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National allergy programme had little impact on parent-reported food allergies in children aged 6-7 years

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CONFLICTS OF INTEREST

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ABSTRACT

Aim: The ten-year Finnish national allergy programme was launched in 2008 to lessen the disease and psychological burden of allergy. This study assessed the prevalence of parent-reported food allergies requiring avoidance diets at primary school in children aged six and seven years.

Methods: The cohort comprised 1,937 children (51% boys) who started primary school in Tampere, Finland in August 2016. School health nurses charted parent-reported, doctor-diagnosed food allergies requiring avoidance diets as part of the routine health examination.

Results: We found that 127 (6.6%) children had parent-reported, doctor-diagnosed allergies to at least one food and 37 (1.9%) were allergic to basic foods, namely cows' milk, wheat and one other grain. All required an avoidance diet. The figure did not differ significantly from the 2.7% and 2.5% found by studies of this age group in 2009 and 2013, respectively. Allergies to fresh fruit and vegetables decreased from 5.8% in 2009 to 3.6% in 2016.

Conclusion. We studied the national allergy programme that started in 2008 and found that there was a non-significant overall decrease in the number of children aged 6-7 on avoidance diets for allergies between 2009-2016. The only allergies that showed significant decreases were fresh fruit and vegetables.

Key words: Avoidance diets, Food allergies, National allergy programme, School health nurses

Key notes:

- Finland launched a national allergy programme in 2008 to lessen the disease and the psychological burden in the population.
- We evaluated the prevalence of parent-reported, doctor-diagnosed food allergies requiring avoidance diets in 1,937 children aged 6-7 years who started primary school in 2016 and compared them to 2013 and 2009 data.
- The need for special avoidance diets for basic foods did not decrease significantly from 2009-2016, from 2.7% to 1.9%.

INTRODUCTION

The aim of Finland's 10-year national allergy programme, which was introduced in 2008, was to reduce the burden of allergies, both at individual and societal levels (1). In 2018, when the programme will be completed, the new practices that have been implemented should be part of routine healthcare in the country. The programme was keen to promote both immunological and psychological tolerance and to change attitudes to support health instead of disease in the case of mild allergies. The established principles before the programme, which focused on avoiding allergens, had not proved effective in decreasing the increase in allergies (2). For example, the programme maintained that avoiding diets for food allergies should be critically evaluated and stopped when possible. The foundation stones for implementing the programme were allergists' networking with other doctors, nurses, nutritionists and pharmacists and campaigning to increase public knowledge of allergies. The programme was published in the *Finnish Medical Journal* in April 2008 (1) and followed by educational sessions in all parts of the country, which peaked in 2009-2012 (3).

In 2009, we evaluated the prevalence of food allergies that required avoidance diets among children starting primary school in Tampere, a city with a population of more than 200,000 in West-Central Finland. This initial study found that 2.7% of the children were reported by their parents to need avoidance diets because of allergies to basic foods like cows' milk, eggs or grains (4). The results reflected the frequency of parent-reported, doctor-diagnosed food allergies the year after the national allergy programme was launched..

In 2013, we performed an identical study among children starting primary school in Tampere and 2.5% had parent-reported allergies to basic foods that required avoidance diets (5). The results suggested that, although the national allergy programme had continued for five years, avoidance diets started in early childhood still continued quite unnecessarily until school age. Fruit and vegetable allergies, which are usually associated with birch allergies, were present in 4.1% of the 2009 respondents and nut allergies were present in 2.2% (4). In 2013 the respective figures were 3.1% and 2.6% (5).

The purpose of this 2016 study was to evaluate whether the prevalence of parent-reported food allergies requiring avoidance diets at primary school had changed when the national allergy programme has run for nine of its programmed duration of 10 years.

SUBJECTS AND METHODS

Design

In August 2016, 1,937 children (51% boys) who were born in 2009 started primary school in Tampere, the third largest city of Finland with about 220 000 inhabitants. The subjects were six to seven years of age. The 42 schools in the city that participated, were covered by 29 school health nurses, who examined all the first-grade students, except those attending two small private schools, between May and September 2016. As a part of this examination, the need for avoidance diets due to food allergies was evaluated. The parents had completed a routine health questionnaire in advance, the school health nurses checked this information, interviewed the parents and children and decided whether an avoidance diet was indicated or not. The children were categorised as having a grain allergy if they could not tolerate one or more grains, namely wheat, rye, oats and barley, and did not have coeliac disease. An allergy to basic food was defined as having an allergy to cows' milk, eggs or grains and a multi-allergy was defined as being allergic to cows' milk, wheat and any other grain. If the parents reported allergies to cows' milk, eggs, soy, fish, grains and cereals, the school health nurses were instructed to only accept those allergies diagnosed by a doctor. However, no time or age limits were applied to when the diagnosis had been made.

Costs

The costs of the lunches served in the school canteens were calculated by using the mean prices per serving in 2009, 2013 and 2016 and these were provided by Tampereen Voimia, a catering company owned by the city of Tampere. Catering companies received 50% extra for the price of special allergy-free meals than for

standard school meals and we calculated the annual costs of both meals by multiplying the price per serving by the number of children and the number of school days, which was 190. Costs were expressed in Euros and adjusted to 2016 prices using the price index of public expenses provided by Official Statistics Finland (6). The annual extra costs were calculated by subtracting the cost of the special diet meals from the cost of the standard meals.

The criteria for receiving a special diet meal were an allergy to basic foods, such as cows' milk, eggs or grains, or to at least five other allergies to non-basic foods until the year 2014. After that point, having just one allergy was enough to entitle a child to a special diet meal. However, we were able to carry out direct comparisons, as we also calculated the numbers of children and the cost of special diets in 2016 using the more restrictive criteria that were in place in 2009 and 2013, before the new rules came in.

Statistics

The data were analysed using IBM SPSS Statistics, version 24.0 (IBM Corp, Armonk, New York, USA). The results are expressed as percentage distributions with 95% confidence intervals (95% CI). Pearson's chi-square test and Fisher's exact test were used in the statistical analyses of the categorised data, as appropriate.

Ethics

Tampereen Voimia provided group data on the special diets, which means that none of the children or schools were individually identified. For that reason, no ethical approval was required.

RESULTS

Prevalence

In 2016, 127 (6.6%) parents reported that their children had an allergy to at least one food. A cows' milk allergy was present in 21 (1.1 %) children, an egg allergy in 22 (1.1%) children and a grain allergy in seven (0.4%) children, without any significant differences between boys and girls (Table 1). Allergies to basic foods were reported in 37 (1.9%, 95% CI 1.4-2.6%) of the children and multi-allergies in two (0.1%, 95% CI 0.0-0.4%) of children, again without any significant differences between boys and girls. We found that 70 children (3.6%) had reported allergies to fresh fruit or vegetables, 46 (2.4%) to nuts, 14 (0.7%) to legumes and seven (0.4%) to spices (Table 1).

Of the 37 children with a basic food allergy - to cows' milk, eggs or grains – 11 (29.7%) also had a reported allergy to nuts, nine (24.3%) to fresh fruit or vegetables, seven (18.9%) to fish and five (13.5%) to soy. Of the nine children with a reported soy allergy, five (55.6%) were also allergic to basic foods, but none of them were allergic to cows' milk. Only nine (12.9%) of the 70 children with fruit or vegetable allergies reported allergies to basic foods: $p < 0.001$ versus those without a fruit or vegetable allergy. In summary, of 106 children (83.5%) who were allergic to the non-basic foods 15.1% were also allergic to basic foods and 84.9% were not (Table 2).

Costs

The cost of an allergy diet was €3.74 per serving in 2009, €3.63 in 2013, and €3.74 in 2016. The total annual extra costs of allergy diets were €10,882 for 46 children in 2009, €10,802 for 47 children in 2013 and €30,119 for 127 children in 2016, two years after the qualifications rules had been relaxed on non-basic food allergies from five foods to one (Table 3). This gave us an approximate cost per child of €237 in 2009, €230 in 2013 and

€237 in 2016. However, if we had used the same qualifying criteria in 2016 as were in place in 2009 and 2013, the annual extra cost would have been €9,249 for 39 children.

DISCUSSION

In 2016, 1.9% of the 1,937 children starting elementary school in Tampere, a city of about 220,000 residents, presented with parent-reported, doctor-diagnosed allergies to basic foods requiring special avoidance diets at school. As seen in Table 4, the figure did not differ significantly from the 2.7% the year after the 10-year national allergy programme was launched in Finland in 2008, and 2.5% in 2013, which was halfway through the programme (4,5). The programme aimed to increase both immunological and psychological tolerance to mild allergy symptoms (1). In 2016, 1.1% were allergic to cows' milk, 1.1% to eggs and 0.4% to grains, and 0.1% were multi-allergic to a combination of cows' milk, wheat and some other grain, without any significant differences to 2009 or 2013.

The national allergy programme in Finland aimed to reduce the burden of allergies both at individual and societal levels (1,3). In the case of food allergies, on-going avoidance diets need critical evaluation and they should be stopped if possible. The theory beyond this new practice is that regularly consuming a food that an individual is allergic to seems essential if they are to achieve desensitisation and finally even tolerance to the food in question. It takes times for symptoms to disappear and mild symptoms have to be endured in the meantime (7,8). New avoidance diets must be based on proper diagnostic work and they have to be precise, specifying what is to be avoided and for how long (1-3)

In American schoolchildren aged 6-10 years, partially corresponding to the age group of the present study, the overall prevalence of doctor-diagnosed food allergies was 7.6%

and peanuts (1.9%), cows' milk (1.5%), tree nuts (1.1%), eggs (0.8%) and wheat (0.4%) were the most common allergens (9). These figures were similar to the figures in the present study, in which food allergies were diagnosed by a doctor but reported by the parents. Evidently, the problem in our study was that too many avoidance diets had continued from early childhood and the real need for the diet was not checked at a later point.

An Italian study presented parents' estimates of the prevalence of food allergies in children aged 5-10 years (10) and the parents reported food allergy symptoms in 9.9% of 463 children, with cows' milk (3.4%), eggs (2.3%), tomatoes (1.5%), peanuts (1.1%) and chocolate (0.9%) being the most common allergens. These figures were higher than the figures in the present study, which reflects different reporting, as the Italian study relied on parents reporting allergies but our study relied on parental reports of doctor-diagnosed allergies in Finland.

Allergies to cows' milk, eggs, wheat and soy typically resolve during childhood, but the resolution rates have slowed down in recent years (11-13). In a study of 154 children from the USA, only 52.6% of doctor-diagnosed cows' milk allergies followed from infancy had resolved by the age of 5.5 years (14). This global trend of a slower resolution of food allergies than in the past may at least partly explain the higher than expected food allergy prevalence figures in the present study. The fact that the prevalence of food allergies did not increase in first-grade pupils might also be a positive sign.

Allergies to fruit and vegetables, which are often associated with having a birch allergy, were equally common in 2016 and 2013 (5). The figures were lower than in 2009 (4), but they were still higher than in many other studies. In Canada, for example, only 1.1% of children reported allergies to fruit and 0.45% to vegetables (15) and in Italy, only 1.5 % reported allergies to fruit and less than 1% to vegetables (10). This decrease up to 2016

was more likely to have been due to greater endurance with mild symptoms and less concern paid by healthcare professionals to the connection between food allergies and seasonal rhinitis, in line with the national allergy programme.

Food allergies reflect exposures to food allergens and the use of nuts has increased in Finland, as it has in other North-European countries (16). In the UK, peanut allergies doubled from 2000 to 2005 (16) and in the USA they tripled from 1999 to 2007 (18). There is always a risk for over-diagnosis, since 75% of the skin test reactivities to nuts only represent cross-reactivity to pollens (19). Importantly, nuts still cause half of the severe allergic reactions to foods and there is no doubt that a strict avoidance diet is needed if there is a history of anaphylaxis (20). It is possible that the observation that there was only a minor, non-significant increase in allergies to nuts from 2013 to 2016 may be due to greater endurance of mild symptoms, even though the prevalence of nut allergies has increased.

The costs of allergy diets increased between 2009 and 2016, but the reason for that was that the criteria for special avoidance diets were less strict from 2014 and fewer allergies were required to qualify. The costs of special diets accounted for 4.2% to 9.5% of the costs of school meals and this result was in line with other published studies. A cross-sectional study from the USA estimated that caring for a child with a food allergy cost families approximately \$3,457 a year in 2012 and that the special diets and allergen-free foodstuffs accounted for most of the costs, as only \$724 of that figure was total direct medical costs (21). In addition, a Swedish questionnaire study that included 144 children and adolescents with food allergies and 150 non-allergic controls reported higher total household costs for those with allergies (22). The annual total household costs were €3,961 higher for children and €4,792 higher for adolescents than for the controls (22). In addition, the higher annual healthcare costs were associated with food allergies in a

European patient-based, cost-of-illness study (23). Thus, the costs of the school lunches we evaluated in this study were only part of the total costs of food allergies to the families and to the community.

There were three main strengths to the present study. First, the 2016 study was identical to the studies performed in 2009 and 2013 and this allowed us to perform direct comparisons of the prevalence of food allergy at various stages after the implementation of the national allergy programme. Even though the qualification criteria for avoidance diets changed in 2014, we were still able to adjust the 2016 figures to allow for actual and adjusted comparisons. Second, the survey was part of the routine health examination carried out by the school health nurses, which means that the coverage of the study was very high and would have included all first-grade pupils who needed a special diet at school. Third, the study population was at an optimal age, of 6-7 years, for evaluating transient versus persistent food allergies. At that age, transient early-childhood food allergies have mostly recovered and allergies to fruit, vegetables, nuts and legumes, which are often associated with pollen allergies, have mainly become symptomatic.

A clear shortcoming of the study was that the data only consisted of parent-reported information, but on the other hand, school health nurses were advised to only register allergies that had been diagnosed by a doctor. This element of the study design was essential, because 30% of parent-reported food allergies were not diagnosed by a physician in a population-based study from America (24). However, it does need to be acknowledged that we did not include when the doctors had diagnosed the parent-reported food allergies and this means that it may have been earlier in childhood and they were no longer allergic necessary.

CONCLUSION

The goals of the Finnish national allergy programme from 2008-2017 included changes in public attitudes and healthcare practices. Our surveillance period of nine years from 2009-2016 may have been too short to register any major changes. Follow-up studies are clearly needed to see if the programme has had any long-term impact. Research is also needed to determine whether food avoidance strategies are being continued unnecessarily for long periods of time, resulting in special diets that increase school catering costs. Based on the current results, and on the experiences of many other cities in Finland, a new practice was introduced in 2017 in Tampere. A doctoral certificate has to be provided if a child needs an avoidance diets at school.

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TABLES

Table 1. Parent-reported food allergies by gender in 1,937 Finnish children starting primary school at 6-7 years of age.

Allergen/allergies	Boys	Girls	All
	n=990 (%)	n=947 (%)	n=1,937 (%) (95%CI)
Cows' milk	10 (1.0)	11 (1.2)	21 (1.1) (0.7-1.7)
Eggs	10 (1.0)	12 (1.3)	22 (1.1) (0.8-1.7)
Grains	3 (0.3)	4 (0.4)	7 (0.4) (0.2-0.7)
Wheat	2 (0.2)	3 (0.3)	5 (0.3) (0.1-0.6)
Rye	3 (0.3)	4 (0.4)	7 (0.4) (0.2-0.7)
Barley	2 (0.2)	4 (0.4)	6 (0.3) (0.1-0.7)
Oat	1 (0.1)	1 (0.1)	2 (0.1) (0.0-0.4)
Multi-allergy	1 (0.1)	1 (0.1)	2 (0.1) (0.0-0.4)
Basic food allergies	19 (1.9)	18 (1.9)	37 (1.9) (1.4-2.6)
Soy	3 (0.3)	6 (0.6)	9 (0.5) (0.2-0.9)
Fish	8 (0.8)	9 (1.0)	17 (0.9) (0.6-1.4)
Legumes	7 (0.7)	7 (0.7)	14 (0.7) (0.4-1.2)
Nuts	22 (2.2)	24 (2.5)	46 (2.4) (1.8-3.2)
Spices	2 (0.2)	5 (0.5)	7 (0.4) (0.2-0.7)
Fruit and vegetables	41 (4.1)	29 (3.1)	70 (3.6) (3.6-4.5)

95% CI = 95% confidence interval

Table 2. Analysis of 103 schoolchildren who were allergic to non-basic foods, including 37 who were also allergic to basic foods.

Food allergen	Number of children allergic to each named food (n=106 children)	Number of children allergic to each named food plus basic foods* (n=16 children)
Fish	17	7
Legumes	14	4
Nuts	46	11
Spices	7	3
Fruit and vegetables	70	9
Soy	9	5

*Basic food allergy means allergy to cow milk, eggs or grains. There were 163 allergies to non-basic foods recorded for 106 children and 39 basic food allergies recorded for 16 of those children.

Table 3. Total cost of school lunches in Tampere schools and cost of allergy diets for the city in 2009, 2013 and 2016, presented as Euros and adjusted for 2016 price levels.

Costs	Year 2009	Year 2013	Year 2016
Number of first grade children	1,542	1,653	1,940
Number of first-grade children on a special avoidance diet	46	47	127 ***
Mean cost per lunch for normal diet	€2.49	€2.42	€2.50
Mean cost per lunch for special avoidance diet	€3.74	€3.63	€3.74
Annual total costs (190 school days)	€743,785	€779,632	€954,674
Annual costs of allergy diets (proportion of the total costs)	€32,646 (4.4%)	€32,408 (4.2%)	€90,357 * (9.5%)
Annual extra cost due to allergy diets	€10,882	€10,802	€30,119 **

The criteria for special diets changed in 2014 and the 2016 figures were reworked using the 2009/2013 criteria. This showed that in 2016:

* The annual costs of the allergy diets would have been €27,747 and the proportion of total costs would have been 2.9%.

** The annual extra costs would have been €9,249.

*** The number of first-grade children on an avoidance diet would have been 39.

Table 4. Parent-reported food allergens in first-grade children in 2009, 2013 and 2016.

Allergen	In 2009* Number (%) (95% CI)	In 2013** Number (%) (95% CI)	In 2016*** Number (%) (95% CI)
Basic foods	2.7% (1.9-3.5)	2.5% (1.9–3.4)	1.9% (1.4-2.6)
Cow milk	1.5% (0.9-2.1)	1.3% (0.9–2.0)	1.1% (0,7-1,7)
Eggs	1.1% (0.6-1.6)	1.5% (1.0–2.1)	1.1% (0,8-1,7)
Grain	1.0% (0.5-1.5)	1.0% (0.6–1.6)	0.4% (0,2-0,7)
Nuts	3.1% (2.2-4.0)	1.8% (1.3–2.6)	2.4 % (1,8-3,2)
Fruit and vegetables	5.8% (4.7-7.0)	3.2% (2.5–4.2)	3.6 % (3,6-4,5)
Fish	0.8% (0.4-1.3)	0.7% (0.4–1.3)	0.9 % (0,6-1,4)

* 2009 study - reference (4)

** 2013 study - reference (5)

*** Current study