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Prevalence and longitudinal trends of food allergy during childhood and adolescence: Results of the Isle of Wight Birth Cohort study

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Summary

Background: The prevalence and time trends of food allergy change during childhood depending on the age of the child and the type of food.

Objective: To study prevalence and longitudinal trends in food allergy from birth to 18 years in an unselected birth cohort in the Isle of Wight.

Method: Information on food allergy was collected at ages 1, 2, 4, 10 and 18 years from the Isle of Wight Birth Cohort (n = 1456). Skin prick testing (SPT) was performed at the age of 1 and 2 years in symptomatic children. At 4, 10 and 18 years of age, participants were tested to a panel of food and aeroallergens. Food allergy was diagnosed based on the criteria: symptoms suggestive of a typical IgE-mediated reaction and reaction <4 hours following exposure to a known food allergen. McNemar's test was used to determine significance of changes in prevalence over time.

Results: The prevalence of food allergy remained relatively constant in early childhood (5.3%, 4.4% and 5.0% at 1, 2 and 4 years, respectively), with significant decline at 10 years (2.3%, $P < .001$ vs 4 years) followed by significant rise at 18 years (4%, $P = .02$ vs 10 years). Cow's milk (1.6%–3.5%) and egg (1.1%–1.4%) were the most common allergens in the first 10 years with peanut (1%) and tree nuts (0.5%) becoming more prevalent beyond 10 years. Fruit and wheat allergy were less common at 10 years, and shellfish and kiwi emerged during adolescence. The prevalence of food allergy plus positive SPT was 1.3%, 0.8%, 0.8%, 0.9% and 2.2% at 1, 2, 4, 10 and 18 years, respectively.

Conclusion: Food allergy is highly prevalent in infancy with partial resolution during late childhood. However, a number of children acquire new food allergy during adolescence resulting in a relatively higher prevalence at 18 years.

KEYWORDS

epidemiology, food allergy, IgE, paediatrics

1 | INTRODUCTION

Food allergy (FA) is increasingly recognized as a public health problem, and along with other atopic conditions is a major cause of

chronic morbidity in the developed world. FA is defined as an immunologically mediated adverse reaction to food, which can be both immunoglobulin E (IgE) and non-IgE-mediated. Allergic sensitization is the development of specific IgE to food or aeroallergens

and can occur in the absence of food allergy symptoms. FA is diagnosed based on an allergy-focussed history and/or oral challenges. Allergic sensitization to the suspected food confirms the presence of IgE-mediated FA.

There is huge variability in the prevalence of FA world-wide; however, a meta-analysis in 2014 showed overall prevalence rates of 17% for self-reported FA and 0.9% for challenge-proven FA. Clinically defined FA prevalence varies widely (1%-13%) depending on the specific criteria used.^{1,2} Food allergy in infancy can be a transient phenomenon or may persist into adulthood. The prevalence and trends in food allergy and sensitization patterns in childhood have been previously explored in birth cohorts.²⁻⁵ However, there is limited knowledge about prevalence, time trends and overall transitions, that is change in status from food allergic to non-food allergic (acquired tolerance) and from non-food allergic to food allergic (acquired food allergy) from one assessment to the next. The Isle of Wight Birth Cohort was followed up from early childhood, into later childhood and on into young adult life, providing a life course perspective between childhood and adulthood.

There is evidence of rising prevalence and severity of FA and anaphylaxis in several studies.⁶⁻⁹ The reasons for reported variation in prevalence include differences in study methodology, the diagnostic criteria used for defining FA (eg self-reported food allergy, skin prick testing, open [OFC] or double-blind, placebo-controlled food challenges [DBPCFC]), geography and local dietary habits.¹⁰ We were in the unique position of being able to analyse 18 years of longitudinal prevalence data on FA which was collected using similar methodology from the same, relatively static, population in the Isle of Wight (IOW), UK. Our study aimed to determine the prevalence and longitudinal trends of FA and sensitization to food allergens over the first 18 years of life. This will add valuable information to the current knowledge of the natural history of food sensitization and allergy.

2 | METHODS

The IOW birth cohort was established in 1989 and has been followed up prospectively for 18 years.^{11,12} This unselected birth cohort was established with the aim of studying the natural history of allergic diseases and the influence of genetic and environmental factors on the development and progression of allergy. The study was approved by the Isle of Wight research ethics committee (06/Q1701/34). All children born on the IOW between 1 January 1989 and 28 February 1990 (n = 1536) were enrolled in the study, and 1456 were available for further follow-up.¹³ Detailed questionnaires were completed at each follow-up. Allergic symptoms of FA, eczema, asthma and rhinitis, atopic family history and home and environmental factors were explored. Prospectively collected food reaction and sensitization data were analysed to study food allergy trends.

2.1 | Definition of FA

The diagnostic criteria used for food allergy have been published previously.^{13,14} In summary, we collected detailed information on food-related allergic reactions and applied an a priori definition of food allergy based on the following criteria:

1. A report involving a recognized food allergen as defined by the Committee on Toxicity of Chemicals in Foods, Consumer Products and the Environment.¹⁵
2. Recognized IgE-mediated symptoms¹⁶ such as:
 - a. localized symptoms: itching, sting/burning of the lips/mouth or throat, urticaria/hives, angioedema
 - b. abdominal: nausea, vomiting, crampy/colicky abdominal pain, diarrhoea
 - c. respiratory: wheeze, stridor, watery rhinitis, redness of eyes/nose
 - d. skin: urticaria, itching, flushed skin, worsening eczema
 - e. systemic reaction: anaphylaxis
3. Temporal relationship of a reaction with symptoms developing within 4 hours of food ingestion.

Only if all 3 criteria were fulfilled, were children designated as having FA.

2.2 | Skin prick test

Skin prick test (SPT) results were available for a subgroup of the dataset. SPT was performed, using a standardized method, at 1 and 2 years in symptomatic children only and at 4, 10 and 18 years in all consenting participants attending the Centre.^{12,13} The SPT panel included common aero- and food allergens: house dust mite, grass pollen mix, tree pollen mix, cat and dog epithelia, *Alternaria alternata*, *Cladosporium herbarum* (aeroallergen panel) plus cow's milk, hen's egg, wheat, soya, cod fish and peanut (food panel). Further SPT was also performed if symptoms were reported to other allergens. Histamine and physiological saline acted as positive and negative control (Alk-Abello, Horsholm, Denmark). A positive skin prick test was defined as a mean wheal diameter ≥ 3 mm larger than the negative control at 15 minutes.

2.3 | Statistical analysis

SPSS statistical package Version 17 was used to analyse data (IBM SPSS Statistics, Version 17, USA). Frequency tables of FA, sensitization and combined FA and sensitization at each time-point (1, 2, 4, 10 and 18 years) were used to determine prevalence of FA and sensitization pattern for allergens over time. Cross-tab analysis was used for paired data in FA over time. Significance of changes in FA prevalence rates over time (1, 4, 10 and 18 years) was tested using McNemar's test for paired data and chi-squared/Fisher's exact test for independent data.

3 | RESULTS

Of the 1536 children enrolled at birth in 1989, 1456 were available for further follow-up. Most children had more than one assessment but not all were seen at every time-point. Figure 1 graphically depicts the availability of information regarding FA and SPT data at various stages of the study. Demographic information and allergic comorbidity in the cohort participants at each assessment, stratified for sex, are provided in the Table S1 and S2.

3.1 | Prevalence of food allergy

The prevalence of FA by self-report and FA diagnosed based on study criteria at ages 1, 2, 4, 10 and 18 years are reported in Table 1. The rates based on study criteria are significantly lower ($P < .05$) as compared to the self-reported rates. The longitudinal trend suggests FA rates remain relatively constant in early childhood, at 5.3%, 4.4% and 5.0% at ages 1, 2 and 4 years, respectively. There is a significant decline at 10 years (2.3%, $P < .001$ vs 4 years) associated with the resolution of pre-existing childhood allergies, followed by a significant rise at 18 years (4%, $P = .02$ vs 10 years) due to an increase in the prevalence of new food allergies between 10 and 18 years. FA data were further stratified based on SPT results (Table S1). Among children with reported food allergic symptoms, SPT information was available in 32.7% to 85.1% of the allergic population at 5 time-points. The prevalence of those with defined FA plus skin prick test ranged from 0.8% to 2.2%, which equated to 16%–54% of those diagnosed with FA.

3.2 | Rates of individual food allergies

The FA rates of individual food groups are provided in Table 2. Cow's milk and egg allergy were most prevalent at ages 1, 2, 4 and 10 years. Their prevalence declined with time and by 18 years, and the prevalence of both milk and egg allergy had significantly dropped

to 0.3% (Figure 2). FA to peanuts, fruits, tree nuts and wheat were most prevalent at 18 years (Figure 3). Vegetables, mushrooms and mustard were new emerging allergies at 10 and 18 years. Allergies to fruits range from 0.3% to 0.9% at different ages (Figure 3) and included reports of a variety of fruits (eg strawberry, kiwi, orange, bananas and apples Table S3).

The prevalence of multiple food allergy (ie 2 or more food groups) remained in the range of 0.7% to 1.3% over 18 years, with no significant increase in prevalence over time. The majority of children with multiple allergies were allergic to 2 food groups and rarely to 3 food groups. Therefore, the subtotal of individual FA percentages exceeds the overall prevalence at 1, 2, 4, 10 and 18 years. Cow's milk and egg were the most common multiple food allergies at 1, 2 and 4 years (4 cases each), while at 10 years, these were peanut and egg ($n = 3$) and at 18 years, multiple nuts (4 cases).

3.3 | Sensitization to food and aeroallergens

The sensitization rates to food and aeroallergens increased with age. For aeroallergens, the sensitization rates were 17.3%, 26.7% and 40.3% at 4, 10 and 18 years, respectively, compared to sensitization rates to food allergens of 3.4%, 4.4% and 21.4% at the same time-points (Table 1). The majority of food allergen sensitized children were also sensitized to aeroallergens (Figure 4).

Milk, peanut, wheat and cod were the most common food allergens causing sensitization. Cow's milk sensitization rates remained similar at 4 (1.1%) and 18 years (1.0%) with a dip to 0.3% at 10 years (Figure 2). Peanut sensitization rates were higher than peanut FA rates and increased between 4, 10 and 18 years from 1.0%, to 1.7%, to 6.3%, respectively (Figure 3). Peanut allergy rates did not mirror this trend and remained at 0.5%, 0.4% and 1%, respectively. Wheat sensitization rates also did not reflect observed food allergy rates. They gradually increased from 0.1% to 6.3%, while wheat allergy rates remained $<0.5\%$ at all time-points. Similarly, cod

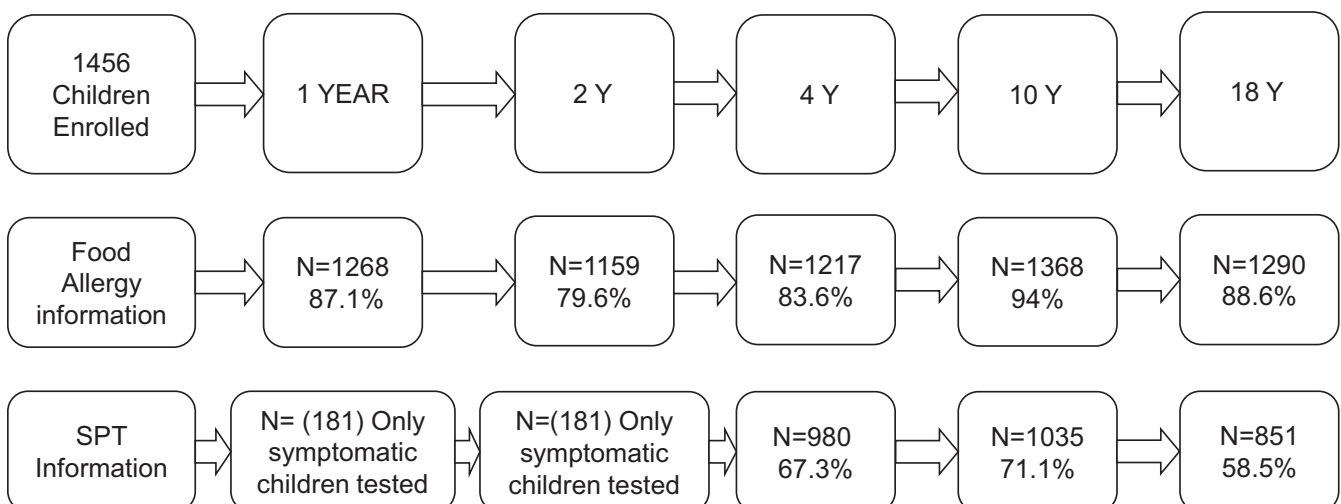


FIGURE 1 Participation data/availability of information at ages 1, 2, 4, 10 and 18 y in the Isle of Wight birth cohort (Consort diagram)

TABLE 1 Prevalence of food allergy, based on self-report and study criteria and food allergen sensitization at varying ages

FA Status	1 y			2 y			4 y			10 y			18 y		
	No	%	95% CI	No	%	95% CI	No	%	95% CI	No	%	95% CI	No	%	95% CI
Reported food allergy	108	8.5%	7-10%	106	9.1%	7.4-10.8%	111	9.1%	7.5-10.7	117	8.6%	7.1-10.1%	103	8.0%	6.5-9.5%
Food allergy (study criteria)	67	5.3%	4.2-6.7%	51	4.4%	3.4-5.7%	61	5.0%	3.9-6.4%	35	2.3%	1.7-3.3%	52	4.1%	3.2-5.4%
Availability of food allergy information	1268 (87.1%)			1159 (79.6%)			1217 (83.6%)			1368 (94%)			1290 (88.6%)		
Food sensitization ^a	-	-	-	-	-	-	31	3.4%	2.2-4.4%	46	4.4%	3.4-5.9%	182	21.4%	18.8-24.3%
FA and SPT positive ^b	16	1.3%	0.8-2.1%	9	0.8%	0.4-1.5%	8	0.8%	0.4-1.6%	9	0.9%	0.4-1.6%	19	2.2%	1.4-3.4%
Availability of food sensitization information	-			-			980 (67.3%)			1035 (71.1%)			851 (58.5%)		

^aSkin prick tests at 1 and 2 y were carried out in only symptomatic children, and hence, it was not possible to calculate cohort prevalence.
^bTotal number of children with "food allergy information" was used as denominator as skin tests were carried out in only symptomatic children.

TABLE 2 Prevalence of food allergies based on food groups and age

Food group	1 y N = 1268	2 y N = 1159	4 y N = 1217	10 y N = 1368	18 y N = 1290
All FA	67 (5.3%)	51 (4.4%)	61 (5.0%)	32 (2.3%)	52 (4.0%)
Cow's milk	44 (3.5%)	19 (1.6%)	32 (2.6%)	7 (0.5%)	4 (0.3%)
Hen's egg	14 (1.1%)	15 (1.3%)	17 (1.4%)	8 (0.6%)	4 (0.3%)
Wheat	6 (0.5%)	5 (0.4%)	3 (0.3%)	1 (0.1%)	6 (0.5%)
Soya	-	-	4 (0.3%)	-	-
Fish	2 (0.2%)	-	2 (0.2%)	2 (0.2%)	2 (0.2%)
Shellfish	-	-	-	2 (0.2%)	3 (0.2%)
Peanut	1 (0.1%)	2 (0.2%)	6 (0.5%)	6 (0.4%)	12 (1.0%)
Tree nuts	-	1 (0.1%)	2 (0.2%)	2 (0.2%)	7 (0.5%)
Fruits	10 (0.8%)	11 (0.9%)	9 (0.7%)	4 (0.3%)	11 (0.9%)
Kiwi	-	-	-	1 (0.1%)	3 (0.2%)
Vegetables	2 (tomatoes) (0.2%)	3 (tomatoes) (0.3%)	4 (tomatoes/brussel sprouts) (0.3%)	4 (tomatoes) (0.3%)	5 (tomatoes/leek/cucumber) (0.4%)
Miscellaneous	-	2 (0.2%)	2 (0.2%)	2 (0.2%)	3 (0.3%)

FA based on study criteria: reaction to known food allergen, typical IgE reaction symptoms and reaction timing < 4 h.
Miscellaneous included corn, chocolate (1 y), red meat and chocolate (2 y), chocolate and oats (10 y), cinnamon, mustard and linseed (18 y).

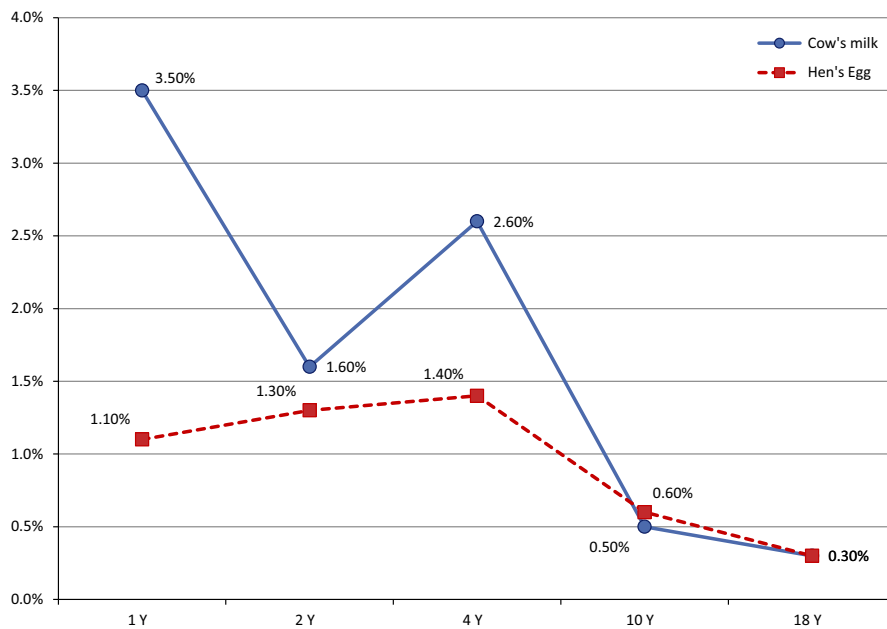


FIGURE 2 Prevalence of cow's milk and hen's egg allergy based on study criteria (known food allergen, typical immediate allergy symptoms and timing <4 h) at 1, 2, 4, 10 and 18 y

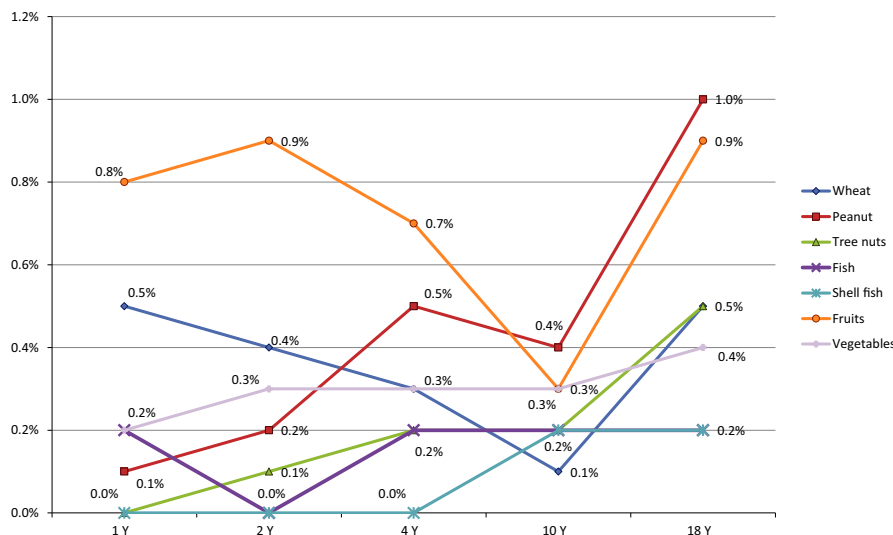


FIGURE 3 Prevalence of other food allergies (wheat, peanut, tree nuts, fish, shellfish, fruits and vegetables) at different ages in the Isle of Wight Birth Cohort

sensitization remained low at 4 and 10 years but increased at 18 years to 1.8% with no corresponding increase in prevalence of cod allergy.

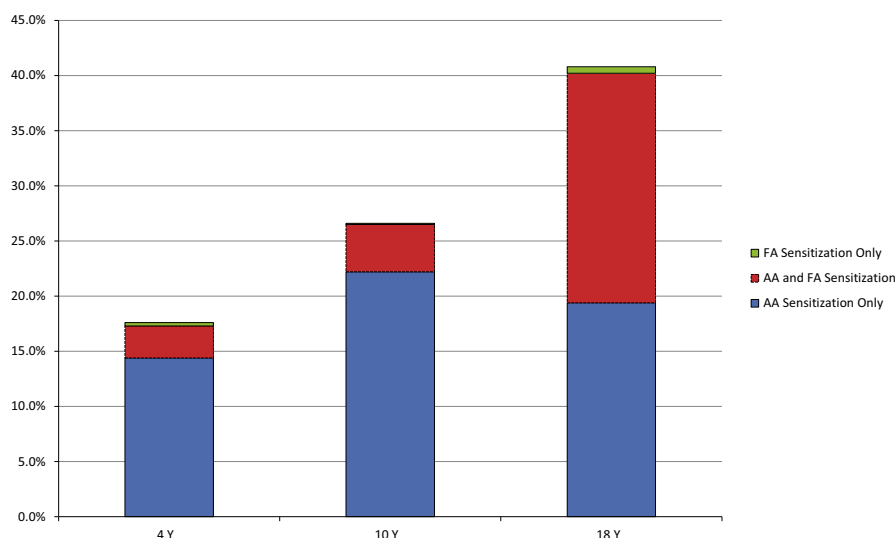
4 | DISCUSSION

This is the first study reporting prevalence and natural history of both food allergy (FA) and sensitization from birth to 18 years in an unselected population, using strict criteria and capturing time trends in individual food allergies. As the IOW cohort is an unselected and longitudinal birth cohort which has been followed up to the age of 18 years, it was possible to follow trends of FA throughout childhood. We showed an expected decline in FA prevalence after early childhood which we associate with the resolution of transient food allergies, but there was an unexpected rise in overall prevalence

during teenage years, which was more prominent for food allergen sensitization than for FA.

The prevalence of FA in childhood has been previously reported using methods which ranged from self-reported questionnaire surveys to double-blind, placebo-controlled food challenges (DBPCFC).¹⁷ DBPCFC is considered the "gold standard" but has only been used in a minority of research studies, often with biased populations due to difficulties in administration. In our study, FA was diagnosed using symptom-based criteria, reflecting clinical practice, and included the characteristics of the reaction, timing from exposure and exposure to common food allergens. The results have been published previously.¹³ We did not use reproducibility of allergic reaction as a diagnostic criterion. Although useful when present, it may not be present in individuals who have had a severe or anaphylactic reaction and would not be further exposed. Other studies have used similar criteria to define food allergy.¹⁸⁻²⁰ We also did not use

FIGURE 4 Sensitization patterns to aeroallergens and food allergens at 4, 10 and 18 y, based on SPT results. Aeroallergen sensitization increases with age and reaches a maximum of 40.2% by 18 y and food allergen sensitization reaches a maximum of 21.4% by 18 y of age. The majority of the food allergen sensitized population are also sensitized to aeroallergens, while there were few who were sensitized only to food allergens. FA, food allergens; AA, aeroallergens; AA+FA: aero- plus food allergens



allergic sensitization as a criterion as we had incomplete information for allergic sensitization at 1 and 2 years and no information on food allergen-specific IgE. Hence, we cannot reliably comment on the prevalence of whether these were IgE or non-IgE-mediated food allergy. However, we have reported IgE-mediated allergy as a subset of those with food allergy if they had a positive skin prick test to food allergens. The prevalence of FA in our cohort varied between 2.3% and 5.3%, in children between 1 and 18 years, while IgE-mediated food allergy varied between 0.8% and 2.2%. Similar prevalence has been reported in other birth cohort studies which have used open and DBPCFC for diagnosis of FA.^{4,18,21-25}

Self-reported FA rates were lower compared to other studies; both cross-sectional and birth cohort.^{5,18} This could be explained by the fact that targeted FA symptom-specific questionnaires were used to collect data in person (where possible) at every assessment, rather than from an anonymous FA questionnaire survey. Similar prevalence rates for FA in children and adolescents have been reported in other studies that have used symptom-based surveys like our study.^{20,26-28} In the food allergic subgroup, SPT availability rates varied between 37.2% and 85.5%, which may explain the low SPT positivity in our food allergic population. However, similar low SPT positivity has been found in other studies.⁵

FA prevalence according to our study criteria was in line with other studies and suggests that our symptom-based criteria were reasonably robust. The FA prevalence at 10 years (2.3%) was the same as previously reported in a cross-sectional study in the IOW for 11-year-old children which used DBPCFC.²⁹ The 18-year prevalence of 4% is similar to that shown in previous cross-sectional studies in adult populations, that is 3.2% and 3.6%.³⁰ In a large Swedish birth cohort, the prevalence of FA and food-related symptoms in early childhood was slightly higher (6.8% and 12.2%, respectively) compared to this study where FA in early childhood ranged from 4.4% to 5.3% and reported FA was ~9%.³¹ However, when compared to the Food Allergy and Intolerance Research (FAIR) cohort, which was also recruited on the IOW, but a decade later (born

between 2001 and 2002), the prevalence in our study is slightly higher.^{5,25} The variance may be attributable to the use of DBPCFC in the FAIR cohort. Similarly, Osterballe et al²³ reported a lower prevalence of 2.3% in children under the age of 3 years old when using food challenges. A recent population-based study from Australia, where participants were recruited at a year of age, found an oral challenges defined FA prevalence of 10% in 2848 1-year-olds (egg allergy 8.9%, peanut allergy 3% and sesame allergy 0.8%).³²

There were no significant overall changes during the prevalence of food allergy during the 1-2 year and 2-4 year transition windows; however, there was a significant reduction in FA between 4 and 10 years (5.3%-2.3%) followed by significant increase between 10 and 18 years (2.3%-4.1%). This negative transition at 10 years may represent the gradual acquisition of natural tolerance of childhood FAs by 10 years of age. The subsequent positive transition at 18 years suggests the resurgence of new and possibly persistent forms of FA. These transitions were similar in the stable subgroup ($n = 843$) of the cohort, where FA information was available throughout the 5 points of assessment.

Cow's milk and eggs were the most common allergens at 1, 2, 4 and 10 years, and peanut, tree nuts and shellfish became more prevalent at 18 years. Fruit, kiwi, mushrooms and mustard were generally new allergies at 10 and 18 years.

The rate of cow's milk allergy varied between 1.6% and 3.5% between 1 and 4 years, 0.5% at 10 and 0.3% at 18 years. Other studies have shown a similar milk allergy prevalence of 2%-3% based on OFC/DBPCFC in the first 3 years of life,^{2,21,33,34} although a study by Gerrard et al³⁵ reported a much higher milk allergy prevalence of 7.4% on the basis of OFC. A large cross-sectional survey of 38,380 children³⁶ showed a self-reported milk allergy prevalence of 1.5% between 6 and 10 years, 1.4% between 11 and 13 years, and 1.6% in children over 14 years, which is significantly higher than our study (0.5% at 10 years and 0.3% at 18 years).

Egg allergy rates varied from 1.1% to 1.4% between the ages of 1 and 4 years, similar to that reported by other population studies at

1-3 years (1%-1.6%) using OFC/DBPCFC.^{2,25} Prevalence at 10 years (0.6%) and 18 years (0.3%) was also similar to that reported in the cross-sectional survey by Gupta et al³⁶ for children over 6 years.

Peanut allergy data from this cohort have been published previously.^{7,9,14,24,37} However, using a different case ascertainment criteria in this study (ie not using allergen sensitization as a requirement), peanut allergy was 0.08%-1% between the ages of 1 and 18 years. This is similar to previous reports up to the age of 10 years but higher at 18 years (1% compared to 0.5% reported previously).¹⁴ Other studies have reported a similar prevalence (0.2% to 1.6%).^{23,38,39}

Fish allergy was 0.2% at all ages, while shellfish allergy started to emerge at 10 and 18 years (0.2%). A recent meta-analysis¹ reported an overall prevalence of fish allergy of <0.5% and shellfish allergy between 0.0% and 1.4% (based on symptoms and specific IgE). Our study reports lower rates for shellfish allergy at 10 and 18 years, which probably captures a period of gradual emergence of shellfish allergy in its natural history where it is more often associated with adult FA.

Wheat allergy prevalence in our study varied between 0.1 and 0.5% between 1 and 18 years. Gupta et al³⁶, in their US cross-sectional survey, reported higher prevalence (0.3%-0.7%), with a peak at 11-13 years whereas our study shows the lowest prevalence at 10 years (0.1%). Allergy to fruits varied between 0.3% and 0.9%. Kiwi allergy was mainly reported at 10 and 18 years (0.1%-0.2%). Other studies have reported fruit allergy between 0.1% and 4.3%.⁴⁰ Among miscellaneous food allergy, chocolate was commonly suspected. This may be due to undiagnosed nut allergy or cross-contamination with nuts.

Focusing on sensitization, we showed a rise in overall prevalence, more prominent for food allergen sensitization than for FA. Kulig et al⁴¹ report diminishing sensitization rates to food allergens (from 10% at 1 year to 3% at 6 years), but this study did not look at sensitization rates beyond 6 years. Pereira et al²⁹ reported food allergen sensitization rates of 5.1% and 4.9% in 11- and 15-year-old children in cross-sectional studies conducted on the IOW (independent of the IOW cohort). This is similar to our findings at 10 years (4.5%), but we found a higher prevalence at 18 years (21.4%), which may indicate that the rise in food allergic sensitization occurs in later adolescence.

Wheat, peanut and milk were the most common sensitizing foods. The high rates of wheat sensitization could be due to cross-reactivity with grass pollen, as increasing wheat sensitization (1%, 2.3% and 19.3% at 4, 10 and 18 years) did not mirror our wheat allergy rates (which instead remained static) but did mirror grass pollen sensitization. Using the FAIR cohort, we have recently shown the significance of cross-reactivity between grass and wheat pollen.⁴² Similarly, the increase in peanut sensitization between 10 and 18 years was likely to be due to cross-reactivity between peanut and grass or birch pollen.¹⁴

Our study has a number of strengths. It is the first to investigate the longitudinal trends in prevalence and the dynamics of change in FA and sensitization patterns in childhood and adolescence. The

unselected nature of the cohort, the high retention rate (84%-94.3%) and prospective and repeated collection of food allergy information (5 specific time-points) are strengths of this study.

The study has a few limitations. There was a significant gap in terms of number of years between 4th (10 years) and 5th (18 years) study assessments. However, different individuals progress through puberty at different times, and so by assessing at 10 and 18 years, we have been able to compare the population when most were pre- and post-pubertal. Clinical studies show that milk and egg allergy continue to decline during teenage years with the trajectories following a straight line, and thus, we have likely captured transition changes before and after puberty.^{43,44} A birth cohort study, where participants were assessed during adolescence, shows similar FA prevalence.³¹ The birth cohort was dynamic, and some children did not participate at one time-point, but rejoined at another, which made it somewhat difficult to interpret transitions (emergence of new allergies and the resolution of existing allergies) in the whole population, but this is unavoidable in a study spanning over 18 years. Although lack of oral challenge remains a limitation, we have used previously published robust clinical criteria,¹³ which have provided results comparable to studies using the "gold standard." Although our definition included reactions up to 4 hours after exposure, this is unlikely to have resulted in much misclassification as other adverse reactions to food would have not presented with the IgE-mediated symptoms in our definition. With lack of SPT data on all children at 1 and 2 years and of specific IgE, we were unable to assess the proportion of IgE-mediated allergy in this report or patterns of sensitization in the whole cohort in the first 2 years of life.

In conclusion, our study provides valuable information on the prevalence and longitudinal patterns of FA and food sensitization not only in childhood but also during adolescence. There is little available data on this age group even though the adolescent population are at the highest risk of severe allergic reactions and death as a consequence of FA.⁴⁵ The prevalence of FAs was high in early childhood with a significant decrease in prevalence at 10 years, suggesting resolution of early childhood allergies followed by onset of new food allergies, resulting in higher prevalence at 18 years.

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CONFLICT OF INTEREST

The authors declare no conflict of interests.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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(Supplementary)

Supplementary tables

Table S1: Basic characteristics of the cohort participants at each assessment in male

Variables	Year 1 (n=1268)	Year 2 (n=1159)	Year 4 N=1217)	Year 10 N=1368	Year 18 N=1290
Height (Cm)*	72.4 (0.2)	83.98 (0.4)	104.3 (0.2)	138.9 (0.3)	178.0 (0.3)
Weight (Kg)*	9.3 (0.1)	12.24 (0.2)	17.7 (0.1)	34.0 (0.3)	71.2 (0.6)
Duration of breast feeding (weeks)*	14.5 (0.6)	17.17 (1.4)	-	-	-
Age first formula introduced (weeks)*	10.3 (0.5)	11.02 (0.9)	-	-	-
Age solids introduced (Weeks)*	14.3 (0.2)	-	-	-	-
Maternal smoking\$	277/631 (43.9%)	240/570 (42.1%)	148/620 (23.9%)	185/654 (28.3%)	171/630 (27.1%)
Paternal smoking	-	-	175/620 (28.2%)	164/673 (24.4%)	153/560 (27.3%)
Cat	201/636 (31.6%)	194/574 (33.8%)	233/620 (37.6)	303/695 (43.6%)	250/637 (39.2%)
Dogs	166/636 (26.1%)	157/574 (27.4%)	168/620 (27.1%)	271/695 (39.0%)	307/638 (48.1%)
Asthma	78/644 (12.1%)	76/578 (13.1%)	98/619 (15.8%)	117/694 (16.9%)	97/637 (15.2%)
Eczema	70/644 (10.9%)	57/578 (9.9%)	78/619 (12.6%)	92/685 (13.4%)	52/641 (8.1%)
Rhinitis	75/644 (11.6%)	67/578 (11.6%)	38/619 (6.1%)	106/691 (15.3%)	218/641 (34.0%)

Note: *Mean and standard error of the mean

\$: At 1 and 2 years, maternal and paternal smoking data are not available separately. The question asked “Is the child exposed to cigarette smoke inside the house”, which therefore combined maternal and paternal smoking

Table S2: Basic characteristics of the cohort participants at each assessment in female

Variables	Year 1 (n=1268)	Year 2 (n=1159)	Year 4 N=1217)	Year 10 N=1368	Year 18 N=1290
Height (Cm)*	70.9 (0.2)	82.75 (0.4)	103.4 (0.2)	139.0 (0.3)	164.5 (0.3)
Weight (Kg)*	8.6 (0.1)	11.51 (0.1)	17.03 (0.1)	36.3 (0.4)	64.6 (0.6)
Duration of breast feeding (weeks)*	13.7 (0.6)	14.72 (1.3)	-	-	-
Age first formula introduced (weeks)*	9.5 (0.5)	10.09 (0.9)	-	-	-
Age solids introduced (Weeks)*	14.7 (0.2)	-	-	-	-
Maternal smoking\$	243/616 (39.4%)	230/573 (40.1%)	159/597 (26.6%)	191/653 (29.2%)	176/627 (28.1%)
Paternal smoking	-	-	141/597 (23.6%)	166/659 (25.2%)	160/556 (28.8%)
Cat	179/619 (28.9%)	174/573 (30.4%)	217/597 (36.3%)	306/672 (45.5%)	306/641 (47.7%)
Dogs	157/619 (25.4%)	145/573 (25.3%)	184/597 (30.8%)	264/672 (39.3%)	316/640 (49.4%)
Asthma	41/622 (6.6%)	53/580 (9.1%)	84/594 (14.1%)	82/669 (12.3%)	124/647 (19.2%)
Eczema	51/622 (8.2%)	67/580 (11.6%)	69/594 (11.6%)	94/668 (14.1%)	104/644 (16.1%)
Rhinitis	47/622 (7.6%)	51/580 (8.8%)	27/594 (4.5%)	99/668 (14.8%)	237/646 (36.7%)

Note: *Mean and standard error of the mean

\$: At 1 and 2 years, maternal and paternal smoking data are not available separately. The question asked “Is the child exposed to cigarette smoke inside the house”, which therefore combined maternal and paternal smoking

(Supplementary) Table S3: Fruits causing allergic reactions

Fruits	Year 1 (n=67)	Year 2 (n=61)	Year 4 N=51)	Year 10 N=35	Year 18 N=52
Apple	2	0	1	0	0
Pineapple	0	1	0	0	0
Water melon	0	0	0	0	1
Passion fruit	0	0	0	0	1
Strawberry	5	1	0	1	1
Kiwi	0	0	0	1	2
Banana	1	1	2	0	2
Orange	2	8	6	2	3
Fig	0	0	0	0	1
Total	10 (0.8%)	11 (0.9%)	9 (0.7%)	4 (0.3%)	11 (0.9%)

