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Assessment of children's nutritional attitudes before oral food challenges to identify patients at risk of food reintroduction failure: a prospective study

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Abstract

Background: Inappropriate dietary eliminations may impair quality of life, affect children's growth and unnecessarily impact on healthcare costs. Previous retrospective studies reported that around 25% of children continue a food-avoidance diet despite a negative oral food challenge (OFC). A definite pattern has not been found yet for patients not reintroducing the food. This study aimed to examine the role of child's nutritional attitudes and maternal anxiety in reintroducing food after a negative OFC.

Methods: A prospective study was conducted involving 81 mothers of children with IgE-mediated food allergy. They completed a survey on nutritional behaviour and attitudes and the State-Trait Anxiety Inventory on the day of OFC and 6 months later.

Results: In total, 11.1% of children never or rarely ate the food after a negative OFC. Consumption of the reintroduced food is positively correlated to child's interest in tasting new foods before and after OFC and to changes in child's nutritional habits after OFC. It is negatively correlated to monotony of the diet after OFC. No correlations were found with other participants' characteristics or maternal anxiety. State anxiety significantly decreased after the OFC. A correlation was found between trait and state anxiety and the degree of change in nutritional habits after OFC.

Conclusions: Evaluating child's approach towards food before the OFC is a promising approach to identify patients at risk of food reintroduction failure. Furthermore, it underlined the importance of reassessing food consumption in all patients after a negative OFC and supporting patients in the reintroduction of food.

Food allergy is an important atopic disease that can result in considerable morbidity, impact negatively on quality of life and prove costly in terms of medical care (1). The prevalence of food allergy reaches 8% in paediatric population (2). Therapy still mainly consists in total avoidance of food allergens via elimination diets and emergency treatment of symptoms caused by unintentional ingestion (1, 3). Food avoidance can have a negative impact on psychosocial well-being due to the daily burden of diet management, the constant vigilance and the fear of possible reactions (4–6). As tolerance can be

acquired spontaneously, particularly in children, there is a need to regularly re-evaluate patients to prevent inappropriate dietary eliminations that may impair the quality of life, affect normal growth (7, 8) and increase healthcare costs unnecessarily. Oral food challenges (OFC) are usually required to confirm the diagnosis of food allergy, to monitor food allergy or to prove oral tolerance to a given food (1, 9). Food allergy health-related quality of life has been demonstrated to improve after OFC (10, 11). Unexpectedly, a number of studies (12–15) reported that around 25% of patients

continue a food-avoidance diet despite a negative OFC. The authors did not identify a definite pattern for the group of patients not reintroducing the food. Eigenmann et al. (12) found that the severity of the initial reaction, the fear of accidental reactions during the avoidance diet, as well as the duration of the diet had no influence on the decision of reintroducing the food. Furthermore, neither the size of the family, the presence of other food allergies, nor social activities outside the home did influence eating habits after the negative OFC. Considering all the previous studies, the reasons expressed by parents for continuing food avoidance were mostly aversion and refusal of the food and fear of reactions (12–15). Feeding difficulties are increasingly being recognized in children with food allergy. For some children, symptoms of nutritional dysfunction may persist after allergens are removed from the diet, due to learned associations with food and discomfort and reinforcement of maladaptive feeding behaviours (16). On the other side, 'fear of the unknown', including 'fear of losing control', 'having faith even though fear prevails', 'reintroducing despite fear' and 'fear of causing harm' has been described as part of mothers' experiences during an OFC (17). A study on food avoidance in children with adverse food reactions showed that food avoidance is related to anxiety about adverse reactions and it seems to be independent of a doctor's diagnosis of food allergy and advice on food avoidance (18). Anxiety can refer to an unpleasant emotional arousal in face of threatening demands or dangers (state anxiety) or can reflect a relatively stable individual tendency to respond in the anticipation of stressful situations (trait anxiety). With concern to food allergy, an example of state anxiety can be feeling fear of child's reaction during an OFC, while trait anxiety can be expressed as a tendency of being worried about possible child's reactions in many general situations.

Moreover, maternal mental health was found to be associated with the quality and quantity of child nutrition. However, correlates associated with maternal child feeding practices are complex, and the pathways by which maternal correlates impact these feeding practices require further investigation (19, 20).

It seems crucial to investigate factors related to food avoidance after negative OFC, considering that continuous total or partial avoidance diets carry the potential of food allergy relapse, in addition to diminished quality of life. Previous research reported food refusal as one of the most reported reasons of food introduction failure (12–15). However, none of the mentioned studies investigated the role of child's nutritional attitudes in the reintroduction of food after a negative OFC. In addition, previous studies are limited by a retrospective approach.

The present study, as the first, aimed to prospectively examine the role of maternal anxiety (trait and state) before and after the OFC and the role of child's nutritional attitudes in reintroducing the food after a negative OFC. We hypothesized that high monotony of the diet and low interest about tasting new foods before OFC could be associated with food reintroduction failure after OFC. With regard to maternal anxiety, a decrease in mothers' state anxiety was expected after OFC.

Furthermore, a negative correlation was supposed between anxiety (state and trait anxiety before OFC, as well as state anxiety after OFC) and children food consumption and level of change in nutritional habits after OFC.

Participants and methods

Procedure

Participants were selected sequentially among the patients visited at the Referral Centre for Food Allergy in Padua over a 12-month period. Inclusion criteria took into consideration children on an elimination diet due to a confirmed diagnosis of IgE-mediated food allergy, on the basis of a clinical history with evidence of sensitization and a positive food challenge or positive skin prick test and/or serum-specific IgE results. Children suffering from serious concomitant nonallergic disease were excluded from the study.

Mothers were invited to participate while accompanying the children to OFC. They were given detailed information with a written description of the study. Mothers interested in participation were requested to sign a consent form and to provide demographic details, as well as information about their children's clinical history. Then, they were asked to complete a brief survey on nutritional behaviour and attitudes in food-allergic children on the day of OFC and 6 months later. State anxiety was assessed in mothers before and after the OFC procedure. Trait anxiety, as it is considered a stable tendency, was evaluated only before the OFC, as it requires the subjects to describe how they feel and respond to situations in general.

Children who had a positive OFC were excluded from the study, and mothers did not complete any questionnaire after the OFC.

Oral food challenge was performed as standard open test. All patients ingested the usual edible form of the food. The test was considered negative when a total cumulative challenge dose of at least 5 g of food proteins were tolerated (1). All patients were advised and guided by an allergist and a dietician for introduction of the food at home after a negative OFC. Reintroduction of food is organized appropriately to patients' age and type of food. Patients are monitored after OFC by regular phone call. The dietician offers suggestions (e.g. recipes, products) on how to insert food in family's dietary routines.

The study was performed in respect of the Italian regulation regarding potential sensitive data and according to the World Medical Association Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects. Moreover, it was approved by the Ethic Committee of Psychology Research of Padua University.

Instruments

The survey was an adaptation of the survey on nutritional behaviour and attitudes in food-allergic children created and employed in a published study (6). Two questions assessed the approach towards food in terms of monotony of the diet

and interest about tasting new foods (on a Likert scale from 1 = not at all, to 5 = extremely) and were asked to mothers on the day of OFC and 6 months later. Two additional questions assessed the frequency of consumption of the reintroduced food (1 = never, 2 = rarely, 3 = sometimes, 4 = often) and the degree of change of nutritional habits (1 = not at all, 2 = slightly, 3 = moderately, 4 = very, 5 = extremely) 6 months after the OFC.

Maternal anxiety was evaluated using the State-Trait Anxiety Inventory (STAI) Y form (21) – Italian version. This simple and widely used test assesses two types of anxiety: state anxiety that is a temporary, transient, emotional condition and trait anxiety as disposition indicating anxiety proneness. State anxiety items include: 'I am tense; I am worried'. Trait anxiety items include: 'I worry too much over something that really doesn't matter'. The state and trait subscales both comprise 20 items rated on a 4-point scale. Higher scores indicate greater anxiety.

Statistical analysis

Descriptive analysis was performed on collected data. Frequencies were calculated on children's nutritional attitude variables, and Wilcoxon test was performed to assess differences between rates before and after the OFC. Mean values and standard deviations were calculated on maternal anxiety scores. The *t*-test was performed to assess differences between scores before and after the OFC. Spearman rank correlation test was used to measure the degree of association between variables. Kruskal–Wallis test was performed to assess differences in frequency of consumption of the reintroduced food and changes in child's nutritional habits after OFC for type of food. Findings were analysed using the spss (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) statistical software package 21 version. The level of significance was set at 0.05.

Results

Patients

Eighty-six patients with a negative OFC were recruited, and 81 questionnaires were completed and returned and entered into the analysis.

Foods involved in OFC were milk (35), egg (36), tree nuts (3) peanuts (3) and wheat (4). Only two patients, who were previously allergic to egg, reported mild symptoms likely related to food allergy after introduction at home. Patients' characteristics were collected through a cross-check between mothers' report and hospital records and are showed in Table 1, along with mothers' characteristics. All children received the diagnosis and started an elimination diet within the first year of age.

Children's nutritional attitudes

Spearman rank correlation test showed no correlations between frequency of food consumption after OFC, degree

Table 1 Patients' and mothers' characteristics

	N (%)	Mean (SD)
Patients' characteristics		
Gender		
Male	48 (59.3)	
Female	38 (40.7)	
Age		
2–10	81	6.5 (4.1)
Number of excluded foods		
1	27 (33.3)	
2	31 (38.3)	
>2	23 (28.4)	
Previous anaphylaxis	18 (22.2)	
Adrenaline prescription	41 (50.6)	
Mothers' characteristics		
Age		
26–48	81	37.93 (4.54)
Education		
Middle school	11 (13.6)	
High school	42 (51.9)	
University	28 (34.6)	
STAI score		
Trait anxiety		37.27 (7.25)
State anxiety before OFC	81	37.84 (8.50)
State anxiety after OFC		30.40 (6.63)

OFC, oral food challenge.

Italian normative scores for women are mean = 39.93; SD = 11.00 for *state anxiety*, and mean = 41.27; SD = 10.82 for *trait anxiety*.

Cronbach's alpha $r = 0.91$; $r = 0.90$.

of change in child's nutritional habits after OFC and participants' characteristics such as mothers' age and education, child's age and sex, number of excluded foods, a previous medical history of anaphylaxis to any food and adrenaline prescription.

When asked about child's interest in tasting new foods before OFC, in a rising rating Likert scale from 1 to 5, 19% of mothers reported the minimum score (not at all), and 40% reported the maximum score (extremely). Six months after, 11% reported the lowest interest in tasting new foods and 48% the highest, showing a significance difference between percentages before and after OFC (Wilcoxon test $P < 0.0001$). Before OFC, 10% of mothers reported that their child's diet was extremely monotonous, while this percentage decreased to 0 after OFC (Wilcoxon test $P < 0.0001$). Complete response rates are showed in Table 2.

With regard to the frequency of consumption of the reintroduced food, only 1 (1.2%) patient never ate the food in the following 6 months after the OFC; 8 (9.9%) children had the food rarely (e.g. less than once a month); 20 (24.7%) patients ate the food sometimes; and 52 (64.2%) often. Regarding how much nutritional habits had changed after the OFC, 3 (3.7%) mothers declared their child did not change their nutritional habits at all, 7 (8.6%) changed them slightly, 18 (22.2%) moderately, 15 (18.5%) very much and 38 (46.9%) extremely. No significant differences were found in frequency of consumption of the reintroduced food and

Table 2 Child's nutritional behaviour and attitudes before and after OFC

Variables	Response rate before and after OFC (%)					Wilcoxon test
	1 not at all	2	3	4	5 extremely	
Child's interest in tasting new foods before OFC	19	9	21	12	40	0.0001
Child's interest in tasting new foods 6 months after OFC	11	9	19	14	48	
Monotony of the child's diet before OFC	36	17	22	15	10	0.0001
Monotony of the child's diet 6 months after OFC	57	16	22	5	0	

OFC, oral food challenge.

levels of change in child's nutritional habits after OFC with regard to type of food reintroduced (Kruskal–Wallis test $P > 0.05$).

Food consumption after negative OFC was positively correlated with child's interest in tasting new food before and after OFC ($r = 0.22$, $P < 0.05$ and $r = 0.32$, $P < 0.01$, respectively) and negatively correlated with monotony of the diet after OFC ($r = -0.24$, $P < 0.05$). No correlation was found between food consumption after negative OFC and monotony of the diet before OFC ($r = 0.06$, $P > 0.05$).

Maternal anxiety

As illustrated in Table 1, mothers reported lower scores for state anxiety before (Mean = 37.84; SD = 8.50) and after (Mean = 30.40; SD = 6.63) OFC in comparison with normative Italian data (Mean = 39.93; SD = 11.00) showing low levels of anxiety although in face of the threat of OFC. State anxiety significantly decreased after the OFC ($t = 8.040$; $df = 80$; $P < 0.001$). Trait anxiety (Mean = 37.27; SD = 7.25), as a stable tendency to experience and report negative emotions such as fears, worries, and anxiety across many situations, was also lower when compared to Italian female population (Mean = 41.27; SD = 10.82). However, differences between scores and norms are not significant.

Higher anxiety was associated with lower change in nutritional habits 6 months after the OFC. In particular, a negative correlation was found between trait anxiety before OFC and level of change in nutritional habits assessed after OFC ($P < 0.02$). State anxiety before and after OFC was found also negatively correlated to level of change in nutritional habits after OFC ($P < 0.02$). No correlations were found between anxiety and the frequency of consumption of the reintroduced food after OFC or participants' characteristics.

Discussion

The present study aimed to prospectively examine the role of child's nutritional attitudes and, secondly, the role of maternal anxiety (trait and state) in reintroducing the food after a negative OFC.

Most participants reported regular consumption of the reintroduced food and substantial changes in nutritional habits 6 months after OFC. However, results showed that 11.1% of children in our sample never or rarely ate the food after a negative OFC. Previous studies on reintroducing food

after negative OFC in children reported higher frequencies of introduction failures ranging from 17% to 32% (12–15). The discrepancy with our results could be explained first of all by the retrospective nature of other studies and then by variations in the definition of 'food introduction failure', by type of foods assessed, by OFC protocol (e.g. differences in total cumulative challenge dose) and by frequency symptoms reported by patients during introduction at home. A further possible factor influencing the rate of successful introduction could be the fact that participants in the present study were advised and guided by an allergist and a dietician for introduction of the food at home after a negative OFC. Reintroduction of food is organized according to patients' age and type of food. Patients are followed up after OFC by regular phone call. Suggestions (e.g. recipes, products) on how to insert food in family's dietary routines, considering also children's tastes, are provided.

Van der Valk et al. (15) underlined the importance of clear dietary advice and support after OFC to effectively reintroduce food at home. However, further research is needed to confirm this hypothesis.

Previous research reported food refusal as one of the most reported reasons of food introduction failure (12–15). This is the first study, to our knowledge, assessing prospectively the reintroduction of food after a negative OFC and exploring the role of child's nutritional attitudes.

Other evidences indicated that a number of children with food allergy may present nutritional difficulties, likely due to their troubled personal history with food (22). A previous study reported low interest in tasting new foods and monotonous or excessively restricted diet among food-allergic children (6). Among psychological treatments held in the Food Allergy Centre, 18% are requested because of eating problems (4). It is reasonable to believe that a complicated relationship with food can affect introduction/reintroduction of food. Consumption of the reintroduced food was positively correlated to child's interest in tasting new foods before and after OFC and to changes in child's nutritional habits after OFC. It was negatively correlated to monotony of the diet after OFC. No correlations were found with any participants' characteristics or maternal anxiety. Although present analysis does not allow to identify causal relations between variables, we can speculate that a positive attitude towards food facilitates reintroduction of food, but at the same time, reintroduction increases interest in tasting new foods, reinforces changes in child's nutritional habits and reduces monotony

of the diet, enabling a virtuous cycle, as illustrated in Fig. 1. This conceptual model should be examined and confirmed by further research.

On the other hand, a negative correlation was found between all maternal measures of anxiety and changes in child's nutritional habits after OFC. Results on maternal anxiety are consistent with previous research indicating that, for mothers of food-allergic children, anxiety scores are not elevated compared with normative data (5, 6, 23, 24).

State anxiety after OFC was significantly lower than state anxiety levels before OFC in our sample, indicating a relevant decrease in preoccupation related to possible reactions during OFC. Zijlstra et al. (25) found that parental state anxiety was significantly lower after double-blind, placebo-controlled food challenges, regardless of a positive or negative outcome and that it was still significant lower after 1 year. Although maternal anxiety was not associated with food consumption by children, in the present study, mothers with higher anxiety scores tended to report lower levels of changes in children's nutritional habits 6 months after OFC. Mothers with higher levels of anxiety could be more fearful or could have more difficulty in adapting to changes. Previously, it has been found that mothers' anxiety was associated with a decrease in the attendance to social events involving foods, highlighting a link between mother's well-being and managing food avoidance (6).

When interpreting the results of this study, some limitations have to be discussed. The survey used to assess child's nutritional attitudes was not formally validated, but composed according to a published study on nutritional behaviour and attitudes in food-allergic children (6) and clinical expertise. The assessment of children's nutritional attitudes was based only on mothers' perspective; further studies should consider other sources of evaluation. Trait anxiety was measured only once as it is considered a stable trait and to not to overburden mothers with questionnaires. However, it would have been interesting to measure it again after OFC

to assess possible variations and validation in this specific sample.

In conclusion, this study showed that child's nutritional attitudes, such as interest in tasting new foods before the OFC, were associated with successful reintroduction. We found low correlations, indicating that further research on a larger sample (and considering a larger number of variables) is needed to better explain food consumption variability. However, these findings can result as very meaningful for clinical practice. It appears that an evaluation of child's approach towards food before the OFC can be useful to identify patients at risk of food reintroduction failure. The importance of regularly reassessing food consumption in all patients after a negative food challenge is confirmed as essential. Children showing low interest in tasting new food before OFC should be particularly monitored in reintroduction of food (e.g. through follow-up phone call after OFC). Providing clear dietary advice to guide introduction of food tolerated at the OFC seems to be crucial in supporting these children and their families, who could also benefit from nutritional and/or psycho-educational support. Patients with evident difficulties could be addressed to a dietician and/or to a psychologist with expertise in food allergy for personalized interventions of food education in order to develop a balanced food approach. A multidisciplinary care plan would be recommended in patients who passed OFC, to reduce the risk of continuing total or partial food avoidance.

Conclusion

Assessing children's nutritional behaviours and promoting positive attitudes towards food and varied and stimulating diet seem crucial not only to an optimal daily management of food allergy, but also to prevent unnecessary food avoidance, psychosocial burden and reduced quality of life.

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Author contributions

All the mentioned authors read and approved the manuscript and agreed to the submission of the manuscript to the Journal. *Laura Polloni* contributed to the conception and design of the study, acquisition and interpretation of the data and preparation of the manuscript. She approved the final version of the manuscript. *Emilia Ferruzza* contributed to the conception and design of the study, interpretation of the data and critical revision of the manuscript. She approved the final version of the manuscript. *Lucia Ronconi* contributed to the design of the study, analysis of the data and preparation of the manuscript. She approved the final version of the manuscript. *Alice Toniolo*, *Francesca Lazzarotto* and *Roberta Bonaguro* contributed to the design of the study, interpretation of the data and preparation of the manuscript. She approved

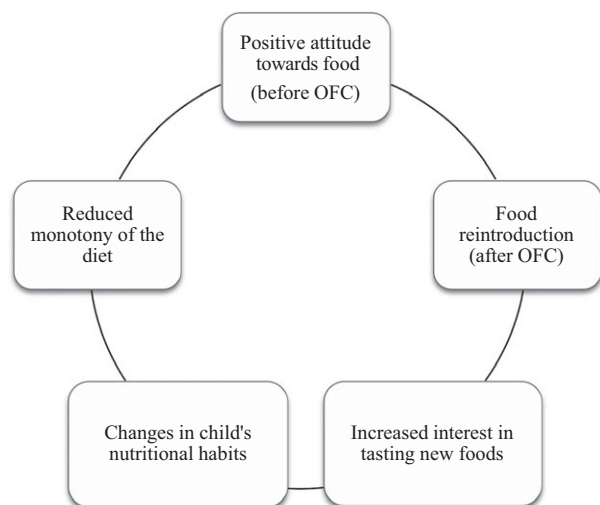


Figure 1 Nutritional attitudes virtuous cycle.

the final version of the manuscript. *Nicolò Celegato* contributed to the design of the study, interpretation of the data and preparation of the manuscript. He approved the final version of the manuscript. *Antonella Muraro* contributed to the conception of the study, interpretation of the data and critical revision of the manuscript. She approved the final version of the manuscript.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

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