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Effects of food allergy on the dietary habits and intake of primary schools' Cypriot children

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KEY WORDS

Food allergy; primary school children; food choices; elimination diet; quality of life

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Doi

10.23822/EurAnnACI.1764-1489.07

Introduction

Most children develop food allergies within the first 5 years of life, one of the most crucial periods of growth and development (1). Among the most common food allergens in the pediatric population are milk, wheat and egg (2), which constitute the main sources of significant nutrients, such as protein, iron and calcium (3). An elimination diet creates an emerging need for alternative sources of all basic macro- and micronutrients, as the diet of food allergic children is in several cases found low in energy, protein, calcium, vitamins D and E, iron and zinc (4), due to inappropriate food exclusions and follow-up after diagnosis of food allergies, but also refusal of food allergic children to try new foods (5), resulting to rickets, kwashiorkor, anaemia and failure to thrive in long-term (6). Furthermore, without ap-

Summary

Aim. To determine whether food allergy affects overall dietary intake and food choices in Cypriot primary school children. **Methods.** As part of the first epidemiological study in Cyprus on food allergy in primary school children, two 24-hour recalls (one from a week and one from a weekend day) of twenty-eight food allergic children (21 girls) and thirty healthy children (20 girls) aged 6-11 years old, were analysed and compared regarding their macro- and micronutrient content, food choices and meal distribution. **Results.** Significant differences between the two subgroups of children were estimated regarding the total energy intake and macronutrients, where food allergic children were found to consume in lower quantities, as well as for calcium, niacin, fiber and vitamin E. Food allergic children were also found to avoid combining foods from the various food groups in their meals, and to prefer specific food products from each category, whereas they consumed higher amounts of sugar and fructose. **Conclusion.** Food allergy in Cypriot food allergic children impacts on both the quality and quantity of food choices, probably due to lack of nutritional education regarding proper elimination diet and alternative nutrient sources.

propriate dietary education on the everyday management (i.e allergen labelling, alternative foods) (7), psychosocial problems arise (8,9) due to high levels of anxiety associated with a potential accidental reaction (5).

The current study aims to identify the effect of food allergy on dietary habits and intake of food allergic in comparison to healthy primary school Cypriot children.

Patients and Methods

Study design

A survey with a specially composed questionnaire for self-reported food allergy (10) was performed among primary school-children, aged 6-11 years old, in Cyprus. Stratified random sam-

pling was used to select 15 schools in urban and rural areas of Cyprus and 3000 questionnaires were distributed, containing also a request for completion of two 24-hour recalls (one from a week and one from a weekend day).

311 completed questionnaires were returned, among which only 59 contained the completed two 24-hour recalls.

The study was approved by the Cypriot Bioethics Committee and the Cypriot Ministry of Education, and informed consent was returned completed together with the questionnaires by the parent or the guardian.

Data analysis

The 24-hour recalls were analysed with dietplan 6.70 (11) to determine the macronutrient and micronutrient consumption of food allergic versus healthy children. To evaluate the impact of food allergy on food choices and meal distribution, these were also analysed and compared with the respective from the healthy individuals. Mann-Whitney U test and Pearson Chi-Square test were used (12) and p-values lower than 0.05 were considered as statistically significant.

Results

Among all distributed questionnaires, only 10.4% were returned completed and from these only 19% (n = 51) included the two 24-hour recalls. More in detail, 28 (21 girls) with a mean age of 8.43 years (SD ± 1.86), reported a confirmed food allergy by a doctor with skin prick test, serological evaluation and/or food challenge, and they were on a food elimination diet to one of the following: 6 to cow's milk, 3 to egg, 1 to

cereals, 2 to tomato, 2 to cherry, 2 to chocolate, 4 to peanuts and 1 to orange. From the healthy participants, 30 children (20 girls) returned the 24-hour recalls completed (mean age 9.2 years, SD ± 1.57).

Food choices from the different Food Groups during the day

Food allergic were found to consume lower servings of almost all food groups, such as dairy products, bread and cereals, fruit and vegetables than the healthy children. Also, the last recorded a higher variety, with combinations of products from all groups in almost all daily meals. Wholegrain cereals and fish were more often consumed, as well as fresh fruit and vegetables. Food allergic preferred commercial juices and dry fruit to fresh fruit, and had the same breakfast in the two days of recall, containing only bread or cereals and dairy products. Overall amount of meat products was similar for both groups (**figures 1 and 2**).

Energy, macronutrients and micronutrients intake

Significant differences were observed for the estimated total energy intake for both the weekday and the weekend day. Food allergic consumed a mean of 1694 kcal (± 230) for the weekday and 2105 kcal (± 180) for the weekend day. In regards of the macronutrients intake, for the weekday carbohydrate intake was 237.1 g (± 75), protein 85.6 g (± 13), and fat 51.5 g (± 13). For the weekend day, consumption of carbohydrate was 245.9 g (± 19), for protein 92 g (± 12.8) and for fat 85.5 g (± 13.4). On the other hand, healthy children consumed 2670 kcal (± 285) on the weekday and 3030 kcal (± 270) on the weekend

Figure 1 - Distribution of foods group consumed during the day (week or weekend day).

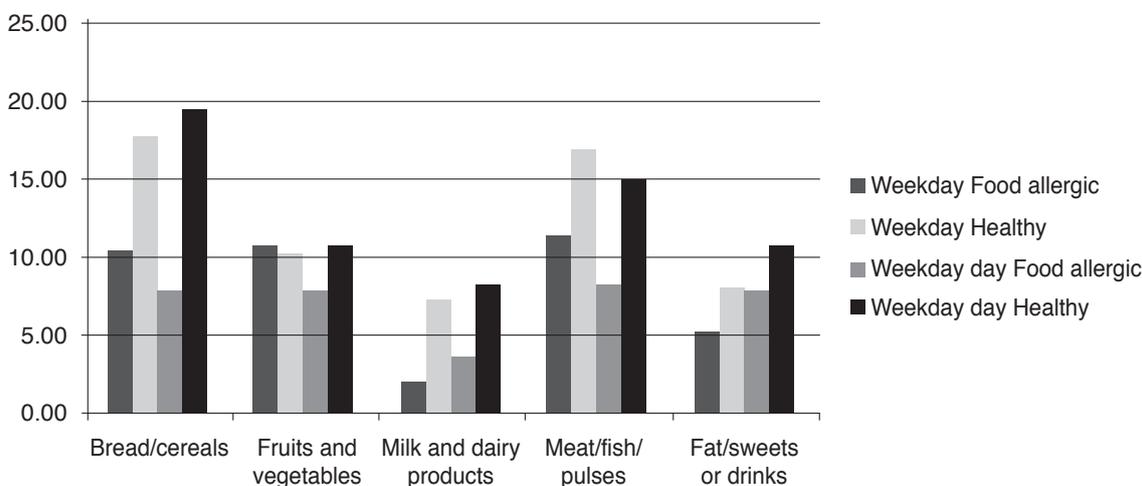
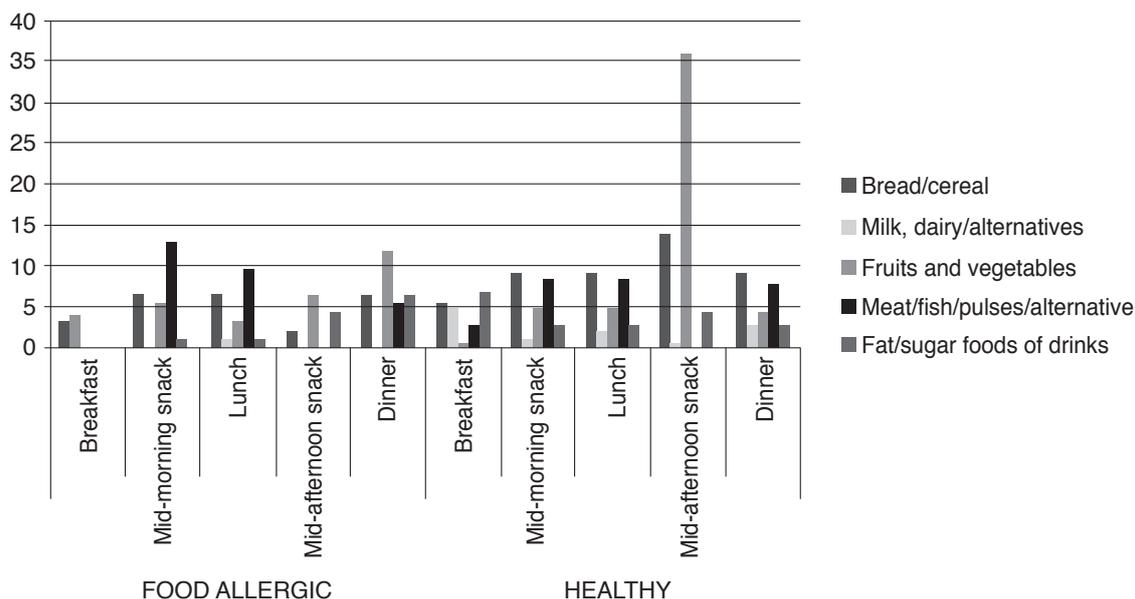


Figure 2 - Relative distribution of food groups in all daily meals (breakfast, mid-morning snack, lunch, mid-afternoon snack and dinner) in both 24-hour recalls.



day. Regarding their macronutrient intake for the weekday these were 276.2 g (\pm 43.7) for carbohydrates, 127.1 g (\pm 18) for protein and 84.2 g (\pm 16.9) for fat. Mean carbohydrate consumption during the weekend was 406.7 g (\pm 80), for protein 132.6 (\pm 19.5) and for fat 113 g (\pm 28).

In regards of micronutrients intake, food allergic children were found to consume significantly higher amounts of sugar and fructose ($p = 0.043$), whereas lower amounts of calcium ($p = 0.046$), vitamin niacin ($p = 0.033$), fibre ($p = 0.037$) and vitamin E ($p = 0.049$).

Discussion

The current study, part of the first epidemiological study on food allergy in Cypriot primary school children, evaluated the effect of food allergy on dietary intake and food choices of Cypriot primary school children through two 24-hour recalls, in comparison to their healthy peers. Children who self-reported themselves as food allergic were found to have lower energy, calcium, niacin, vitamin E, fibre intake, and variety of food choices on daily meals, whereas sugar and fructose were higher than the ones of healthy children.

To start with, food allergic children had lower energy intake and overall macronutrient consumption. This could be due to the monotonous diet they reported to follow, and to the avoidance of combining foods from different food groups in their meals. This could be due to the anxiety they experience due to the

food allergy, resulting into food refusal, aversion and/or food neophobia affecting, as reported elsewhere, the overall nutrient intake and leading to growth disturbances and malnutrition (9,13,14). Additionally, the quality of life can be disturbed, as shown by different researchers, where food allergy was shown to cause psychological distress and anxiety to the children and their families (14), which avoided social events.

Children with food allergies are at risk of developing eating disorders (15). Although all children in our study reported that they were sharing family meals, the food allergic ones did not increase either the quantity or variety of food they consumed, nor the quality. Opposite to this, food choices were found unhealthier in the food allergic, that were consuming more sugar, in line with other studies (16).

Fruits and vegetables were consumed in lower amounts, especially during the weekend by the food allergic. Fructose intake was found higher though, probably due to the higher consumption of fruit juices and dry fruit such as dry figs. These are in line with other studies, showing that food allergy affects choices in fruit and vegetables, usually by increasing fruit consumption and lowering vegetables (17,18).

Calcium intake was relatively lower, due to lower amount of milk and dairy products or inadequate alternatives consumed. Milk and dairy products are key foods for children's growth and development, as they are rich in protein, fat, vitamin A, vitamin D, riboflavin, pantothenic acid, vitamin B12, calcium,

phosphorous and niacin (19). Elimination diet to dairy without appropriate substitution can lead to insufficient intake of basic nutrients and pronounced delay of growth (20).

Significantly lower fiber in allergic children could be relevant to the low intake of whole grain products consumed. Limited consumption of starch also affects negatively vitamin D, calcium, zinc, iron and vitamins B intake (21). Choosing processed products, such as white instead of whole-wheat bread could be due to lack of knowledge of the nutritional value of whole grains or to financial difficulties leading to choose processed products rather than whole-wheat (22). Also, lower niacin levels could be due to the relatively lower dairy and starch intake, as also reported elsewhere (23).

Vitamin E intake was significantly lower in food allergic children, probably due to the lower consumption of vegetable oils. Vitamin E is associated with optimal health and cell protection from oxidative damage (24), whereas it can have a protective role together with other antioxidants against allergies (25).

The current study revealed several significant differences between nutrient intake and food variety among healthy and food allergic elementary school children, despite the low rates of response. Unfortunately, we did not have sufficient data related to the anthropometric measurements (height and weight) of the participants, in order to determine growth disturbances.

The 24-hour recalls used as the main tool to evaluate food consumption, qualitatively and quantitatively, revealed several differences among the two subgroups, despite the low rates of response. Although there was a request for completing in parallel a food frequency questionnaire regarding the dietary habits of the last 6 months (26), in order to have an overall estimation of the diet, we did not achieve to have a significant number returned, to come into significant estimates.

Conclusion

Food allergic elementary school children have a less variety of foods in their diet, and their overall intake is lower, resulting on several significant differences in macronutrients and micronutrients, in comparison to their healthy peers. This could be due to the anxiety caused by a putative new allergic reaction or to limited education on sufficient alternatives.

Acknowledgements

Sincere acknowledgements to University of Nicosia for covering the cost for the 3000 reprints of the questionnaires. Special thanks to the students of the Department of Nutrition and Dietetics of University of Nicosia for their contribution on data collection.

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