



Research Article

A Study on Maternal Diet and Prospective Allergenic Solid Food Introduction among Chinese Infants Surveyed in a Private Hospital in Hong Kong

Chan JKC^{1*}, Lee TH¹, Chan WM¹, Chow WS², Luk WP³, Fung LH³, Kwok C⁴ and Chi SF¹

¹Allergy Centre, Hong Kong Sanatorium & Hospital, Hong Kong

²Hospitals Administration Department, Hong Kong Sanatorium & Hospital, Hong Kong

³Medical Physics & Research Department, Hong Kong Sanatorium & Hospital, Hong Kong

⁴Corporate Affairs Department, Hong Kong Sanatorium & Hospital, Hong Kong

Abstract

Introduction: Delayed introduction of solids in infants could be partly responsible for an increase in food allergies. While new guidelines on infant feeding recommend earlier introduction of solid food, our clinical experience suggests that many parents still believe they should delay feeding of solids, especially common allergens. The present study investigated maternal dietary avoidance; breast, formula and complementary feeding histories and intentions; and dietary allergen introduction in infants of Chinese parents in a private hospital in Hong Kong.

***Corresponding author:** Chan JKC, Allergy Centre, Hong Kong Sanatorium & Hospital, Hong Kong, Tel: +852 28358430; Fax: +852 28987565; Email: June.kc.chan@hksh.com

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Methods: Self-administered questionnaires about dietary habits in pregnancy and infant feeding intentions were distributed to pregnant Chinese women or their husbands; or parents of Chinese infants from 1 to 3 days old. Data were summarized with descriptive statistics and analyzed by Fisher's exact test and linear-by-linear association test.

Results: Maternal dietary restriction during pregnancy was common. Less than 10% of participants reported planning to breastfeed exclusively up to 6 months. Most parents planned to introduce solids when infants were older than 6 months, and even older than 9 months for common dietary allergens. Parents with allergic diseases planned to introduce shellfish and egg white later in their infants as compared to non-allergic parents, and fewer parents (5.2% vs. 11.6%, $P=0.03$) planned to introduce all allergenic foods by 12 months.

Conclusion: Planning for exclusive breastfeeding up to 6 months is uncommon in our study population. Complementary feeding of solids is often delayed, especially when there is a family history of allergy. Parents can be benefit from further guidance.

Keywords: Allergy; Feeding; Food; Infant; Prevention

Introduction

The prevalence of food allergies has increased in Hong Kong, with a prevalence of doctor-diagnosed adverse food reactions of around 4.8% [1]. The most commonly reported food allergens are shrimp, egg, milk and peanuts. The recent increase in prevalence of food allergies may have been linked to the delayed introduction of potent food allergens [2,3].

In the 1960's solid food was usually started before 4 months of age but guidelines recommended delaying the introduction of solid food [4] and since 1990s recommended exclusive breast feeding until infants were at 6 months of age [5-7].

The Department of Health in Hong Kong (DHHK) recommends exclusive breastfeeding until around 6 months of age and then continuing breast milk until 2 years of age and beyond while introducing solid food and other milk alternatives [8]. The DHHK does not recommend eating any solid food before 4 months [9]. The latest breastfeeding survey shows that 27.9% of infants were breastfed without any infant formula supplementation; 27.0% had been started on complementary foods by 6 months of age, and 0.9% were exclusively breastfed according to the World Health Organization's definition of exclusive breastfeeding [10,11].

Earlier guidelines had recommended avoidance of food allergens in high-risk infants to prevent food allergies but there is a lack of evidence to support this advice [12]. To the contrary, delayed allergenic food introduction may actually increase the risk of food allergy and eczema [2,13]. Recent research continues to support early introduction of allergenic foods to prevent allergy [3,14-18] and many guidelines have been updated [5,6,19,20].

However, many parents in Hong Kong still believe that they should delay the introduction of allergenic food and even health professionals often continue to provide such advice. There is very limited data on infant feeding practices to inform local strategies for early introduction of allergenic solid food. Therefore, we have conducted a survey in a group of Chinese parents attending a private hospital in Hong Kong on their maternal and child's dietary intentions for the time of introduction of solid food and allergenic food. Differences in behavior between parents and children with different allergic histories have also been analyzed.

Methods

Chinese pregnant women or their husbands, or Chinese parents of infants from 1 to 3 days old were included for the present survey. Questionnaires about infant feeding practices were distributed in November and December 2016 to eligible subjects attending the Allergy Centre; Dietetic Unit; Obstetrics and Gynecology (O&G) Centre; and maternity wards of the Hong Kong Sanatorium & Hospital. Subjects were invited to complete the self-administered questionnaires, and were asked to return them to our staff afterwards (Figures 1A & 1B). The questionnaires were available in both English and Chinese languages.


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Infant Feeding Questionnaire (Prospective)

Research indicates that if one of the parents has any allergic diseases, the child's allergic risk will be increased by half; if both parents have any allergic disease, the risk is even greater. Parents can help to prevent the risk of food allergies of their child by controlling their diet. The HKSH has been involved in public health education, and we are inviting you to participate in this survey to let us better understand the relationship in infant feeding practices and allergy, and to further educate the public.

Please take a few minutes to fill out the questionnaire. Related information is only used for research purposes. Thank you!

Part 1: Background Information

- How many weeks are you/ your spouse into the pregnancy?
 Less than 12 weeks 12-24 weeks 25-36 weeks More than 36 weeks
- Is this child your first child?
 Yes (Please go to Question 4) No (This child is my ___ child)
- How many children do you have?
 2 3 4 or above
- Are you the father or mother of your child?
 Father Mother
- Do you have any allergic condition?
 Yes No (Please go to Question 7)
- Which allergic condition(s) do you have? (can check more than one box)
 Asthma Eczema Allergic Rhinitis Urticaria (Hives)
 Food Allergies (Please specify: _____)
 Others (Please specify: _____)
- Does your spouse have any allergic condition?
 Yes No (Please go to Question 9)
- Which allergic condition(s) does your spouse have? (can check more than one box)
 Asthma Eczema Allergic Rhinitis Urticaria (Hives)
 Food Allergies (Please specify: _____)
 Others (Please specify: _____)

PART 2: Maternal Diet

- Did mother of the child purposely avoid any foods during pregnancy?
 No Yes, because mom has food allergy Yes, but it is not related to food allergy
(If yes, please specify the food: _____)
- Where did you get your information on maternal diet during pregnancy from? (Can check more than one box)
 Relatives Friends Newspaper/ Magazines Internet/ Social Media Medical professionals
 Others (Please specify: _____)

(For O&G/ Dietetic) Continued on page 2

Figure 1A: Questionnaire.



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Part 3: Breast Feeding and Formula Feeding

11. Predicting the breastfeeding and/ or formula feeding pattern for your child?
 Exclusively breast fed Exclusively milk formula fed
 Only breast fed in the beginning, then changed to milk formula later
 Only breast fed in the beginning, then feeding both breast milk and milk formula, at last changed entirely to milk formula at the end
 Feeding both breast milk and formula from birth
 Not decided yet Others (Please specify: _____)

12. At what age do you expect your children last breast feed?
 0-3 months old 3-6 months old 6-9 months old 9-12 months old
 12 months or older
 Not consider breastfeeding Not decide yet

13. At what age do you expect your child first feed with a milk formula?
 0-3 months old 3-6 months old 6-9 months old 9-12 months old
 12 months or older
 Not consider formula feeding Not decided yet

Part 4: Solid Feeding

14. At what age do you expect your child first introduce to solid foods?
 0-3 months old 3-6 months old 6-9 months old 9-12 months old 12 months or older
 Not decided yet

15. What solid food do you expect will be first introduce to your child? (can check more than one box)
 Rice cereals Vegetables Fruits Egg Soy Nuts Wheat (bread, pasta)
 Shellfish Fish Others (Please specify): _____ Not decided yet

16. Is there any hardship or problems you expect for the mother during weaning? (can check more than one box)
 Busy work schedule Child was refusing solid foods The mother's concerns of the child having allergic reactions
 Relatives' opinions on child's feeding
 None at all Others (Please specify: _____)

Part 5: Introduction of Potent Foods

17. Please check the age range that your child was introduced to each potent foods:

	0-3 months old	3-6 months old	6-9 months old	9-12 months old	12 months or older	還未決定
Egg Yolk						
Egg White						
Soy (tofu, soy milk)						
Wheat (bread, pasta)						
Shellfish						
Fish						
Nuts						
Dairy (yogurt, cheese)						

Part 6: Food Allergies Prevention

18. Studies have shown, early introduction of solid allergenic food to infants at 4 months of age can help reduce the risk of developing food allergies in the future. Will you let your children to join our Allergy Prevention program?
 Yes, reason: _____
 No, reason: _____

~ Thank you very much! Please return your questionnaire to Allergy Centre/ Obstetrics & Gynaecology Centre/ Dietetic Unit ~

For official use

Figure 1B: Questionnaire.

Statistics

The estimated total number of O & G and maternity patients who came to the hospital for prenatal consultation during the study period was approximately 2400, and we assumed that 70% parents would plan to finish introducing all 8 allergenic foods after 12 months. The sample size required to determine the proportion of parents who planned to introduce all 8 allergenic foods after 12 months, with 95% confidence level and 5% absolute precision, was estimated to be at least 284. Descriptive statistics were used to summarize the data. Missing data were excluded from analysis for each question. Fisher's exact test was adopted to examine the association between groups. Linear-by-Linear Association test was also conducted to investigate

time trend among different groups. Statistical analysis was performed by R Statistical Software version 3.3.2.

Ethics

The study was approved by the Research Committee of the Hong Kong Sanatorium & Hospital. Subjects gave verbal assent to participate and the data was anonymized.

Results

A total of 393 (78.3%) questionnaires were returned from the 502 eligible parents, and all questionnaires returned were the Chinese language version. One hundred and nine parents did not return their

questionnaires back to our staff. All questionnaires were completed by pregnant women or their husbands, or mothers who had given birth in hospital within the previous 3 days; more than half (55.8%) reported that this was their first pregnancy.

Parents' allergic history and maternal diet

About one third (35.4%) of the respondents reported having one or more allergic diseases themselves, and 29.1% among their spouses. For those who reported being allergic (n=138), 51.4% had rhinitis, 25.4% had eczema, 20.3% had food allergies, 10.9% reported asthma, while 18.1% had other allergic diseases. For those who reported their spouses were allergic (n=113), the prevalence of rhinitis, eczema, asthma, and food allergy was 59.3%, 27.4%, 12.4% and 11.5% respectively. Collectively, approximately half of the parents (50.1%, n=191) reported having one or more allergic diseases.

Over half (55.1%) had instituted some non-allergy-related dietary restrictions during their current pregnancy, while 7.3% had avoided foods for various allergy-related reasons. In those who had avoided foods for allergy-related reasons, over half (57.1%) had stopped eating shellfish including shrimp, crab and scallops. In those who reported non-allergy-related dietary restrictions, avoidance of shellfish (38.2%), raw foods such as sashimi and salad (31.1%) and 'cold' foods as defined by Chinese culture such as herbal tea (16.5%) were frequently reported.

Subjects were asked about their sources of dietary information with multiple answers allowed. A majority of respondents had sought advice from relatives and friends for dietary information during pregnancy, 52.7% and 47.8% respectively; Internet/social media networks (45.9%) and newspaper/magazines/books (37.7%) were also common sources of maternal dietary information. On the other hand, only 26% had sought advice directly from healthcare professionals.

Infant feeding plans

The majority of parents had planned to start breastfeeding their newborn infants from birth and less than one-tenth planned to breast feed exclusively (Figure 2). Approximately half of the parents planned to start formula feeding within the first 6 months and about half reported planning to stop breast feeding before their child reached 9 months of age.

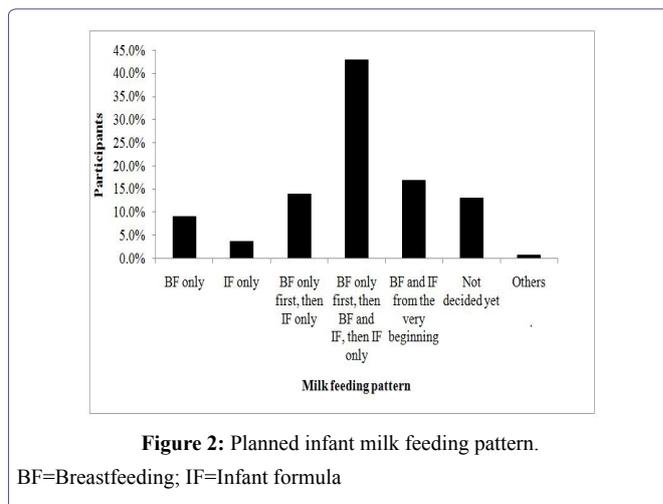


Figure 2: Planned infant milk feeding pattern.

BF=Breastfeeding; IF=Infant formula

Introduction of solid food and common food allergens

More than half of the parents (53.5%) planned to introduce solid food when their child is at 6 to 9 months of age, 12.8% planned to start feeding solids after 9 months, and 13.4% planned to start feeding between 3 to 6 months. Most parents (77.4%) planned to introduce rice foods (rice congee/rice cereals) as the first, or one of the first, solid foods into their infant's diet, followed by fruits (35.9%) and vegetables (32.6%). There was no difference in solid food introduction time and first-food choices between parents with different allergic histories.

A majority of the parents planned to start introducing each of the common allergen after their baby was 6 months old (cumulative percentage 86.0-95.8%; Table 1). There was no significant difference between any of the 8 foods. Only 35.3% of the parents intended to introduce egg yolk after the child is 9 months old. Over half planned to introduce egg white, soy, wheat and fish after 9 months (51.2-61.2%). They intended to introduce shellfish and nuts even later, usually after the child is 12 months old.

	Relative Percentage (%)					Number of Responses	Cumulative Percentage (%)	
	0-3 Months	3-6 Months	6-9 Months	9-12 Months	12 months onwards		After 6 Months*	After 9 Months†
Egg yolk	1.1	12.9	50.7	21.0	14.3	272	86.0	35.3
Egg white	1.5	10.2	35.3	24.8	28.2	266	88.4	53.0
Soy	0.8	6.3	31.8	34.1	27.1	255	92.9	61.2
Wheat	0.8	7.3	38.9	31.5	21.5	260	91.9	53.1
Shellfish	0.9	3.3	11.7	18.7	65.4	214	95.8	84.1
Fish	1.6	6.3	41.0	29.3	21.9	256	92.2	51.2
Nuts	1.0	3.3	10.5	14.8	70.5	210	95.7	85.2
Milk	4.4	6.4	35.3	25.3	28.5	249	89.2	53.8

Table 1: Planned age of child for introduction of common food allergens.

*after 6 months=total % of 6-9 months, 9-12 months and 12 months onward.

†after 9 months=total % of 9-12 months and 12 months onward.

Compared to those without allergic history, significantly fewer parents with allergic history planned to introduce all 8 allergenic foods before the child is 12 months old (11.6% vs. 5.2%, $p=0.03$) (Table 2). Overall, only 8.1% of parents are planned to introduce all 8 allergenic foods by 12 months. Moreover, parents with allergic diseases planned to introduce shellfish and egg white later in their infants as compared to those without a family history of allergic diseases, p for trend=0.02 and $p=0.02$, respectively (Table 3). There was no significant difference in time trend between the other 6 foods assessed.

Concerns about solid introduction

When parents were asked whether they had any concerns about feeding solids, about one-third reported anxiety that the baby would refuse solids and reported concerns about the development of food allergies, respectively (Figure 3). In participants with allergic histories themselves or in either one of the parents, over 60% in both categories indicated interest in joining a program related to early solid introduction if it became available.

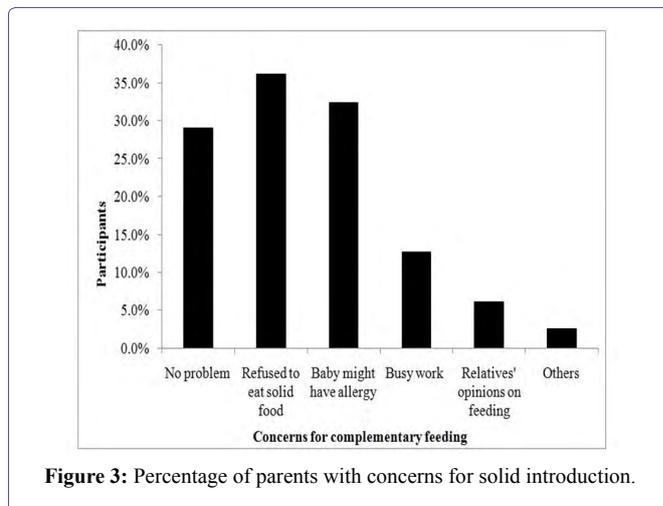


Figure 3: Percentage of parents with concerns for solid introduction.

Planned Time When All 8 Common Food Allergens are Introduced (Age of Child)											
Parents Allergic Histories	Total	<= 12 Months		> 12 Months		Answered < 8 foods		No Answer/Not Planned at all		95% Confidence Interval †	P-Value*
		n	%	n	%	n	%	n	%		
All	393	32	8.1	135	34.4	115	29.3	111	28.2		
With Allergy	191	10	5.2	65	34.0	64	33.5	52	27.2	2.54-9.42	0.03
Without Allergy	190	22	11.6	67	35.3	49	25.8	52	27.4	7.4-17	
Not indicated	12	0	0	3	25.0	2	16.7	7	58.3		

Table 2: Comparison of the planned time to introduce all common food allergens in babies of parents with different allergic histories.

* p value comparing the % of babies introduced or planned to introduce all 8 allergenic foods by 12 months between parental allergic histories.

†95% Confidence Interval for % of babies introduced or planned to introduce all 8 allergenic foods by 12 months.

	Parents	0-3 Months		3-6 Months		6-9 Months		9-12 Months		> 12 Months		No Answer / Not Planned	P-Value*
		n	%	n	%	n	%	n	%	n	%		
Egg yolk	With Allergy	1	0.8	13	9.8	68	51.1	33	24.8	18	13.5	58	0.15
	Without Allergy	2	1.5	21	15.7	68	50.8	22	16.4	21	15.7	56	
Egg white	With Allergy	1	0.8	11	8.3	45	34.1	29	22.0	46	34.9	59	0.02
	Without Allergy	3	2.3	16	12.4	45	34.9	36	27.9	29	22.5	61	
Soy	With Allergy	1	0.8	8	6.4	38	30.4	48	38.4	30	24.0	66	0.69
	Without Allergy	1	0.8	8	6.4	40	31.8	38	30.2	39	31.0	64	
Wheat	With Allergy	1	0.8	9	7.2	50	40.0	40	32.0	25	20.0	66	0.65
	Without Allergy	1	0.8	10	7.7	49	37.7	40	30.8	30	23.1	60	
Shellfish	With Allergy	1	1.0	4	3.9	7	6.9	13	12.8	77	75.5	89	0.02
	Without Allergy	1	0.9	3	2.8	17	15.7	27	25.0	60	55.6	82	
Fish	With Allergy	3	2.4	7	5.5	56	44.1	36	28.4	25	19.7	64	0.86
	Without Allergy	1	0.8	9	7.3	46	37.1	38	30.7	30	24.2	66	
Nuts	With Allergy	1	1.0	3	3.1	9	9.2	15	15.3	70	71.4	93	0.28
	Without Allergy	1	0.9	4	3.7	13	12.2	16	15.0	73	68.2	83	
Milk	With Allergy	6	5.0	7	5.8	45	37.2	25	20.7	38	31.4	70	0.47
	Without Allergy	5	4.1	9	7.3	41	33.4	35	28.5	33	26.8	67	

Table 3: Comparison of the planned time to introduce each common allergen in parents with different allergic histories.

* p value comparing the % of babies introduced or planned to introduce all 8 allergenic foods by 12 months between parental allergic histories.

†95% Confidence Interval for % of babies introduced or planned to introduce all 8 allergenic foods by 12 months.

Discussion

Approximately 50% of the subjects in our survey reported at least one parent with allergic history, indicating that about half of the infant population surveyed was at high risk of developing allergic diseases. As urbanization is associated with higher risk of food allergies, allergy prevention becomes very important in urban societies like Hong Kong [21].

The survey relied on convenience sampling which has advantages and disadvantages. While it gives valuable information in a timely manner for future larger scale study, this sampling method is bound for selection bias and sampling error. The Hong Kong's health service is delivered through the public and private sectors. Private hospitals provide approximately 11% of hospital beds and treat 21% of the in-patients [22]. The current survey was conducted in the largest private hospital group in Hong Kong so will be skewed towards the segment of the community who can afford private healthcare and may not be representative of the whole local population [23]. However, high social economic status has been linked to increased risk of peanut allergy [24] as well as higher epinephrine auto-injector prescription [25]. Therefore, the findings are still informative not only because privately treated patients are a significant part of the community utilizing healthcare services in Hong Kong, but also because a similar study on the influence of allergic histories on parental feeding patterns for their babies in Hong Kong had not been conducted previously.

Maternal diet during pregnancy

Prophylactic allergen avoidance in maternal diet during pregnancy did not decrease risk of food allergies in the offspring [7,26,27], and should not be advised [28]. However, non-allergy-related maternal dietary avoidance was common among the Chinese pregnant women in the current survey. There are many dietary beliefs in the Chinese culture, often promoted by traditional Chinese medicine [29]. In our study group, shellfish was commonly avoided during pregnancy, followed by foods that were eaten raw or at a cold-temperature. Strikingly, less than 30% of our participants had obtained dietary information directly from medical professionals. The most frequently reported source of information was family and friends. The social media network and the Internet were also frequently used even when there is no certainty of the reliability of the health advice [30].

Exclusive breastfeeding and formula feeding

The World Health Organization (WHO) and DHHK [31] recommend breastfeeding exclusively for at least six months and to continue breastfeeding until 2 years old. The exclusive breast feeding rate in Hong Kong is 33.8% and 30.7% for 1 month and 4 months, respectively. At 6 months, 27.9% of infants were fed with breast milk, but of these children 27% had already been introduced to solids, so the exclusively breast fed rate was 0.9% [10,11]. While most of the mothers we studied chose to breastfeed, less than 10% of them planned to breastfeed exclusively, and only about 5% would continue breast feeding exclusively for at least 6 months. A majority of families planned to supplement breastfeeding with formula.

Complementary feeding

Complementary feeding refers to the introduction of solid food into an infant's diet [6]. Nutritionally, breastfeeding may be able to supply up to 90% of nutrients to infants at 6 months of age, but

complementary feeding is needed to support growth in infants from that time onwards [32].

Earlier guidelines had recommended delayed introduction of allergenic foods including dairy products, eggs, peanuts, tree nuts and fish [11]. However later studies have shown that delayed introduction of allergenic foods was correlated with increased risk of allergic diseases [3,14-18,33,34]. Furthermore, increased food diversity in the first year of life is inversely associated with allergic diseases [35]. Thus the early and diverse oral introduction of solid food may induce tolerance [36].

Newer guidelines recommend earlier allergen introduction during infancy [5,6,13,19,20]. The revised recommendations were supported by the Learning Early about Peanut Allergy (LEAP) study demonstrating that avoidance of peanut results in increased risk of developing peanut allergy in early childhood in high-risk infants [17]. As a result, the advice for introducing peanuts during infancy has been modified [5,37,38]. The Enquiring about Tolerance (EAT) study demonstrated the importance of early introduction of common allergens, especially egg and peanut, in food allergy prevention for the general population [18].

Focusing on the Asian population, the LEAP study showed that there was no peanut allergy in the peanut consumption group versus a 44.4% incidence in the peanut avoidance group, suggesting that early introduction is even more effective for preventing food allergy in the Asian population [17]. The Asia Pacific Association of Pediatric Allergy, Respiriology & Immunology (APAPARI) has already recommended that there should be no delay in introducing allergenic foods in high-risk infants [26].

Most Chinese infants were fed with solids after 6 months old and about one third had started complementary feeding at 4 to 6 months old [38]. This survey has shown that parents often planned to introduce solid food and allergens after the infant are 6 months old and some after 9 months of age. Some parents in the high-risk population reported planning to introduce solids after 12 months. Significantly fewer families with a history of allergic diseases planned to introduce all allergenic foods by 12 months.

A significant percentage of parents reported a fear of their child getting food allergy. They were also afraid that their child would refuse solids. In addition, how and when a child is introduced to solid food can be affected by a family history of allergic diseases. A previous study from the United States also indicated that maternal allergic history and the Asian race are risk factors for late solid introduction [39]. These findings highlight the importance of seeking professional advice early so that appropriate support and guidance can be offered.

As a result of this survey, we now provide advice in our routine maternity classes about maternal diet for allergy prevention in the offspring. We have also launched a program for the early introduction of solids to educate and provide guidance for parents of high risk infants. The Eating Allergen Safely & Early (EASE) Program was designed and launched by a multi professional team that included dietitians and nurses specializing in allergy and consultant allergists [40]. The program consists of consultations with an allergist and skin prick testing to common food allergens to rule out existing allergies, followed by monthly dietetic consultations and nursing advice in the first year to guide parents in the introduction of various solids including

commonly allergenic foods. Parents are taught to observe signs of readiness for solid food introduction in their infants and to start with rice cereals as the first food beginning at 4 to 6 months while continuing to breastfeed. They are also encouraged to try different grains, vegetables and fruits. After the infants are eating solid food on a daily basis, parents are guided to introduce the common allergenic foods, including milk, fish, shellfish, soy, egg and peanut. The infants are expected to consume these foods on a regular basis by 12 months of age. Early symptoms of food allergy are referred to an allergist and treated in a timely fashion. Parents are educated on nursing care related to their baby's eczema or other allergic symptoms as needed. Food allergy status is reviewed at 1 and 3 years old, or as medically needed.

The introduction of any local policy to change infant feeding patterns to prevent allergic diseases in Hong Kong will require a major shift in societal culture. Before this public health policy can be recommended more evidence is required. We propose that a community wide survey in Hong Kong should be conducted to document whether our findings are applicable to the wider community and whether the delayed feeding of allergenic foods predisposes to an increased risk for allergic diseases.

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