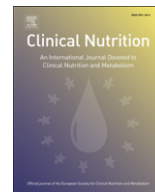


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Clinical Nutrition

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Original article

Knowledge and practice of physicians and nutritionists regarding the prevention of food allergy

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ARTICLE INFO

Article history:

Received 13 December 2011

Accepted 31 October 2012

Keywords:

Food hypersensitivity

Primary prevention

Pediatrics

Knowledge

Education, professional, retraining

Education, continuing

SUMMARY

Background & aims: To evaluate the knowledge and practice of pediatricians, pediatric gastroenterologists, allergists and nutritionists regarding the primary prevention of food allergy.

Methods: A descriptive, cross-sectional study that enrolled pediatricians ($n = 80$), pediatric gastroenterologists ($n = 120$), allergists ($n = 100$) and nutritionists ($n = 220$). A self-administered questionnaire concerning the current recommendations was used.

Results: Despite the lack of current recommendations, 17.1% ($n = 89$) of all professionals, mainly nutritionists, recommended a maternal exclusion diet during pregnancy. More professionals in the sample group, 40.8% ($n = 212$), recommended a maternal exclusion diet during breastfeeding, and the rates of recommendation were higher in nutritionists and pediatricians compared to allergists and pediatric gastroenterologists ($p < 0.001$). Regarding the recommended timing of the introduction of complementary feeding, 41.9% ($n = 218$) of the professionals recommended modifying the age of introduction to prevent the development of food allergy. The majority of the professionals believed that prebiotics (61.2%; $n = 318$) and probiotics (44.4%; 231) prevent the development of food allergy. The recommended age of introduction for the main allergenic foods was 12 months.

Conclusions: This study revealed that there are gaps in the knowledge of professionals about the primary prevention of food allergy.

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1. Introduction

Currently, there is a strong interest in the primary prevention of food allergy due to the considerable increase in the incidence of allergic diseases, mainly in Western countries.¹ Given the gravity of some allergic conditions and their implications for the quality life of the patient and their family, the primary prevention of food allergy has become a public health priority in developed countries and has become a matter of concern in developing countries.²

Allergic diseases comprise a combination of clinical manifestations, such as asthma, rhinitis, conjunctivitis, atopic dermatitis and food allergy. Food allergy is the primary allergic manifestation in infancy, which typically is a cow's milk protein allergy.³ This allergy is more frequent in infants that receive infant formulas or whole cow's milk but can also occur in exclusively breastfed infants due to the passage of food allergens ingested by the mother's diet into the mother's milk.⁴

Food allergy burdens increase the costs of the health system and lead to hospital admissions, specialized attendance, the expense of subsidiary exams and the use of specialized infant formulas. The major treatment remains the exclusion of food that contains the allergic protein for a determined period until the acquisition of tolerance.⁵ Nevertheless, strategies for the primary prevention of food allergy were recently reviewed, and new guidelines were established.^{6–13}

Because new treatments are established based on the results of research, the clinical practice of health professionals should include a constant updating of their knowledge. The identification of at-risk subjects enables health professionals to monitor the patient and to offer specific guidance to reduce the chance of developing a food allergy. Primary prevention practice includes guidance about infant foods, including the duration of exclusive breastfeeding, the use of specialized infant formula and complementary feeding.

Most of the time, the guidance in infancy is determined by a professional who has frequent contact with the mother and the infant. Therefore, it is important for health professionals to be able to provide recommendations that are supported by scientific evidence and not to suggest practices that expose the infant to nutritional risk or to factors that can enhance the chances of

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developing a food allergy. Hence, the present study aims to evaluate the knowledge and practice of physicians and nutritionists about the prevention of food allergy.

2. Material and methods

This was a descriptive, cross-sectional study that included pediatricians, pediatric gastroenterologists, allergists and nutritionists. The participants were selected by approaching the professionals at scientific meetings: Brazilian Congress of Nutrition (June/2009), Brazilian Congress of Allergy and Asthma (October/2009), Brazilian Congress of Pediatric Gastroenterology and Congress of Pediatrics of the State of São Paulo (March/2010). A self-administered questionnaire was prepared by the authors. The questionnaire was based on the current recommendations of the major committees and societies related to the prevention of food allergy: the Brazilian Society of Pediatrics, the Brazilian Association of Allergy and Immunology, the American Academy of Pediatrics, the European Society of Pediatric Allergy and Clinical Immunology, the European Society for Pediatric Gastroenterology, Hepatology and Nutrition, the Section on Pediatrics of the European Academy of Allergology and Clinical Immunology and the Australasian Society of Clinical Immunology and Allergy published since 1999 until 2008.^{6–13}

The questionnaire included a section that was focused on the identification of the professional. The second part of the questionnaire contained specific questions about the groups of infants considered to be at high risk for the development of food allergy, the recommendations on a maternal exclusion diet during pregnancy and breastfeeding and the list of foods that might be excluded (peanuts, cocoa, coffee, pork, meat, colorants, beans, seafood, cow's milk, eggs, fish, soybean and wheat). The questionnaire also asked about the recommendation of modifying the time of introduction of complementary feeding, the influence of the type of delivery on the development of allergic diseases, the use of prebiotics and probiotics for the prevention of food allergy, the age of introduction of the main allergenic foods and the factors related to the constitution of the intestinal microbiota.

The study was approved by the research ethics committee of the Federal University of São Paulo (UNIFESP). Authorization for data collection during all of the scientific meetings was previously granted by the Conference Committee. All of the participants signed a written consent.

The data collected through the questionnaires were entered into Microsoft Excel (2007 version, Redmond, WA, USA). The data processing and statistical analysis were performed using SigmaStat in SigmaPlot® (version 11.2, 2009–2010, Systat Software, San Jose, CA, USA) and Statcalc in Epi-Info® (version 3.5.1, 2008, Atlanta, GA, USA).

For the statistical analysis of continuous variables with normal distributions, a one-way analysis of variance (ANOVA) was used and was complemented by Tukey's test of multiple comparisons

when appropriate. The frequencies and proportions were compared using the χ^2 test or Fisher's exact test complemented by the partitioning of the χ^2 test when appropriate. The alpha error was established as 5% for the rejection of the null hypothesis. Bonferroni's correction for the adjustment of the alpha value was used for the comparisons between six possible the pairs of professionals ($p < 0.008$).

3. Results

The data were collected during 4 scientific meetings between March 2009 and March 2010. The total sample consisted of 520 professionals: pediatricians ($n = 80$), pediatric gastroenterologists ($n = 120$), allergists ($n = 100$) and nutritionists ($n = 220$). Regarding the gender of the participants, 470 (90.4%) were female and 50 (9.6%) were male. The distribution of gender among the specialties was 215 (97.7%) female nutritionists, 65 (81.2%) female pediatricians, 106 (88.3%) female pediatric gastroenterologists and 84 (84.0%) female allergists. The mean age of the professionals was 29.1 ± 5.8 years, and the mean ($\pm$ standard deviation) professional experience was 7.2 ± 5.8 years.

The groups of infants that were identified by the professionals as those considered to be at high risk for developing a food allergy are presented in Table 1. According to the professionals, the main groups that are considered to be at high risk were, in decreasing order, infants with a family history of allergic diseases (91.9%), pre-term newborns (66.2%), wheezing infants (63.1%), low-birth-weight newborns (54.8%) and infants with gastroesophageal reflux (43.1%). Only the family history of allergic disease is the correct answer.

The results regarding the recommendation of a maternal exclusion diet during pregnancy and breastfeeding, modifying the time of introduction of complementary feeding, the influence of the type of delivery in the development of allergic diseases and the use of prebiotics and probiotics in the prevention of food allergy are described in Table 2. Regarding the recommendation of a maternal exclusion diet during pregnancy, 17.0% of professionals agreed with such a practice, and nutritionists had the highest rate of recommendation. The pediatric gastroenterologists statistically differed from the other professionals and had the lowest rate of recommendation. A maternal exclusion diet during breastfeeding was recommended by 40.8% of the sample, with higher rates of recommendation by nutritionists and pediatricians compared to allergists and pediatric gastroenterologists. The main foods chosen for exclusion in the maternal diet during pregnancy were similar to those excluded during breastfeeding: peanuts, colorants, seafood, cow's milk, eggs and soybeans (data not shown).

Regarding the time of introduction of complementary feeding, 41.9% of professionals recommended modifying the age of introduction to prevent the development of food allergy. The highest recommendation rate was found among allergists. The participants' answers regarding the age of introduction of the main allergenic

Table 1

Answers to the question: "Which one(s) of the group(s) do you consider to be infants at high risk of developing food allergy?".

	Nutritionists ($n = 220$)	Pediatricians ($n = 80$)	Pediatric gastroenterologists ($n = 120$)	Allergists ($n = 100$)	Total ($n = 520$)	p
Infants with a family history of allergic disease	199 ^a (90.5%)	72 ^a (90.0%)	113 ^a (94.2%)	94 ^a (94.0%)	478 (91.9%)	0.488*
Pre-term newborns	126 ^a (57.3%)	58 ^{a,c} (72.5%)	93 ^{b,c} (77.5%)	67 ^{a,c} (67.0%)	344 (66.2%)	<0.001*
Wheezing infants	94 ^c (42.7%)	73 ^{a,d} (91.2%)	82 ^b (68.3%)	79 ^{a,b} (79.0%)	328 (63.1%)	<0.001*
Low-birth-weight newborns	147 ^a (66.8%)	29 ^b (36.3%)	71 ^{a,c} (59.2%)	38 ^{b,c} (38.0%)	285 (54.8%)	<0.001*
Infants with gastroesophageal reflux	105 ^{a,b} (47.7%)	18 ^c (22.5%)	72 ^a (60.0%)	29 ^{b,c} (29.0%)	224 (43.1%)	<0.001*

* χ^2 test: the different letters in the rows represent statistically significant differences ($p < 0.008$) taking into account Bonferroni's correction.

Table 2

Numbers of professionals who answered “yes” to the following questions.

	Nutritionists (n = 220)	Pediatricians (n = 80)	Pediatric gastroenterologists (n = 120)	Allergists (n = 100)	Total (n = 520)	p
Would you recommend a maternal exclusion diet during pregnancy?	56 ^a (25.5%)	13 ^{a,b} (16.3%)	5 ^{a,b} (4.2%)	15 (15.0%)	89 (17.0%)	<0.001*
Would you recommend a maternal exclusion diet during lactation?	130 ^a (59.1%)	43 ^a (53.7%)	15 ^b (12.5%)	24 ^b (24.0%)	212 (40.8%)	<0.001*
Would you recommend modifying the time of introduction of complementary food?	73 ^a (33.2%)	33 ^{a,b} (41.3%)	42 ^{a,b} (35.0%)	70 ^c (70.0%)	218 (41.9%)	<0.001*
Do you believe that the type of delivery influences the development of allergic diseases?	118 ^a (53.6%)	21 ^{b,c} (26.3%)	44 ^{a,b} (36.7%)	31 ^b (31.0%)	214 (41.21%)	<0.001*
Do you believe that prebiotics prevent food allergy?	164 ^a (74.5%)	36 ^{b,c} (45.0%)	51 ^b (42.5%)	67 ^{a,c} (67.0%)	318 (61.2%)	<0.001*
Do you believe that probiotics prevent food allergy?	107 ^a (48.6%)	16 ^b (20.0%)	35 ^{a,b,c} (29.2%)	73 ^c (73.0%)	231 (44.4%)	<0.001*

* χ^2 test: the different letters in the rows represent statistically significant differences ($p < 0.008$) taking into account Bonferroni's correction.

foods are presented in Fig. 1. The recommended age and the percentage of respondents recommending the age for the allergenic foods are as follows: peanuts at 24 months by 41.3% of respondents; milk and dairy products at 12 months by 51.3% of respondents; eggs at 12 months by 60.4% of respondents; fish at 12 months by 56.9% of respondents; soybeans at 12 months by 45.4% of respondents; and wheat at 6 months by 46.9% of respondents.

A total of 41.2% of respondents believed that the type of delivery influences the development of allergic diseases (Table 2). The highest frequency of this belief was found in nutritionists as compared to the other professionals. Of those who believe that the delivery method influences allergy, 95.8% of respondents indicated that vaginal delivery is more beneficial than Caesarean delivery, and this response was not significantly different between professionals (data not shown).

With respect to the use of prebiotics, 61.2% of respondents believed that prebiotics prevent food allergy (Table 2). This response was indicated in 74.5% of nutritionists and 67.0% of allergists, which were higher rates than for the other professionals. For probiotics, 44.4% of professionals believed that they prevent food allergy, and a larger number of allergists indicated this recommendation than nutritionists and the other professional categories (Table 2).

Factors that interfere with the constitution of the intestinal microbiota are described in Table 3. The most-selected topics in decreasing order were as follows: the type of feeding (95.2%), age at pregnancy (55.6%), family history of allergic diseases (52.5%), the type of delivery (44.0%) and the birth weight (41.1%). The correct answers were the type of feeding and the type of delivery.

4. Discussion

The results revealed that there are some gaps and a certain degree of downgrading in the knowledge and practice of the prevention of food allergy by health professionals. The most critical question is the definition of infants considered to be at high risk for developing food allergy and who should be targeted for preventive measures. According to published studies, the only group at high risk is infants with a family history of allergic diseases.¹⁴ This group was selected by 91.9% of the study population. However, prematurity, low birth weight, wheezing and gastroesophageal reflux were erroneously recognized as risk factors by approximately 43.1%–63.1% of the participants in the study.

The definition of the groups at high risk for developing food allergy is important so that the recommendations and changes in food practices are targeted at those infants who are at risk. The most commonly selected options by the professionals were pre-term newborns (wrong answer) and infants with a family history of allergic diseases (correct answer). The incorrect selection of pre-term newborns by some respondents may be attributed to the fact that pre-term newborns have immature immune systems and digestive and absorptive functions and, therefore, theoretically has a greater likelihood of developing a food allergy.¹⁵ This rationale has been evaluated in several trials, but epidemiological evidence has not confirmed this hypothesis. What is known is that food allergy is more likely to occur in infants with a family history of allergic diseases (elevated risk between 50.0 and 80.0%) in comparison to those without a family history of allergic diseases.¹⁶ Nevertheless, 66.2% of professionals erroneously selected pre-term

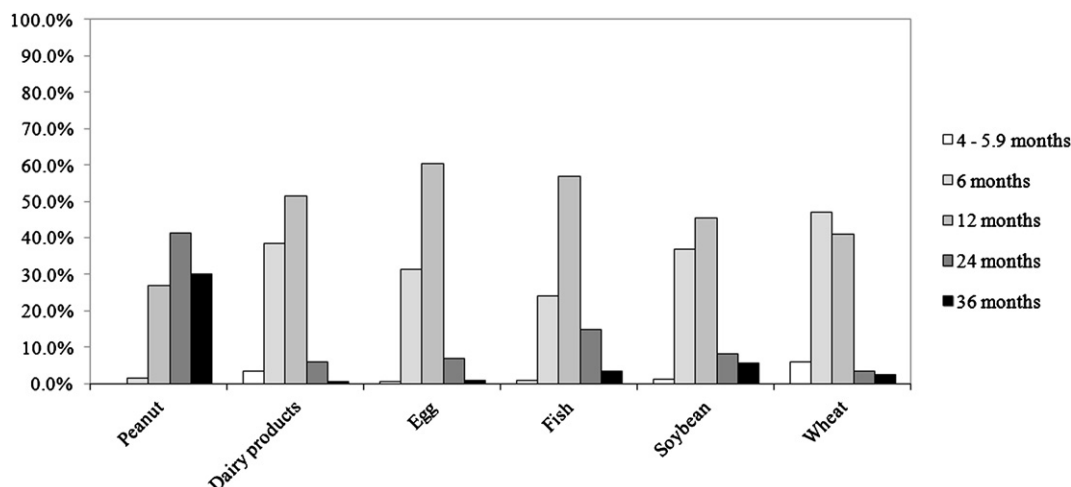
**Fig. 1.** Time for the introduction of the main allergenic foods according to all of the professionals (n = 520).

Table 3

Answers to the question: "Of the options below, which are related to the formation of the intestinal microbiota?".

	Nutritionists (n = 220)	Pediatricians (n = 80)	Gastro-pediatricians (n = 120)	Allergists (n = 100)	Total (n = 520)	p
Type of feeding	217 ^a (98.6%)	76 ^{a,c} (95.0%)	109 ^{b,c} (90.8%)	93 ^{a,c} (93.0%)	495 (95.2%)	<0.008*
Pregnancy age	102 ^a (46.4%)	26 ^a (32.5%)	85 ^b (70.8%)	76 ^b (76.0%)	289 (55.6%)	<0.001*
Family history of allergic diseases	104 ^a (47.3%)	66 ^b (82.5%)	42 ^a (35.0%)	61 ^b (61.0%)	273 (52.5%)	<0.001*
Type of delivery	100 ^a (45.5%)	31 ^a (38.7%)	62 ^a (51.7%)	36 ^a (36.0%)	229 (44.0%)	0.088*
Birth weight	46 ^a (20.9%)	64 ^b (80.0%)	68 ^{b,c} (56.7%)	36 ^{a,c} (36.0%)	214 (41.1%)	<0.001*

* χ^2 test: the different letters in the rows represent statistically significant differences ($p < 0.008$) taking into account Bonferroni's correction.

newborns, 63.1% selected wheezing infants, 54.8% selected low-birth-weight newborns, and 43.1% selected infants with gastro-esophageal reflux as groups at high risk for developing food allergy.

Maternal exclusion diets during pregnancy and during breastfeeding to prevent the development of food allergy were recommended by 17.0% ($n = 89$) and 40.8% ($n = 212$) of respondents, respectively, and the greatest proportion of respondents recommended an exclusion diet during the period of lactation. The foods that were recommended for exclusion during pregnancy (peanuts, colorants, seafood, cow's milk, eggs and soybeans) were also recommended for exclusion during breastfeeding with no changes in the recommendation pattern. One American study, which was performed by the American Committee of Adverse Reactions to Food Allergens, compared the strategies for primary prevention between two different medical specialties.¹⁷ They examined the recommendation of a maternal exclusion diet during pregnancy and observed that this practice was adopted by 21.7% of allergists and 13.2% of non-allergist professionals. During breastfeeding, 42.5% of allergists and 38.6% of non-allergists recommended a maternal exclusion diet. These findings confirm that there is a stronger trend for recommending a maternal exclusion diet during breastfeeding. However, the study did not provide the details as to the type of food to be excluded. In summary, American and Brazilian health professionals have similar levels of knowledge and are not in accordance with the present recommendations. It is important to highlight that presently, the major committees and societies have agreed that the practice of exclusion diets is unsupported by scientific evidence.^{6–13} Therefore, it is unnecessary for mothers to exclude any kind of food during pregnancy or while breastfeeding. According to a meta-analysis published by the Cochrane group, the practice of a maternal exclusion diet is unlikely to reduce the risk of developing allergic diseases; in addition, food restriction could have a negative effect on fetal and maternal nutrition.¹⁸

Regarding the practice of modifying the time of introduction of complementary feeding, 41.9% ($n = 218$) of professionals, mainly the allergists, agreed with this practice. The American study found agreement among 62.2% of allergists and 45.7% of non-allergists in the recommendation to withhold the introduction of solid foods until the age of 6 months.¹⁷ In contrast, clinical trials revealed that this practice does not reduce the incidence of food allergy and that it could increase the risk of allergic sensitization.¹⁹

There is a new concept regarding the ideal time for the introduction of complementary feeding. An Australian research group proposed that tolerance to food proteins occurs via early and regular introduction during a period considered critical to the development of food allergy, which they called a "critical early window". This window comprises the period between 4 and 6 months of age, when the introduction of allergenic foods could promote tolerance and have a protective effect against food allergy, celiac disease and autoimmune diseases.²⁰ Recent study performed in Australia observed that children were at an increased risk of developing a parent-reported nut allergy if they were exclusively breastfed in the first six months without introduction of any food.

This is a controversial conclusion, but it is important to be stressed for the need of professionals adheres to the current recommendations of the guidelines so that changes can be made based on evidence.²¹

Foods such as dairy products, eggs, fish, seafood and soybeans are considered allergenic due to the structure of their proteins. Therefore, some professionals recommend withholding or postponing the introduction of these foods to reduce the risk of developing of food allergy. In our study, when professionals were asked about the time for the introduction of the major allergenic foods, they held the conservative position of postponing the introduction of these foods, particularly the introduction of peanuts, to 24 months. According to the recommendations of the major committees and societies, the introduction of eggs, fish, soybeans and wheat should occur after 6 months of age both for infants considered at high risk of developing food allergy and for those at low risk.^{6–13}

Regarding the introduction of wheat, the majority of the professionals in this study selected the time of introduction as 6 months (46.9%) or 12 months (41.0%). In practice, recommendations suggest that wheat should be introduced after 6 months of age. However, there is controversy about the age of introduction of gluten and the development of celiac disease. Observational trials suggest that the introduction of small amounts of gluten during the breastfeeding period could reduce the risk of celiac disease.²² On the other hand, introduction before 3 months and after 7 months of age is associated with increased risks of celiac disease.

The intestinal microbiota has an important role in the development of oral tolerance. The composition of the intestinal microbiota is influenced by the type of delivery, the presence of maternal allergic diseases and the type of feeding. The gastrointestinal tract of the newborn is sterile until the moment of delivery, at which microorganism colonization occurs from environmental and maternal sources. Vaginal delivery provides contact between the mouth of the newborn and the maternal vaginal and intestinal microbiota. In contrast, Caesarean delivery does not provide this contact, and colonization occurs exclusively by the microorganisms of the environment.

The use of prebiotics and probiotics appears to be promising in developing tolerant intestinal microbiota, which may prevent food allergy. Of the professionals in our study, 61.2% ($n = 318$) of respondents believed that prebiotics prevent food allergy, and 44.4% ($n = 231$) believed in the use of probiotics. Clinical trials have evaluated the use of pre- and probiotics in the prevention of food allergy separately or in combination (symbiotics) by maternal and infant ingestion during the first months of life. Despite their possible beneficial effects in the modulation of the intestinal microbiota, there is no scientific evidence supporting their use, especially for the prevention of food allergy.²³

Only one study in high-risk infants evaluated the use of prebiotics added to a hydrolyzed infant formula. Infants that could not be breastfed were studied in a randomized, double-blind, placebo-controlled trial. This clinical trial evaluated the development of atopic dermatitis as the clinical outcome. Out of 259 infants, atopic

dermatitis occurred in 10 infants in the study group compared to 24 infants in the control group. This trial concluded that the beneficial effects of prebiotics could be explained by the modulation of the immune system in response to changes in intestinal microbiota.²⁴

According to the hypothesis that an increased risk of food allergy is caused by a lack of early microbial stimulation in the immature immune system, probiotics could be used to modulate the allergic risk. A randomized, double-blind, placebo-controlled trial performed in mothers of infants at high risk of developing allergy evaluated the use of probiotics in food allergy prevention. The mothers received *Lactobacillus GG* during the prenatal period; after delivery, the infants received the same treatment until they reached 6 months of age.²³ At 2 years of age, the proportion of infants that presented with atopic dermatitis in the group that received probiotics was lower than that of the control group. Reassessment at 4 and 7 years of age revealed that the protective effect against atopic dermatitis remained. However, another study in Germany that used the same probiotic did not find a positive effect.²⁵ According to the conclusions of a meta-analysis published by the Cochrane group on the use of prebiotics and probiotics, there is no scientific evidence that justifies their use as a strategy for the primary prevention of food allergy. There is a need for more clinical trials that have good quality methodologies that define an acceptable limited drop-out rate and that define the development of food allergy as the outcome to evaluate the effects of pre- and probiotics in high-risk infants.²⁶

With regard to the profile of the professionals in our study, it is known that there are inherent limitations in convenience sampling, especially considering the fact that the data collection occurred at scientific meetings. This may suggest that the professionals in our study present initiative in seeking updated information and are willing to increase their current knowledge. The gender of the sample was predominantly female; therefore we suggest that future studies should involve more male respondents. However, our results confirm some practices observed by professionals in maternity units in Italy that also recommended specific maternal dietary restrictions during lactation (31.8%) and that only 2/22 maternity units have a policy in complete agreement with the nutritional intervention proposed by the AAP. The authors concluded that further efforts should be planned to improve the knowledge and the application of these preventive strategies.²⁷ We emphasize that even in different areas about physicians and nutritionists knowledge in different countries, there are gaps of knowledge as verified by another studies.^{28,29}

This study revealed that current practice does not reflect current evidence with regard to the prevention of food allergy in the professional categories studied. It is important to highlight the practice of the recommendation of maternal exclusion diets during pregnancy and breastfeeding, which was especially prevalent in the nutritionists. A recommendation for modifying the time of introduction of complementary feeding was most selected by the allergists. The recommendation to postpone the introduction of the main allergenic foods was chosen by all of the professionals. We also observed an incorrect identification of the infants at high risk of developing food allergy.

Our findings confirm that evaluating the knowledge and practice of professionals contributes towards defining the content that should be included in continuing education programs in the area of food allergy. This is very important considering the recent changes in the recommendations for the prevention of food allergy. The main points that should be highlighted through education are the lack of efficacy of an exclusion diet during pregnancy and breastfeeding, the identification of infants at risk of developing food allergy (those who have a family history of allergic diseases, excluding preterm infants), the recommendation not to postpone the introduction of

complementary foods and that prebiotics and probiotics, despite promising possibilities, are not yet confirmed for clinical use.

Statement of authorship

Camila Cury Ribeiro participated in the design of the study, collection of data and writing of the manuscript. Patrícia da Graça Leite Speridião participated in the design of the study, analysis of data and writing of the manuscript. Mauro Batista de Moraes participated in the design of the study, analysis of data and writing of the manuscript. All authors read and approved the final manuscript.

Conflict of interest

Support Advanced Medical Nutrition/Danone in providing resources to Camila Cury Ribeiro to participate in scientific events where data were collected for the study.

Acknowledgments

Camila Cury Ribeiro received a scholarship from Coordination of Improvement of Higher Education Personnel (CAPES).

We would like to thank Dan L. Waitzberg, Dirceu Solé and José Hugo de Lins Pessoa; all presidents of the Congress that have authorized the collection of data.

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