Food allergy: Influences of Heredity, Environment and A Maternal Dietary Modification Program on Children's Food Allergy

Case-control studies with questionnaire and clinical records

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Abstract

During the last quarter century, the prevalence of allergic disorders has increased considerably, and Australian children have the fifth highest global rates of atopic disease. To prevent food allergy, the Royal Prince Alfred Hospital Allergy Unit has been advising maternal dietary modifications to prevent their children's allergy. The main objectives of this study were to document the common atopic symptoms and allergy, to assess environmental and hereditary influences on the children's atopic symptoms and allergy and to evaluate the effectiveness of a maternal dietary modification program aimed at modifying risk of siblings of a child with food allergy. 207 questionnaires and 395 clinical records, including the result of skin prick test and dietary advice information, were analysed to ascertain the purposes. Chi-squared tests were used to determine the prevalence of allergy in groups of age, sex, parent's allergic status and maternal dietary status, and a P-value of <0.05 was considered statistically significant. Egg allergy was found to be common in children aged 1 to 3 years, and allergy to peanuts tended to emerge in later life (3 to 5 years of age). Although peanuts allergy has been reported to be persisting, the prevalence was less common the group aged over 15 and adults. The influence of genetics on the children's predisposition to food allergy was only significant for fish allergy. A significant preventive effect was observed in the maternal modification group for peanuts ($p=0.018$) until 16 months although the strategies did not reduce siblings getting other food allergies. This study suggested that the prevalence of peanuts allergy may be increasing, and it is difficult to predict the individual at low or high risk of food allergies by parental allergic status. Although follow up study needs, in order to prevent the upward trend of nuts allergy, all women may need to follow nuts avoidance in late pregnancy and lactation.

Introduction

During the last quarter century, the prevalence of allergic disorders has increased considerably in the developed countries [1, 2]. Australia has the fifth highest global rates of atopic disease in the world [3], and about a third of infants and young children with eczema have been shown food allergies [4]. Atopic disorders cause enormous burden for sufferers and their health care providers [5], in addition allergic particle can cause a severe and potentially life threatening allergic reaction called anaphylactic shock [6, 7]. It is reported that around 1 in 166 school-aged children have an experience of anaphylaxis in Australia [8]. Peanuts allergy was considered one of the most serious and persistent allergen in Western countries [9, 10]. In this regard, the role of primary prevention of allergic diseases is crucial.

There are considerable evidences supporting genetic, environmental, and dietary factors to allergic disorders [11]. A twin study suggested that a genetic influence on peanut allergy; the concordance rate is 64 % in monozygotic twins but only 7% in dizygotic twins [12]. Also, Numerous cohort studies have documented the influence of parental atopy on children's allergy, however a high proportion of infants with obvious atopic diseases had not parental allergic history [13]. In addition, no reliable gene has yet been identified to play a role in pathogenesis for IgE sensitization or specific allergic diseases [14]. At present, although family history of allergy can caution against the children's predisposition to allergy, it is difficult to predict the individual at low or high risk of allergy.

In view of the fact that Australia is surrounded by the sea and most population live in coastal area, allergy to house dust mite shows the strongest association with asthma followed by allergy to furred pets [15]. Also, in Western countries, carpet is common in household, which provides an adequate environment for mould and dust mite [16]. In addition, several studies suggested that a significant association between parental smoking and wheezing and asthma in children [17]. In this respect, in order to assess children's allergy, it is important to consider these environmental factors.

It has been well reported that the prevalence of allergic disease is greater in the industrialized area than in rural community. While non-atopic people show mainly T-helper 1 (Th1) immunity producing interferon γ, which inhibits the growth of Th2 cells, atopic people have T-helper 2 (Th2) immunity characterized by production of interleukin-4 and interleukin-5, which promote IgE production[18]. An Australian study suggested that neonatal Th2 responses were lower in the atopic group than in the non-atopic group, however non-atopic group showed rapid suppression of Th2 responses during the first year, whereas atopic group had the long-term expression of allergen-specific Th2 immunity[18]. A

hygiene hypothesis indicates that exposure to environmental bacteria drive a Th1 mediated response, and may protect against atopic disorders. It seems that the current Western environment and life style may contribute the increasing prevalence of allergic disease[11].

The maternal dietary factors in predisposition of children's food allergy have matter of debate, because routes of occult exposure are not usually obvious [19]. Potential but unproven routes of first exposure include exposure in utero and exposure to allergen from the maternal diet via breast milk during lactation [20]. It was reported that specific IgE to foods and T-cell responses to milk and egg proteins and aeroallergens are seen in the fetus and newborn. Also, milk, egg, and peanut allergen have been detected in nano gram per milliliter concentrations in most samples of breast milk from mother, irrespective of atopic status, within 1 to 6 hours of consuming these foods [20-23]. However, little information is known regarding these threshold doses for specific allergenic foods, and the trial investigating this problem is now undergoing [24]. Also, the methodological shortcomings such as non-randomized trial and the possibility of burdening on maternal health status interrupt the conclusion of effectiveness of an antigen avoidance diet to a high-risk woman during pregnancy and lactation [25-27].

Since 1994, Royal Prince Alfred Hospital (RPAH) Allergy Unit has been advising maternal dietary modifications to prevent their children's allergy. As a guide for dietary avoidance strategies, the older child's allergies were referred. In the second half of the pregnancy and during breastfeeding, the mothers were recommended to avoid bingeing on any food especially nuts, eggs, cheese, chocolate and considerable allergen. In regard to the severeness and persistence, complete peanut and nut avoidance was recommended in most cases. In order to avoid nutritional deficiency and weight gain in mothers and infants and maternal stress, avoidance of trace amounts of egg, milk or other foods were not recommended [28]. Soutter et al. suggested that this avoidance measure could reduce the number of food allergies and severeness in the high risk children, although 44% of children showed one or more positive skin prick test [28]. In this respect, it is important to assess the effectiveness of the maternal dietary avoidance measure aimed at preventing the children's food allergies.

The main objectives of this study were to document the common atopic symptoms and allergy in each age group, to assess environmental and hereditary influences on the children's atopic symptoms and allergy and to evaluate the effectiveness of a maternal dietary modification program aimed at modifying risk of siblings of a child with food allergy. To attain the aims, questionnaire survey and a case control study with clinical records were employed.

Methods

Ethical Approval

The study was approved by the Ethics Review committee of the Central Sydney Area Health Service (CSAHS). An Ethics application was also submitted to the University of Wollongong (Appendix 1). All subjects information was entered into a password protected database with a study identification number. The study was funded by The RPAH Allergy Unit.

Part 1: Questionnaire survey

Subject recruitment and selection

This questionnaire survey was conducted as a part of the study focused on the women's health, allergies, dietary preferences and supplement intake. In order to obtain the data as much as possible for the study, women aged over 18 were recruited on a volunteer basis. The participants comprised (a) patients or patients' families who attended RPAH Allergy Unit from June 2004 to September 2005 (b) nutrition students (Sydney University and Wollongong University) (c) mothers who attended local early child care centers from July 2005 to September 2005, and (d) general public.

The potential subjects were handed a package in order to inviting them to participate in the study including

1. A patient information sheet outlining the aims and procedures of the study. (Appendix 2)
2. A food frequency questionnaire booklet (Women's health, allergies, dietary preferences and supplement intake). (Appendix 3)
3. A reply paid envelope for return of the questionnaire if they decided to participate.

From June 2004 to September 2005, 1290 questionnaires had been handed out, and by September 2005, 207 questionnaires (16%) had been completed. The data of 323 children, 204 women (3 out of 207 was uncompleted) and 158 men were included in this study to document the common allergen. To assess the hereditary influence on children's allergy, the data of 150 parents and 286 children who were reported the allergic status were included in this study

The Questionnaire booklet

The standardized questionnaire was developed in order to investigate the women's health, allergies, dietary preferences and supplement intake in Australia by RPAH Allergy Unit in 2004. (See Appendix 3) In this study, the validated questionnaire was utilized to ascertain the women, their husband, and their children's allergic status and environmental factors that might have contributed to the development of their children's food allergy.

Procedure

Data collection

The data was entered into the RPAH Patient Database 2004 (Microsoft Access 2002) that was password protected; Microsoft SQL Analyser 2000 and Excel 2002 were used to organize the data for analysis.

To document the evolution of common allergy, the subjects were divided into 7 groups:

1. Less than 1 years old
2. 1 to 2.9 years old
3. 3 to 4.9 yeas old
4. 5 to 8.9 years old
5. 9 to 14.9 years old
6. More than 15 years old of children
7. Parents

Then, the prevalence of atopic symptoms and food allergies in children and the prevalence of food allergies and airborne allergies in adults were documented.

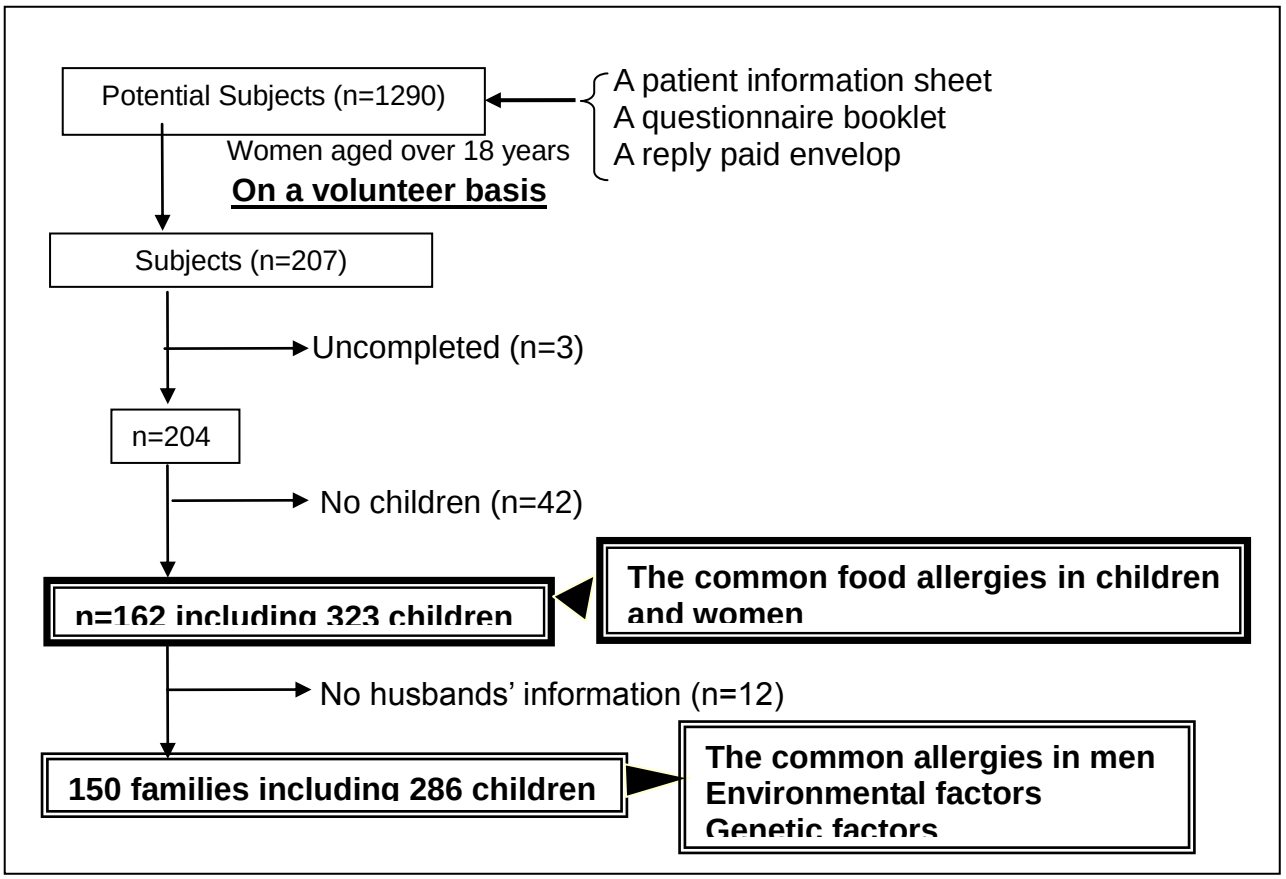
The differences of environmental aspects such as use of dust mite cover, avoidance of carpet, parental smoking status and the presence of food allergen (nuts and fish) in household were compared between families with allergic children and without allergic children.

In order to analyse the genetic influence of allergic disease, the parents were divided into following 4 groups for reported non-specific allergy (airborne or food allergies)

1. Both parents with allergy
2. Only mother with allergy
3. Only father with allergy
4. Parents without allergy.

Then, the differences in children's atopic symptoms and food allergic status between the groups were compared.

Figure 1: Diagram of Study Methodology (Part 1)



Part 2: Case-control study with clinical record.

Sample size calculations

The sample size was calculated with the aim of being able to demonstrate that the prevalence of the outcome is 60 % in the lower in the intervention group, which is it will be reduced from 50 % to 20 % about main allergy (egg, milk, peanut, and other nuts.) according to the previous study by Dr Soutter. [28] For a power of 80% and a significance level of 0.05, a minimum number of 20 children will be needed in each group. However, in regard to the various recommendation depended on the older siblings' allergy or maternal preference, the information were collected as much as possible during the study period.

Subjects

To assess the effectiveness of maternal avoidance measure to prevent the children's allergy, 162 clinical records (395 children) were included in this study. The criteria were:

- •Family records including one of siblings with a food allergy at least.
- •Family records including all the siblings' Skin Prick Test (SPT) results.
- •Children aged 0 to 18 years old.
- •Children who was breast fed
- •Only child in a family was excluded.

The subjects were selected from a total cohort of 2114 patients with eczema and possible food related symptoms who were seen by Dr. Velencia Soutter (Paediatrician) Allergy Consulting Rooms, Royal Prince Alfred Hospital (RPAH) from 1992 to 2005. To avoid a selected bias, the subjects were selected alphabetically with their last name, and the subjects who had the last name of A to F were included in this study. 77 of 395 subjects were employed some maternal avoidance measures.

Skin prick tests (SPTs)

Positive results were taken as a weal of 3 mm or greater in the presence of a positive response to 1% histamine of 3 mm or greater and no response to the negative control (0.9% saline) after 10-15 minutes. The results of egg, milk, peanuts, other nuts, and fish allergy were included in this study.

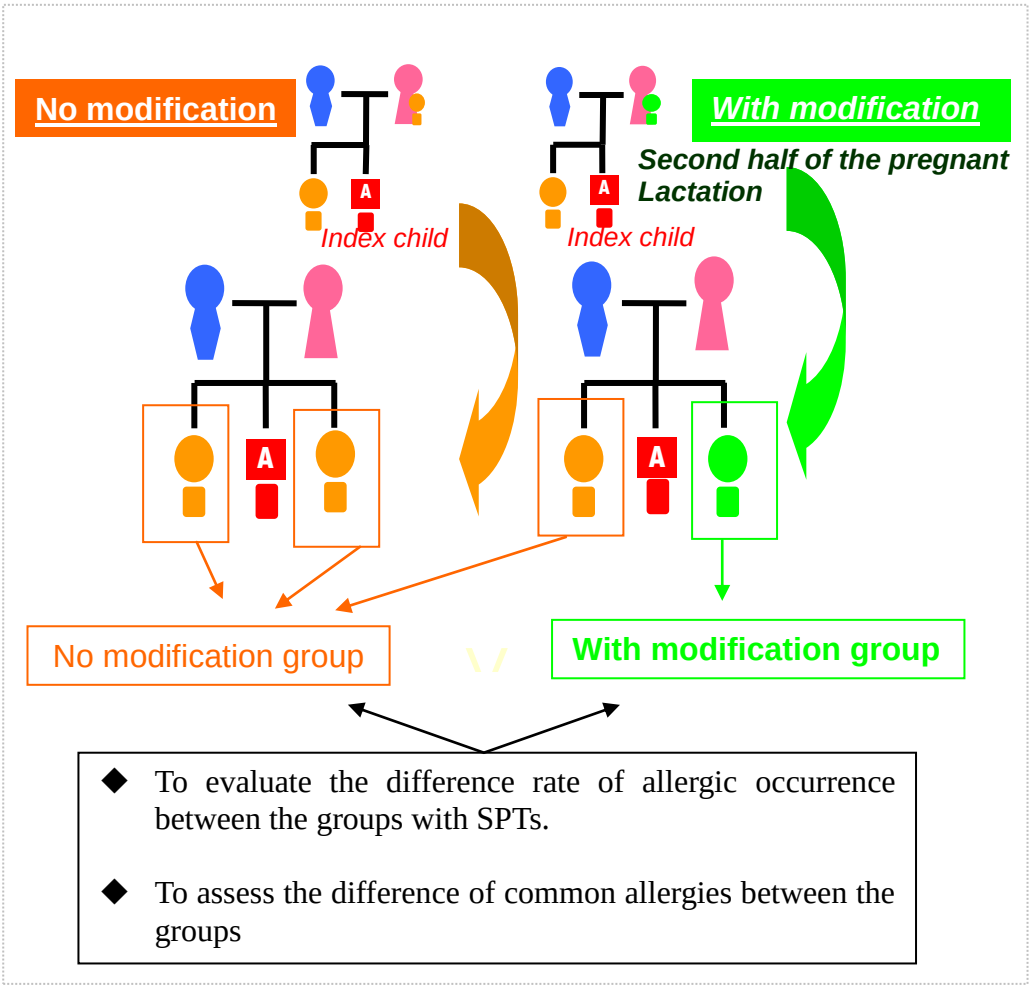
The information about avoidance strategies was obtained from the case history and dietetic notes of children in the clinical records.

Procedure

Data collection

The data was entered into Excel 2002 to organize the data for analysis. For the purpose of this study children with a allergic siblings were divided into a group with the maternal avoidance strategies and a group without them, then evaluated their allergy occurrence with SPTs. Also, the differences of common allergen between the groups were analysed.

Figure 2: Diagram of Study Methodology (Part 2)



Statistical Analysis

Comparisons of the background factors between the groups were performed with the chi-squared test when the variables were categorical (sex and recruitment places). Prior to statistical analysis the data of age was examined for normality using the Shapiro-Wilk test, and with the Kruskal-Wallins and Mann-Whitney tests were used when the variables were not normally distributed. Environmental factors and prevalence of allergies in different groups were analysed by the chi-squared test for age, sex, the parents' allergic status maternal avoidance strategies. Statistical analyses were done using the SPSS software package (version 10 for Windows, Chicago, IL, USA) and a P-value of <0.05 was considered statistically significant

Results

Part 1-A (1): The common atopic symptoms and food allergens in children and adults

Children

Table 1: Backgrounds of the groups (children)

Group	Age category	N	Boy/Girl	Allergy unit:Others	Mean age ±SD
A	n<1	33	13/20*	29 : 4	0.66 ± 0.22
B	1≤n<3	69	44/25*	66 : 3	1.68 ± 0.51
C	3≤n<5	68	36/32	68 : 0	3.49 ± 0.54
D	5≤n<9	67	40/27*	66 : 1	6.30 ± 1.20
E	9≤n<15	43	21/22	42 : 1	10.63 ± 1.46
F	15≤n	43	17/26*	35 : 8	26.47 ± 6.79
	Total	323	171/152	306 : 17	7.4 ± 8.5

Chi-squared test * A vs B p=0.02, B vs F p=0.012,and D vs F p=0.039

Figure 3: The reported rates of atopic symptoms in children

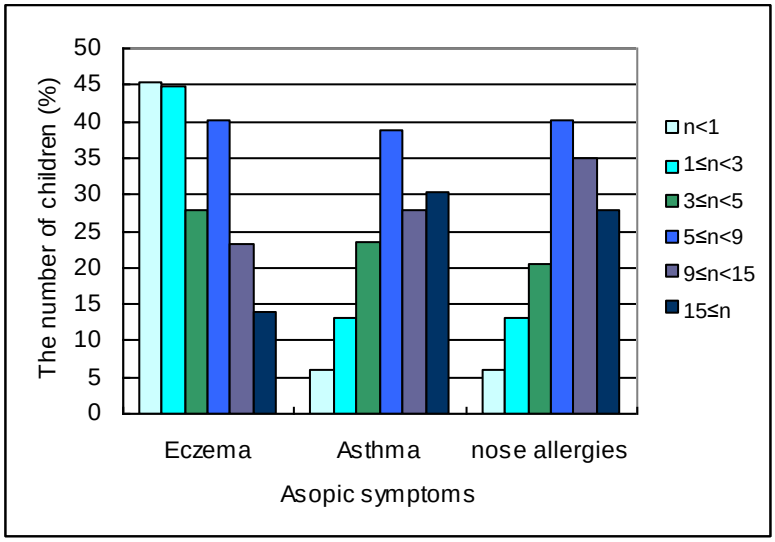
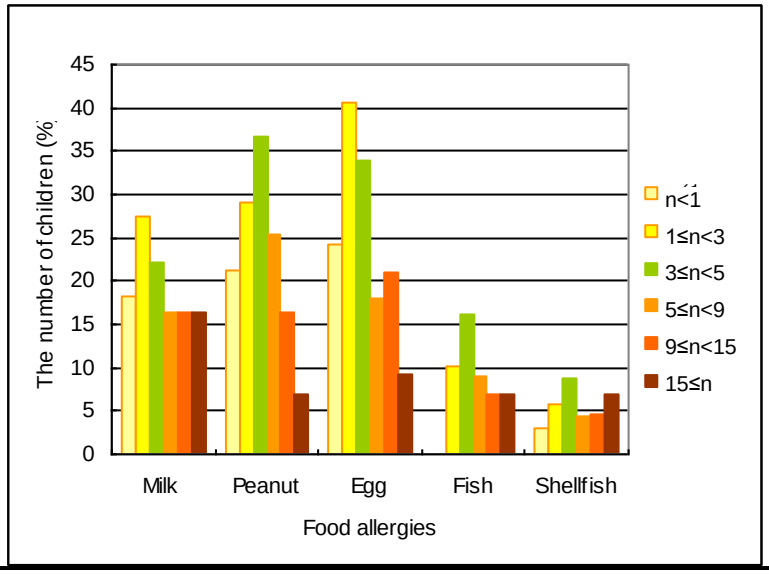


Figure 4: The reported rates of food allergies in children



In the total sample population of 323 children from the questionnaires, the majority of subjects were recruited from the Allergy Units. There were significant differences between the groups in distributions of sex (Table 1), however there were no significant differences in the prevalence of allergic symptoms and food allergies in children between genders (Appendix 4).

The prevalence of eczema was reported by younger age group (0 to 3 years old) than asthma and nose allergies. Comparing to eczema, asthma and nose allergies tended to be persistent later life (Figure 3).

The common food allergies in children were egg, peanut, and milk allergy. Egg and milk allergy were common among the children aged 1 to 3 years old, while peanut, fish and shell fish allergy tended to be common among the children aged 3 to 5 years (Figure 4). In this study, peanut and egg allergy were not very prevalent in the group aged over 15 years. There were no significant differences in the food allergy prevalence between the recruitment places in the group aged over 15.

Adults

Figure 5: The reported rates of allergies in adults

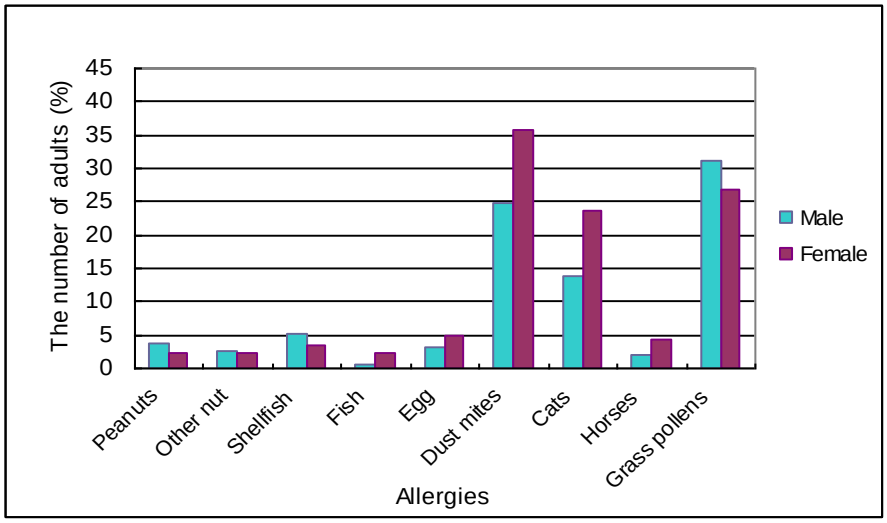


Table 2: Backgrounds of the adults

	n	Allergy unit:others	Mean age ±SD
Male	158	149:9	Unknown
Female	204	179:25	36.7 ±8.43
Total	362	328:34	-

Although the women filled in the questionnaires, there were no significant differences in the reported allergies between genders. Food allergies were not very common in adults (less than 5 %), while airborne allergies were prevalent (Figure 5).

Part 1-A (2): The environmental aspects relating to the allergic status of children

The adoption of avoidance measures to prevent airborne allergies in children

Table 3: Reported rates of environmental status in children. Values are numbers (percentages).

	Allergic status	N	Use of dust mite covers	Sleeping on lower level of a bunkbed	Bathroom directly off bed room	Damp smell or mould in the bed room	Carpet in the bed room	Visits a house with carpet	Avoid carpet	Visits a house with cat
Allergic symptoms in children	-	155	36 (23.2)	9 (5.8)	17 (11.0)	6 (3.9)	94 (60.6)	106 (68.4)	27 (17.4)	93 (60.0)
	+	168	80 (47.6)***	6 (3.6)	41 (24.4)**	16 (9.5)*	93 (55.4)	123 (73.2)	31 (18.5)	108 (64.3)
Food Allergies in children	-	180	48 (26.7)	9 (5.0)	30 (16.7)	14 (7.8)	108 (60.0)	129 (71.7)	26 (14.4)	119 (66.0)
	+	143	68 (47.6)***	6 (4.2)	28 (19.6)	8 (5.6)	79 (55.2)	100 (69.9)	32 (22.4)	82 (57.3)

Chi-squared test * p=0.044 **p=0.002 ***p=0.0001

To improve the children's allergic symptoms, the use of dust mite covers and the off location of bedroom from bath room were significantly observed in the group with allergic symptoms than the group without symptoms ($p<0.0001$ and $p=0.002$). Also, the children with food allergies used dust mite covers than the group without any food allergies ($p=0.044$). However, the presences of damp smell or mould in the bedroom were reported in the group with allergic symptoms more frequently, and the access to carpet and cat were not significantly different between the groups (Table 3).

Smoking status in house-hold

Figure 6: The influence of children's allergic status on the reported rates of smoking in household

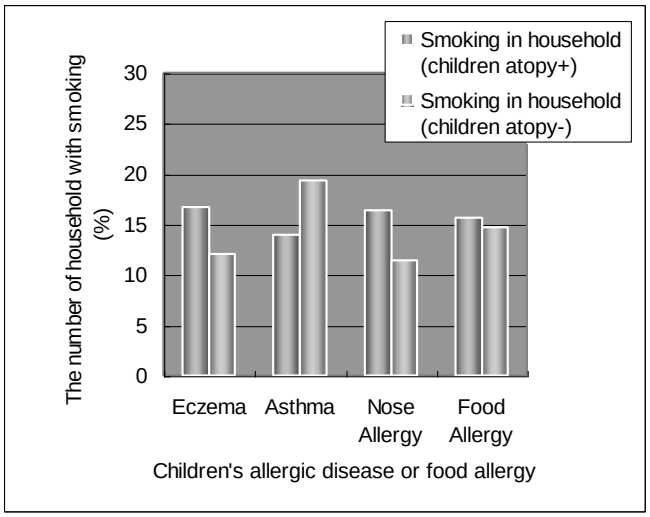
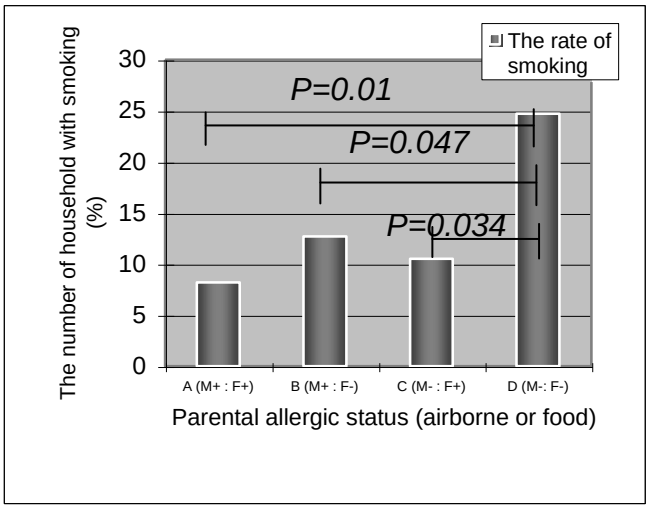


Figure 7: The influence of parental allergic status on the reported rates of smoking in household



In this study group, the children's allergic disease or food allergy did not affect the smoking status in household (Figure 6); although the reported rate was lower than the average smoking rate in National Health Survey 2001 (24%). On the other hand, parental allergic status significantly influenced the reported rates of smoking in household (A vs D p= 0.01, B vs D p=0.047, and C vs D p=0.034) (Figure 7).

The reported presence of allergen (nuts and fish) in household

Figure 8: The influence of children's allergic status on the presence of nuts in household. (The number in the graph is the reported number)

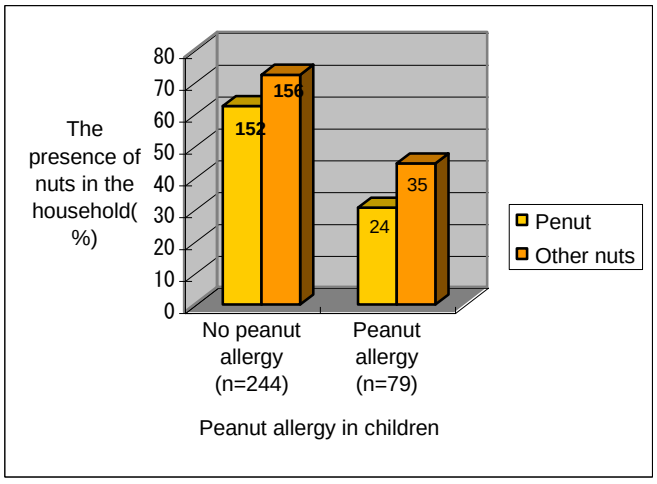
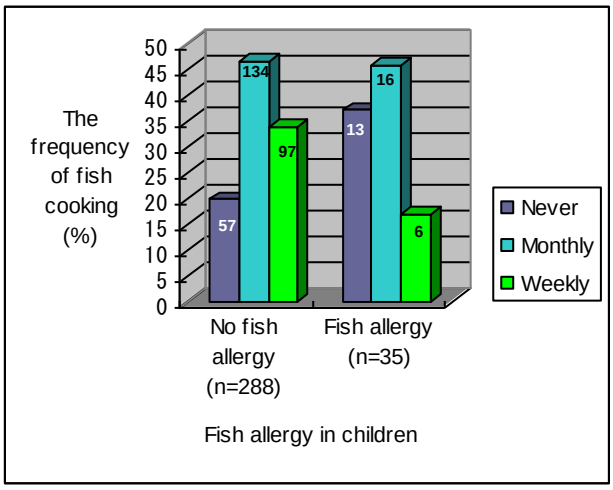


Figure 9: The influence of children's allergic status on the frequency of fish cooking. (The number in the graph is the reported number)



Although the family with allergic children for nuts or fish tended to avoid the allergen more significantly than the family without children's allergy (peanuts and other nuts p<0.0001, fish p=0.03), the number of families with the allergies still had the allergen in their household (Figure 8, 9).

Part 1-B: The hereditary influences on the atopic symptoms and food allergies in children

Table 4: The background of children with their parental non-specific allergies (airborne or food) status

Group	Parental allergy	Smoking in household	N of family (Total 150)	N of children (Total 286)	Average age (years) ± SD	Boy / Girl
A	M+,F+	5 (5.2%)*	31	61	5.3 ± 5.3	34 / 27
B	M+,F-	10 (12.7%)*	42	79	7.8 ± 8.6	38 / 41
C	M-,F+	6 (10.5%)*	31	57	5.1 ± 4.5	30 / 27
D	M-,F-	22 (24.7%)*	46	89	6.8 ± 8.9	53 / 36
p-value		A vs D p=0.01 B vs D p=0.047 C vs D p=0.034				

Chi-squared test *p<0.05

Table 5 : Reported rates of allergic symptoms and food allergies in children with **parental non-specific allergy (airbone or food)**. Values are numbers (percentages) of individuals with allergy

Group	Parental allergy	The allergic symptoms in children					The food allergies in children				
		Eczema at present	Eczema in first year	Eczema after solids	Asthma	Nose allergies	Milk	Peanut	Egg	Fish	Shellfish
A	M+,F+	25 (41.0)	34 (55.7)*	34 (55.7)#	16 (26.2)	23 (37.7)*	16 (26.2)	21 (34.4)	22 (36.1)	10 (16.4)*	6 (9.8)
B	M+,F-	29 (36.7)	34 (43.0)	30 (38.0)	18 (22.8)	18 (22.8)	16 (20.3)	16 (20.3)	16 (20.3)	6 (7.6)	4 (5.1)
C	M-,F+	23 (40.4)	29 (50.9)*	22 (38.6)	21 (36.8)*	16 (28.1)	15 (26.3)	17 (29.8)	20 (35.1)	7 (12.3)	2 (3.5)
D	M-,F-	24 (27.0)	29 (32.6)*	22 (24.7)#	13 (14.6)*	14 (15.7)*	14 (15.7)	20 (22.5)	22 (24.7)	5 (5.6)*	3 (3.4)
p-value			AvsD p=0.005 CvsD p=0.028	AvsD p<0.0001	CvsD p=0.002	AvsD p=0.002				AvsD p=0.031	

Chi-squared test * p<0.05 # p<0.0001

There were no significant differences in the distribution of age and gender among the groups. Although the significant differences in the smoking status in the household were observed (Figure 5, Table 4), the less reports of smoking there were, the stronger hereditary factors for allergies the parents had. The parental allergic status affected on the atopic symptoms in their children, however the influence of genetics on the children's predisposition to food allergy was only significant for fish allergy in this study (p=0.031).

Part 2: The effectiveness of maternal avoidance measure aimed at preventing the allergy of children who had allergic siblings

237 children who had a food allergic sibling were included in this study. The significant effect of maternal avoidance on the children's peanuts allergy was observed (p=0.018). However, the rates of any food allergy were mostly same between the groups (28% for the group with no measures and 29.9 % for the group with the maternal avoidance measures) (Table 6).

Table 6: The effectiveness of a maternal avoidance measures aimed at preventing the allergy of children who had allergic siblings

		Egg	Milk	Peanut	Other nuts	Fish	Any food allergy
No measures	N (Boy : Girl)	199 (100 : 99)	217 (108 : 109)	168 (84 : 84)	169 (85 : 84)	227 (111 : 116)	160 (79 : 81)
	Mean age (Years) ± SD	3.9 ± 3.4	3.7 ± 3.3	4.4 ± 3.5	4.4 ± 3.5	3.7 ± 3.3	4.0 ± 3.5
	The number of children with food allergies	40 (20.1%)	12 (5.5 %)	33 (19.6 %)*	28 (16.6 %)	11 (4.8 %)	45 (28%)
With maternal modified measures	N (Boy : Girl)	38 (15 : 23)	20 (7 : 13)	69 (31 : 38)	68 (30 : 38)	10 (4 : 6)	77 (36 : 41)
	Mean age (Years) ±SD	2.0 ± 1.7$	1.8 ± 1.9$	1.6 ± 1.4$	1.6 ± 1.4$	1.3 ± 0.7$	1.6 ± 1.4$
	The number of children with food allergies	8 (21.1%)	0%	5 (7.2 %)*	5 (7.4 %)	0%	23 (29.9%)

Chi Square analysis, * p=0.018
Mann-Whiney test $ p<0.0001

In the 68 children with food allergies, peanut and other nuts allergies were significantly less common in the modified group (p=0.012 and p=0.041), while egg allergy was more prevalent in this group, although the difference was not significant (Table 7). Also, the modification strategies contributed to reduce the number of food allergies in this group (p=0.041).

Table 7: The differences in the prevalence of food allergies between the children with a food allergic sibling with maternal modification measures and the group without the measures. All subjects had at least one food allergy.

	N (Boys and Girls)	age	the average of n of allergies	Egg	Milk	Peanut	Other nuts	Fish
The children with any food allergy without modified measures	45 (27 : 18)	3.7 ± 3.1$	3.0 ± 2.0$$	29 (64.4%)	9 (20.0%)	30 (67.0%)*	27 (60.0%)**	9 (20.0%)
The children with any food allergy with modified measures	23 (14 : 9)	1.7 ± 1.9$	2.0 ± 1.5$$	19 (82.6%)	2 (8.7%)	8 (34.8%) *	6 (26.1%)**	2 (8.7%)

Mann-Whitney tests $ p=0.003, $$ p=0.041

Chi-squared test * p=0.012, ** p=0.008

Including the index siblings with food allergy, 226 of 395 children had any food allergy. In this subjects group, the trend of the prevalence of food allergy was same as the data of the children who have a sibling with food allergy (Table 7, 8, and 9). The analysis showed peanut allergy was significantly less common in the modified group (p=0.007), while egg allergy was more prevalent in this group (p=0.035) (Table 8). To reduce the differences of age between the groups, the data was reviewed to focus on the children aged 0 to 5 years old (n=178). Among the children with food allergy aged 0-5, the peanut allergy was also significantly less common in the children with maternal avoidance strategies (Table 9).

Table 8: The differences in the common food allergies between the group with maternal modification measures and the group without the measures. All subjects aged 0 to 18 years had more than one food allergies.

	N (Boys and Girls)	Age	The average of n of allergies	Egg	Milk	Peanut	Other nuts	Fish
The children with any food allergy without modified measures	203 (119 : 84)	5.0 ± 3.1$	2.6 ± 1.9	122 (60.1%)*	42 (20.7%)	129 (63.5%)**	94 (46.3%)	32 (15.8%)
The children with any food allergy with modified measures	23 (14 : 9)	1.7 ± 1.9$	2.0 ± 1.5	19 (82.6%)*	2 (8.7%)	8 (34.8%) **	6 (26.1%)	2 (8.7%)

Mann-Whitney tests $ p<0.0001

Chi-squared test * p=0.035, ** p=0.007

Table 9: The differences in the common food allergies between the group with maternal modification measures and the group without the measures. All subjects aged 0 to 5 years had more than one food allergies.

	N (Boys and Girls)	Age	The average of n of allergies	Egg	Milk	Peanut	Other nuts	Fish
The children with any food allergy without modified measures	156 (90 : 66)	2.7 ± 1.3$	2.5 ± 1.7	104 (67.0%)	36 (23.1%)	99 (63.5%)**	61 (39.1%)	20 (12.8%)
The children with any food allergy with modified measures	22 (13 : 9)	1.7 ± 1.3$	2.0 ± 1.4	18 (81.8%)	3 (13.6%)	7 (31.8%) **	5 (22.7%)	2 (9.1%)

Mann-Whitney tests $ p<0.001

Chi-squared test ** p=0.005

Discussion

The results of this study indicate that the maternal dietary avoidance strategies to prevent the children's food allergies may reduce the children's nuts allergy, although the strategies did not reduce siblings getting other food allergies. In this study, there was a still significant difference in age between the group with the avoidance measure (1.7 ± 1.3) and the group without it (2.7 ± 1.3) after focusing on the children aged between 0 and 5 (Table 9). However, it was reported that the average age of onset of peanut allergy is 1.8 years old, with approximately 75% of children experiencing a reaction with their first known peanut exposure[29, 30]. Milk or egg allergy will generally resolve in the first 4 to 5 years of life, while as numerous studies have suggested, peanuts and nut allergy are rarely out grown, and can cause life-threatening reaction [6, 31]. In addition, comparing to milk or egg allergy, peanut is not an essential food, its avoidance will not affect the maternal and the children's health status [27]. In this regard, the strategy may be regarded as an effective measure in terms of focusing on nuts allergy, although follow up to confirm the effectiveness of avoidance needs.

While a number of clinical studies suggested that peanuts allergies tend to persist in later life, in this study, peanuts allergy was less common in the group aged over 15 as well as the adults. In this respect, the prevalence of peanuts allergy may have increased over the 15 years, although follow up study to understand the change of prevalence of the food allergies needs next 10 to 30 years. A study published in 1996 indicated that peanut allergy was reported increasingly by successive generations, and more common in siblings of people with peanut allergy than in the parents or the general population in United Kingdom [30]. The same upward trend may occur in Australia. In addition, as previous studies suggested, a number of allergic children without parental allergies were observed in this study. It is practical to refer the sibling's food allergies rather than the parental allergies. Also, this study indicated that all women might need to follow the nuts avoidance strategy to prevent the upward trend of nuts allergy.

Although the RPAH Allergy Unit has recommended environmental avoidance measures to reduce the children's symptoms, this study showed carpet avoidance was difficult in the study group. Also, most subjects lived in Sydney area where is coastal area, so it is important to control the humidity. Regular steam cleaning, laying carpets out in the sun can reduce the problems. Dust mite covers and selection the off bedroom from bathroom were commonly adopted. These practical alternative strategies can be recommended continuously at the Allergy Unit.

In this study, although the parents knew their children's allergies, life threatening allergen still existed in households. Patients allergic to peanuts were also risk of developing allergy to tree nuts, and it is unpredictable when the severe shock will occur [6]. Consumption of peanut can lead to peanut allergens on parents' body or clothing, providing unknowingly an exposure of their infants to peanut product [27]. In addition, there is a problem about peanuts allergies in school canteen. In 2005, The State Government has advised 2200 public schools to avoid the use of any peanuts products to reduce the risk of fatal anaphylaxis [32]. The education program for families and schools is essential.

Limitations, Future Research

In the questionnaire survey, the response rate was low (16%), so only highly motivated subjects might participate in this study. In addition, the allergic status was self-reported, so subject bias might occur. It is important to consider the recruitment or follow up method, for example follow up by telephone. This study is a part of ongoing research, so future study will be able to detect the prevalence of food allergies, genetic factors, and environmental factors more accurately.

In the case control study with the clinical records, the environmental factors were not included in this study. The use of dust mite covers, or changing their smoking status might influence the children's allergies. Also, the maternal compliance was self-reported. In the RPAH Allergy Unit, the women's food frequency questionnaires have been collecting as a part of their clinical record, and the questionnaires can collect the data their pregnant or lactating status, their allergen avoidant status (food and airborne), and their dietary status. This large-scale survey will enable to confirm the effectiveness of the maternal dietary avoidance measure to prevent the children's food allergies.

Conclusion

The common food allergy in children and adults, environmental factors, genetic factors, and the effectiveness of maternal dietary avoidance measure to prevent the children's allergy has been described. In terms of the upward trend of peanuts allergy and the difficulty in predicting a individual at low or high risk of food allergies, all women may need to follow nuts avoidance in late pregnancy and lactation in order to prevent the upward trend of nuts allergy. Follow up study to confirm the effectiveness and understand the change of prevalence of food allergies needs next 10 – 30 years.

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Appendix 4; Reported rates of food allergies in children for genders

			Atopic symptoms				
	N	Mean age ± SD	Eczema	Eczema at first year	Eczema after solid	Asthma	Nose allergies
Boy	171	6.6 ± 7.6	61 (35.7%)	79 (46.2%)	70 (40.9%)	43 (25.1%)	41 (24.0%)
Girl	152	8.2 ± 9.3	47 (30.9%)	64 (42.1%)	53 (34.9%)	35 (23.0%)	38 (25.0%)
			Food Allergies				
	N	Mean age ± SD	Milk	Peanut	Egg	Fish	Shell fish
Boy	171	6.6 ± 7.6	40 (23.4%)	42 (24.6%)	46 (26.9%)	14 (8.2%)	7(4.1%)
Girl	152	8.2 ± 9.3	25 (16.4%)	37 (24.3%)	38 (25.0%)	16 (10.5%)	12 (7.9%)