525.7 ± 158.5	0.68
PIIINP	12.5 ± 3.75	14.1 ± 5.18	0.36	10.02 ± 2.53	10.2 ± 3.24	0.82
ICTP	16.94 ± 7.29	16.07 ± 3.20	0.71	13.64 ± 2.76	14.9 ± 2.10	0.13
AFOS	727.4 ± 463.9	557.1 ± 145.2	0.26	527.3 ± 101.9	541.5 ± 126.4	0.72
Alb	42.8 ± 3.1	43.7 ± 2.1	0.28	42.8 ± 2.9	43.6 ± 2.5	0.38
Pre-alb	192.5 ± 27.06	203.0 ± 37.4	0.30	208.1 ± 26.9	191.0 ± 30.2	0.07
IgA	0.364 ± 0.25	0.38 ± 0.26	0.89	0.563 ± 0.31	0.73 ± 0.53	0.25
IgG	6.0 ± 2.2	6.8 ± 1.8	0.18	7.2 ± 1.5	8.4 ± 2.2	0.045**
IgG1	5.03 ± 1.98	5.5 ± 1.8	0.36	5.3 ± 0.93	5.9 ± 1.5	0.16
IgG2	0.80 ± 0.49	0.94 ± 0.43	0.34	1.26 ± 0.51	1.30 ± 0.79	0.55
IgG3	0.26 ± 0.10	1.10 ± 3.40	0.25	0.24 ± 0.08	0.29 ± 0.15	0.23
IgG4	0.34 ± 0.54	0.18 ± 0.23	0.23	0.44 ± 0.34	0.50 ± 0.45	0.67
IgM	0.73 ± 0.24	0.87 ± 0.36	0.15	0.84 ± 0.27	0.97 ± 0.39	0.28
Sommed-C	9.4 ± 3.59	8.4 ± 5.5	0.54	10.8 ± 3.6	11.0 ± 5.8	0.91
B-EOS-L	210.6 ± 316.09	106.3 ± 104	0.35	300 ± 245	367 ± 250	0.45
B-Trom	359 ± 89	402.3 ± 138	0.21	353 ± 105	347 ± 69	0.87

Shown is mean (s.d.) for visits 1 and 3; visit 2 is not shown.

*t-test; **p-value <0.05.

Table 3 Comparison of daily nutrient intake between food-allergic children avoiding milk and wheat (Group MW) or milk (Group M)

Characteristic	Group MW	Group M	p-Value*
Calories (kcal)	1065 (968–1192)	876 (786–1166)	0.09
Protein (g)	30.7 (22.8–37.5)	27.3 (22.9–31.3)	0.77
Fat (g)	42.1 (31.1–51.6)	34.3 (23.5–46.9)	0.28
Iron (mg)	6.3 (5.2–10.0)	8.0 (6.9–9.0)	0.53
Total Calcium (mg)	616.4 (420.1–684.4)	601.7 (469.6–620.9)	0.67
Dietary	367.3 (206.1–454.9)	369.6 (294.8–518.9)	0.70
Supplement	200.0 (93.0–250.0)	200.0 (50.0–250.0)	0.74
Total Vit D (µg)	12.1 (10.3–13.9)	11.8 (10.5–14.6)	0.83
Dietary	5.9 (2.9–8.4)	5.8 (3.7–8.6)	0.84
Supplement	6.8 (3.4–10.0)	6.0 (5.5–10.0)	0.95

Results are expressed as median (IQR).

*Mann–Whitney test. RDA for calcium is 500 mg a day and for vitamin D 10 µg per day.

two on amino acid-based formulas, three on no nutritional formulations, and one tolerated cow's milk by the end of follow-up. Of the 28 in Group MW, nine were on a hydrolyzed formula, three on a soy-based formula or soy milk, three

breastfed, four on an amino acid-based formula, seven on no nutritional formulas, and two ultimately tolerated cow's milk. Of those consuming formula, the average intake was 4.6 dl (IQR: 3.75–6.25) per day for Group M and 5.3 dl (IQR: 4.5–7)

for Group MW. There was a trend for children in Group MW to consume more total calories, protein, and fat than those in Group M, $p = 0.09$ (Table 3). Similarly, intake of iron, calcium, and vitamin D were comparable. The average intake of different nutrients of the children in this study was well within the Nordic Nutrition Recommendations (26). When compared with the average intakes of healthy Finnish children (27), our subjects received lower amounts of protein and carbohydrate but higher amounts of fat.

Discussion

In the present study, we found that growth, nutritional status, and nutrient intakes were comparable between food-allergic children who avoided only cow's milk and those who avoided both cow's milk and wheat in their diet. Our data suggest that there is no negative impact on the nutritional status of young children with these food allergies after elimination of these dietary staples. This study also highlights the importance of frequent monitoring of these food-allergic children, including dietitian support with meticulous attention to dietary assessment and supplementation. Having a dietitian as part of the treatment team ensures that macro- and micronutrient needs are met and that reasonable dietary changes are implemented (23).

Stunted growth has been shown to occur in approximately 2–15% of children with food allergies (12). The most recent study gathered information from dietitians of 97 pediatric food allergy patients from 13 different clinics throughout the UK (9) and showed that the height and weight for age were ≤ -2 Z-score for 11% and 8.5% of the patients, respectively. The study also showed that patients who eliminated three or more foods were at highest risk for lower weight for age (9). Another study from France (10) found that the elimination of ≥ 3 foods from the diet was linked to poor weight gain, compared with children who eliminated fewer foods. In a Brazilian study, children with cow's milk allergy with gastrointestinal manifestations had a height and weight for age ≤ -2 s.d. in 23% and 15%, respectively (11). However, supplementation included inappropriate alternatives such as goat's milk and lactose-free milk. A Korean study concluded that as the number of foods avoided increased, z-scores of weight and height for age decreased (14). US children with two or more food allergies were shorter, based on height-for-age percentiles, than those with one food allergy ($p < 0.05$) (19). Our findings are in disagreement with these reports in that we show no additional impact on height or weight with additional food allergens avoided. This may be explained by the fact that our cohort was a follow-up study involving a dietitian trained in food allergy as opposed to the observational studies. Our frequent follow-up by a physician/dietitian team was likely to positively impact dietary intakes and adherence to diet. Consequently, nutrient deficiencies were identified and adjustments to the diet were carried out in a timely manner. Another Finnish follow-up study found that there was growth impairment in cow's milk-allergic patients when compared to healthy controls, but no further impact of additional food allergies was reported (8).

Unsupervised elimination diets can have a major impact on nutrient intake. Cow's milk avoidance is associated with inadequate calcium intake; however, children receiving nutritional counseling or an age appropriate alternative formula or soy milk were less likely to have inadequate intakes of calcium and vitamin D (19, 28). With wheat, rye, barley, and oat elimination, a large source of complex carbohydrates, micronutrients, and dietary fiber is lost. In celiac disease, as reported by Penagini et al. (29), children following a wheat free diet often suffer nutrient imbalance of calcium, vitamin D, iron, zinc, and B-vitamins, and the authors concluded that close follow-up by a trained nutrition or medical professional is imperative to the nutritional soundness of the gluten-free diet. In our study, elimination of cow's milk and wheat, which are staples in the diet of a young child, did not negatively impact levels of macro- or micronutrients indicating that adequate alternatives were found to supplement the diet. This was the case despite the fact that several of the subjects were avoiding additional foods in their diet, including egg, fish, and nuts, and some were on diets including only a few foods.

Although our data suggest that the type or nutritional quality of foods eliminated does not lead to nutrient deficiencies as long as the diet is adequately supplemented, food-allergic subjects were smaller than their peers when plotted on growth charts and compared to the national average. This may be due to increased caloric requirements or suboptimal absorption in the food-allergic children. Consistent with this, we have recently shown that a significant proportion of children with milk and egg allergy had altered intestinal permeability, which in turn was associated with shorter stature suggesting that either these children had poor absorption due to ongoing innocuous exposures (unlikely as children were asymptomatic) or that intrinsic factors related to food allergy are related to poor growth (17). It is important to identify and treat growth impairment as children with stunted growth early in life are at increased risk for central fat gain, lower fat oxidation, lower energy expenditure, and lower insulin production (13). Black et al. (30) also found that children with adequate growth in younger life were taller, heavier and had better arithmetic scores.

The strengths of this study include prospective follow-up, thorough assessment of both nutritional intake and nutritional status utilizing diet records, diet analysis, laboratory data, and anthropometric measures spanning a period of 1.5 years. Elimination of specific staples of pediatric diets as opposed to random heterogeneous groups of eliminations was included. Limitations include the lack of a control group comprising healthy individuals without food allergies. However, growth and nutritional status parameters were compared to normal reference values available. We included a relatively small number of patients seen in a tertiary referral center limiting the generalizability of the results. Other atopic diseases were not systematically recorded. The length of elimination diet and growth patterns prior to study were not reported.

In conclusion, our study showed that the number and nutritional quality of foods restricted in an elimination diet does not necessarily affect the growth of children as long as their diet is adequately supplemented and there is frequent

follow-up. This underscores the need for close monitoring by a team consisting of a physician and a dietitian for proper management of food-allergic children on elimination diets to ensure they are meeting their nutritional needs.

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References

1. Sicherer SH, Sampson HA. Food allergy: epidemiology, pathogenesis, diagnosis and treatment. *J Allergy Clin Immunol* 2014; **133**: 291–307.
2. National Institute for Health and Clinical Excellence. *Diagnosis and assessment of food allergy in children and young people in primary care and community settings*. 2011. www.nice.org.uk/guidance/CG116. Last accessed December, 2012.
3. Sova C, Feuling MB, Baumler M, et al. Systematic review of nutrient intake and growth in children with multiple IgE-mediated food allergies. *Nutr Clin Pract* 2013; **28**: 669–75.
4. Gupta RS, Springston EE, Warrier MR, et al. The prevalence, severity, and distribution of childhood food allergy in the United States. *Pediatrics* 2011; **128**: 9–17.
5. Järvenpää JI, Paasilta M, Salmivesi S, et al. Stability of parent-reported food allergy in six and 7-year-old children: the first 5 years of the Finnish allergy programme. *Acta Paediatr* 2014; **103**: 1297–300.
6. Pawankar R, Canonica G, Holgate S, et al. *White Book on Allergy 2011–2012 Executive Summary*. Milwaukee, Wisconsin: World Health Organization.
7. Boyce JA, Assa'ad A, Burks AW, et al. Guidelines for the diagnosis and management of food allergy in the United States: report of the NIAID sponsored expert panel. *J Allergy Clin Immunol* 2010; **126**(6 Suppl): S1–58.
8. Isolauri E, Sutas Y, Salo MK, Isosomppi R, Kaila M. Elimination diet in cow's milk allergy: risk for impaired growth in young children. *J Pediatr* 1998; **132**: 1004–9.
9. Meyer R, De Koker C, Dziubak R, et al. Malnutrition in children with food allergies in the UK. *J Hum Nutr Diet* 2014; **27**: 227–35.
10. Flammarión S, Santos C, Guimber D, et al. Diet and nutritional status of children with food allergies. *Pediatr Allergy Immunol* 2011; **22**: 161–5.
11. Vieira MC, Morais MB, Spolidoro JV, et al. A survey on clinical presentation and nutritional status of infants with suspected cow's milk allergy. *BMC Pediatr* 2010; **10**: 1–7.
12. Laitinen K, Isolauri E. Allergic infants: growth and implications whilst on an exclusion diet. *Nestle Nutr Workshop Ser Clin Perform Programme* 2007; **60**: 157–67.
13. Sawaya AL, Martins PA, Baccin Martins VJ, et al. Malnutrition, long-term health and the effect of nutritional recovery. *Nestle Nutr Workshop Ser Pediatr Program* 2009; **63**: 95–105.
14. Cho HN, Hong S, Lee SH, et al. Nutritional status according to sensitized food allergens in children with atopic dermatitis. *Allergy Asthma Immunol Res* 2011; **3**: 53–7.
15. Troncone R, Caputo N, Florio G, Finelli E. Increased intestinal sugar permeability after challenge in children with cow's cm allergy or intolerance. *Allergy* 1994; **49**: 142–6.
16. Ventura MT, Polimeno L, Amoroso AC, et al. Intestinal permeability in patients with adverse reactions to food. *Dig Liver Dis* 2006; **38**: 732–6.
17. Järvinen KM, Konstantinou GN, Pilapil M, et al. Intestinal permeability in children with food allergy on specific elimination diets. *Pediatr Allergy Immunol* 2013; **24**: 589–95.
18. Henriksen C, Eggesbo M, Halvorsen R, Botten G. Nutrient intake among two-year-old children on cows' milk-restricted diets. *Acta Paediatr* 2000; **89**: 272–8.
19. Christie L, Hine RJ, Parker JG, Burks W. Food allergies in children affect nutrient intake and growth. *J Am Diet Assoc* 2002; **102**: 1648–51.
20. Ukabam SO, Mann RJ, Cooper BT. Small intestinal permeability to sugars in patients with atopic eczema. *Br J Dermatol* 1984; **110**: 649–52.
21. Noimark L, Cox HE. Nutritional problems related to food allergy in childhood. *Pediatr Allergy Immunol* 2008; **19**: 188–95.
22. Meyer R, Venter C, Fox AT, Shah N. Practical dietary management of protein energy malnutrition in young children with cow's milk protein allergy. *Pediatr Allergy Immunol* 2012; **23**: 307–14.
23. Groetch M, Nowak-Węgrzyn A. Practical approach to nutrition and dietary intervention in pediatric food allergy. *Pediatr Allergy Immunol* 2013; **24**: 212–21.
24. Venter C, Laitinen K, Vlieg-Boerstra B. Nutritional aspects in diagnosis and management of food hypersensitivity—the dietitians role. *J Allergy* **2012**: Article ID 269376, 11 pages.
25. Järvinen K-M, Turpeinen M, Suomalainen H. Concurrent cereal allergy in children with cow's milk allergy manifested with atopic dermatitis. *Clin Exp Allergy* 2003; **33**: 1060–6.
26. Nordic nutrition recommendations. *Scand J Nutr* 1996; **1996**: 161–5.
27. Räsänen L, Ylönen K. Food consumption and nutrient intake of one- to two-year-old Finnish children. *Acta Paediatr* 1992; **81**: 7–11.
28. Madsen CD, Henderson RC. Calcium intake in children with positive IgG RAST to cow's milk. *J Paediatr Child Health* 1997; **33**: 209–12.
29. Penagini F, Dilillo D, Meneghin F, et al. Gluten-free diet in children: an approach to a nutritionally adequate and balanced diet. *Nutrients* 2013; **5**: 4553–65.
30. Black MM, Dubowitz H, Krishnakumar A, Starr RH Jr. Early intervention and recovery among children with failure to thrive: follow-up at age 8. *Pediatrics* 2007; **120**: 59–69.