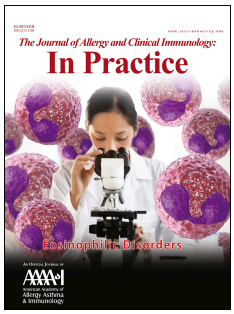
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Impact of a dietitian-led counselling program to support transition to whole foods during oral immunotherapy

Hélène Leroux, RD, Stéphanie Pernice, RD, Élise Dufresne, RD, Kathryn Samaan, MD, Jonathan Lacombe Barrios, MD, Louis Paradis, MD FAAAAI, Anne Des Roches, MD FAAAAI, Geneviève Mailhot, RD, PhD, Philippe Bégin, MD, PhD, FAAAAI

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Impact of a dietitian-led counselling program to support transition to whole foods during oral immunotherapy

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Author Contributions: HL, GM and PB conceived the project, HL, KS, JLB, LP, ADR and PB assessed and recruited participants, HL and SP performed the intervention, HL and ED performed data collection; HL and PB analysed the data and drafted the original manuscript. All authors critically reviewed the final manuscript.

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Clinical Implications

Adherence to OIT treatment can be compromised by lack of suitable alternatives in allergen doses. This study demonstrates the efficacy of a nutritional intervention program to support patients and highlights the need to include dietitians in multidisciplinary OIT teams.

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To the Editor:

Treatment of food allergies is entering a new era with the emergence of oral immunotherapy (OIT) as a valid alternative to strict avoidance of the causal food allergen [1 2]. OIT involves the daily ingestion of the allergenic food protein following a personalized dosing schedule and is often initiated using food flours precisely weighed by trained professionals. Allergen doses are progressively increased until an equivalent amount in whole food can be measured at home by families (whole peanuts, milk, tahini, soy milk, etc.) [1 3]. Lack of variety and taste aversion are frequent and non-negligible issues that can seriously compromise treatment adherence and potentially lead to the loss of desensitization [1].

The role of the registered dietitian has not yet been defined in the context of OIT [1 4]. To address this gap in knowledge, we created a dietitian-led counselling program based on patients' needs with supporting written documents to facilitate the appropriate selection and equivalent dosage of food alternatives. Methods and results for the needs assessment interviews and for the development of the written documents are available in the online repository. Examples of these written documents will also be made available through the Canadian OIT guidelines. The impact of this intervention on parent's satisfaction and competency at safely preparing equivalent doses with food alternatives and on the likelihood of using them at home was assessed.

An open-label randomized controlled trial was undertaken with food allergic children treated with OIT for peanut, wheat, milk, nuts, sesame and/or soy in Montreal, Canada. The study was approved by the institution's ethic committee. Written informed consent was provided by each participant prior to data collection.

Parents able to communicate in French were invited to participate. Exclusion criteria included not being treated for any of the allergens listed above, having already introduced whole foods or being unwilling to comply with study requirements. Participants were randomized when transitioning to whole foods to one of the three intervention arms, using computer-generated block randomization (Figure 1):

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A) Dietitian counselling on whole food alternatives with supporting written documents (full intervention), performed 2 weeks after randomization.

B) Dietitian counselling on whole food alternatives performed 2 weeks after randomization, with documents provided only 4 weeks later (partial intervention).

C) No intervention other than normal OIT follow-up for 6 weeks, followed by the full intervention.

Difference in competency before and after intervention as well as between full and partial intervention were measured by submitting parents to a practical exam (example provided in online repository). Parents were asked to provide the equivalent amount of three alternative products for a given dose of one of their child's allergens. A margin of error of 10% was tolerated. They were allowed to use any resources available to them (e.g. internet, notes, etc.). Competency assessment was repeated after 3 months to measure knowledge retention.

Four weeks after the initial intervention, parents rated their overall satisfaction with equivalence training and indicated if they had used any alternative foods at home.

Statistical analysis used paired or unpaired T-test, Mann-Whitney Test and Fisher's exact test, with significance level at a p-value < 0.05.

Thirty (30) participants were recruited from February 2018 to February 2019 (Table 1). Seven participants were excluded and replaced because they had completed their OIT updosing before the second study visit and declined to come back (Figure E1).

At 4 weeks, the practical exam score was in average 90 percentage points higher (± 1.7) in the full intervention group compared to group without intervention ($p<0.0001$) (Figure 1). When combining group A and C (n=20), competency increased immediately after the full intervention, from a mean score (± SEM) of 1.7% (± 1.7) to 93.3% (± 3.1) ($p < 0.001$). Competency was maintained over time with mean scores of 88.2% (± 4.9) and of 88.9% (± 4.7), 4 and 12 weeks after intervention, respectively (Figure 1).

Partial intervention (group B) improved baseline scores, but had a more modest effect on parent's competency compared to full intervention (46.7% ± 7.3) (Figure 1). After 4 weeks, the average

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score in that group decreased to 26.7% ± 5.1, indicating poor retention, but still remained significantly higher than without counselling. Importantly, competency could be rescued by the addition of the written documents at week 4 (83.3% ± 7.5) and was maintained at week 12 (81.5% ± 5.9) (Figure 1).

The average time (± SEM) required to perform calculations immediately after counselling alone in group B (543 ± 68 seconds) was also greatly decreased by the addition of the written documents (67 ± 10 seconds) ($p < 0.001$).

Parent's satisfaction concerning the support with food dosing increased from a median neutral perception to a generalized high satisfaction following partial or full intervention ($p<0.0001$) (Figure E2). None of the participants had spontaneously used alternative food forms prior to the intervention or following counselling alone without documents. When considering all patients, 15 patients (50%) had experimented food alternatives at home, 4 weeks after getting the documents. The most frequent options used for peanut included M&M®, peanut butter, peanut flour in muffins or apple sauce. For alternative to milk, yogurt was generally preferred to ice cream.

This study demonstrates the efficacy of a nutritional intervention program in OIT to teach families manage whole foods at home. There is little literature on the use of whole foods as most clinical trials have used flour to allow consistency and blinding [5 6]. However, finding appropriate whole food alternatives appears essential to the success of OIT over time. One study of long-term outcomes of peanut OIT reported that all participants used other forms than peanut, often varying between products to ensure diversity [7]. Private allergists offering OIT in North America have also reported using various food forms for daily dosing, but without mentioning how patients could alternate between them [3].

Providing written documentation in association with the dietitian-led counselling is shown to be essential, as it was associated with higher immediate competency, better retention and successful use of alternative foods at home. Some parents were able to perform calculations

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116 correctly without the documents, but took in average 10 times longer to complete them. It may
117 therefore still constitute a barrier for the use of these alternatives in real-life.

118 Parents reported higher satisfaction following the intervention, which highlights the importance of
119 including a dietitian in the multidisciplinary management team for OIT. It is likely that the
120 unblinded intervention had an impact on the parents' expression of satisfaction. Elements raised
121 to justify lower satisfaction expressed prior to the intervention was the fact that food alternatives
122 had not been systematically or enough addressed by allergists or nurses.

123 One strength of this study was the randomized controlled design which allowed a robust
124 demonstration of the intervention efficacy. One limitation to consider is that the small sample size
125 did not allow for subgroup analysis, which could have informed on potential cofactors affecting
126 the competency. However, considering the universally low score on initial exam, there does not
127 appear to be a subgroup of parents who would not benefit from the intervention.

128 The pre-intervention examination shows that calculation of equivalent food alternatives is not self-
129 evident and needs to be taught. Simply allowing the use of food alternatives without validating
130 patient's competency is insufficient considering that most parents are unable to adequately
131 perform calculations on their own without training. It is also important to note that the role of the
132 dietitian during OIT goes beyond counselling on whole food alternatives. Eating habits can be
133 substantially modified during OIT and lead to a variation of the nutritional status[8] and nutritional
134 deficiencies can persist even after an OIT protocol [9].

135

136 In conclusion, this study provides compelling evidence for the benefit of a dietitian-led intervention
137 to ensure parents' competency with the use of whole food alternatives. Registered dieticians
138 should therefore be included in the multidisciplinary OIT team.

139

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Tables and figure

Table 1. Study population characteristics

Characteristics		Group A (n = 10)	Group B (n = 10)	Group C (n = 10)	Total (n = 30)
Patient	**Gender**				
	Male	7 (70%)	9 (90%)	7 (70%)	23 (77%)
	Female	3 (30%)	1 (10%)	3 (30%)	7 (33%)
	Age, years	4.9 ± 1,8	9.6 ± 4,9	5.6 ± 4,3	6.7 ± 4,3
	No of allergens treated				
	1	2 (20%)	6 (60%)	5 (50%)	13 (43%)
	2	3 (30%)	2 (20%)	2 (20%)	7 (23%)
	3	1 (10%)	2 (20%)	0	3 (10%)
	4	3 (30%)	0	2 (20%)	5 (17%)
	5	1 (10%)	0	1 (10%)	2 (7%)
	Allergens treated				
	Peanut	8	7	8	23
	Wheat	1	0	0	1
	Milk	3	5	4	12
	Nuts	7	1	3	11
	Sesame	4	2	2	8
Parent	**Gender**				
	Male	3 (30%)	1 (10%)	4 (40%)	8 (27%)
	Female	7 (70%)	9 (90%)	6 (60%)	22 (73%)
	Age				
	25-34	4 (40%)	0	2 (20%)	6 (20%)
	35-49	6 (60%)	10 (100%)	7 (70%)	23 (77%)
	50-64	0	0	1 (10%)	1 (3%)
	Education				
	Diploma of vocational studies	1 (10%)	0	1 (10%)	2 (7%)
	Diploma of College studies	0	2 (20%)	1 (10%)	3 (10%)
	University certificate	0	1 (10%)	2 (20%)	3 (10%)
	Bachelor	5 (50%)	5 (50%)	3 (30%)	13 (43%)
	Master	2 (20%)	1 (10%)	1 (10%)	4 (13%)
	Doctorate	2 (20%)	1 (10%)	2 (20%)	5 (17%)

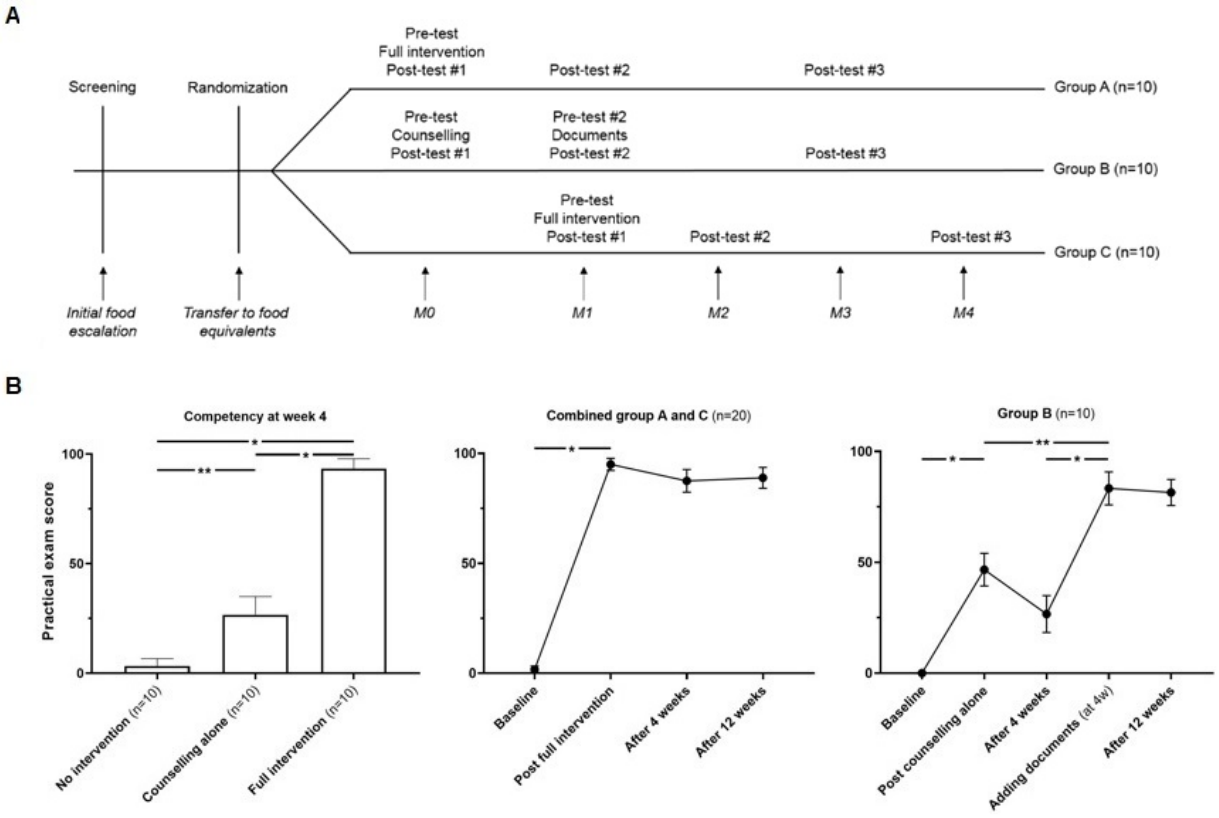
Data are presented as number (and percentage) of participants or mean ± SD.

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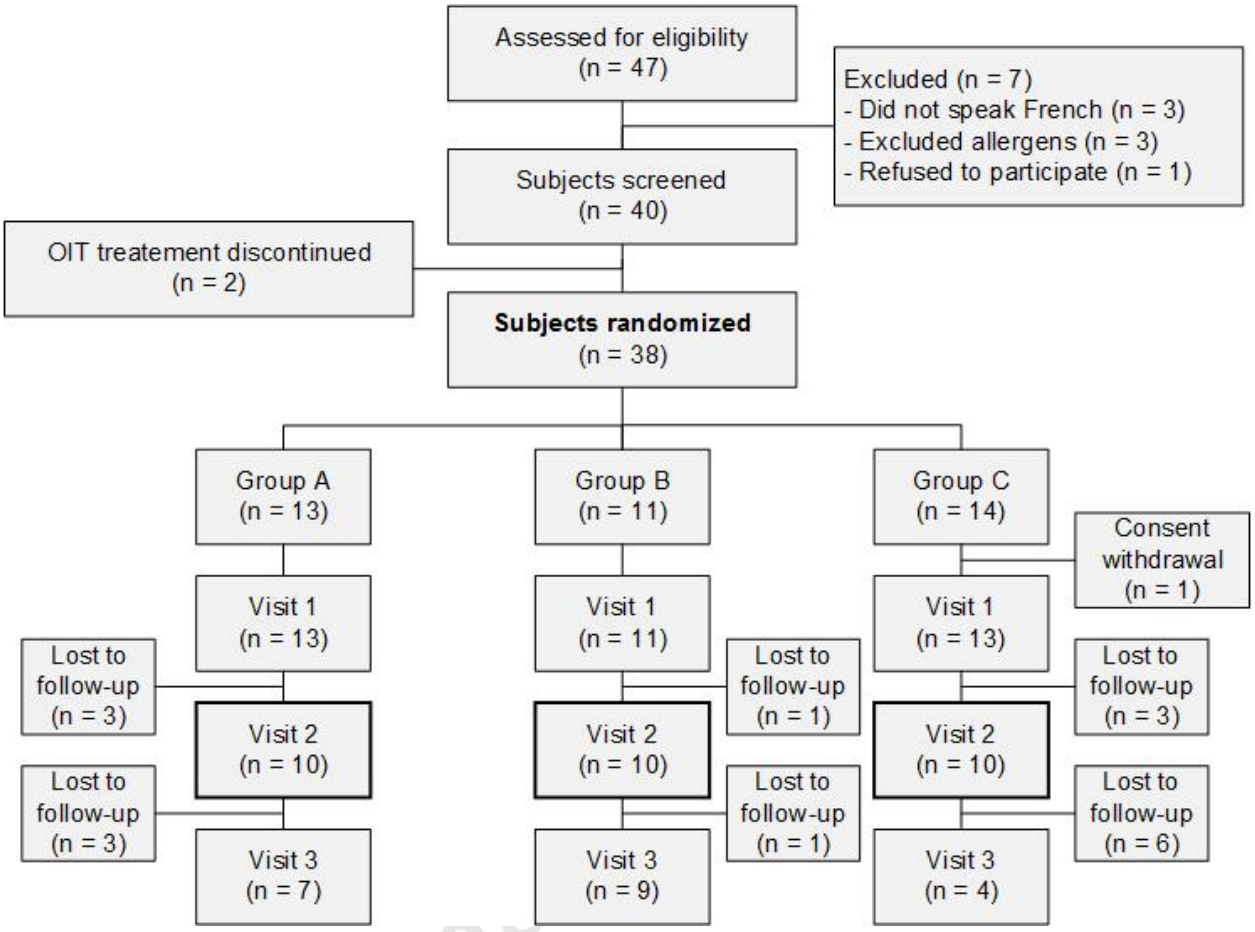
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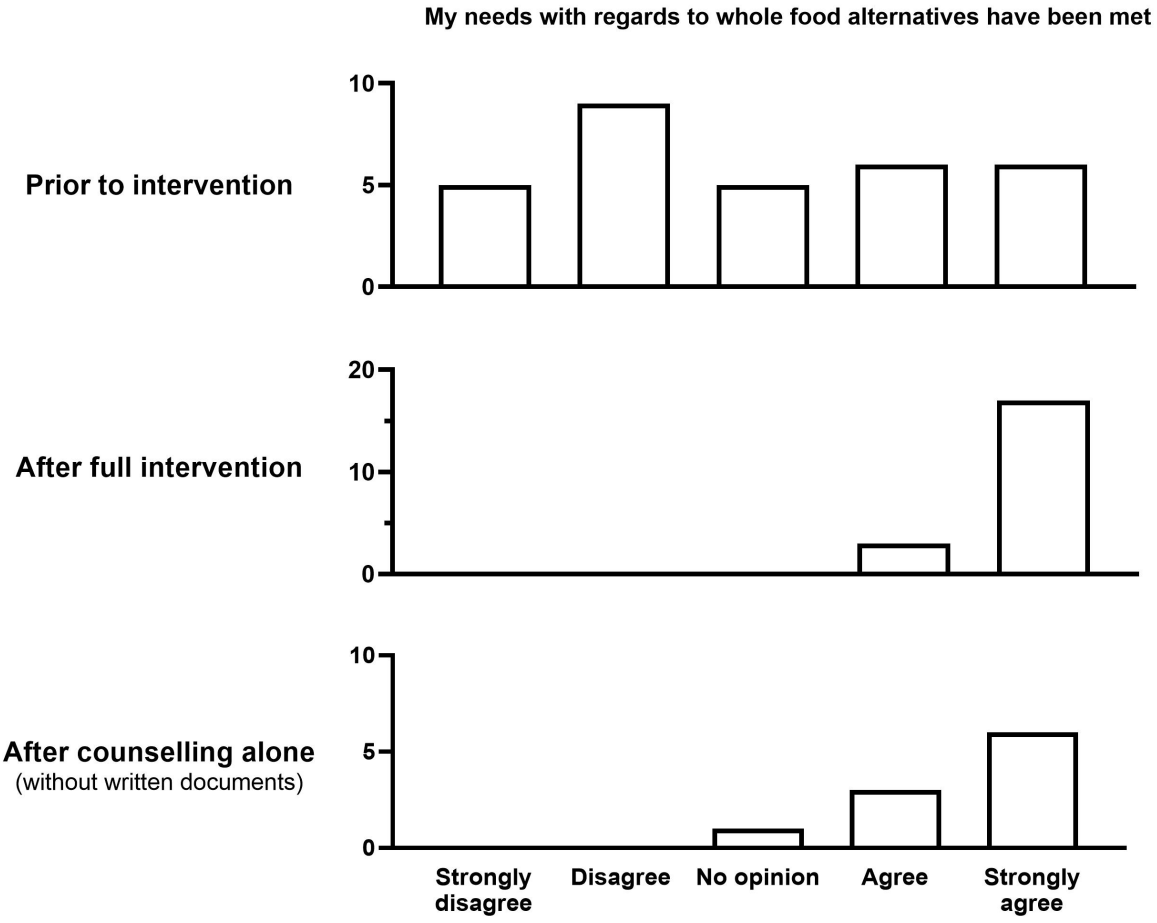
Figure 1. Impact of intervention on patient competency. Panel A indicates the general study design based on randomization arms, where M0 represents Month 0 (first visit after transfer to whole foods) and where full intervention represents the dietitian counselling with supporting written documents. Panel B shows the improvement in parent's competency over time for each study arm. Error bar indicates standard error of mean. * $p < 0.001$; ** $p < 0.05$

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A
Screening
Randomization
Pre-test
Full intervention
Post-test #1
Post-test #2
Post-test #3
Group A (n=10)
Pre-test
Counselling
Post-test #1
Pre-test #2
Documents
Post-test #2
Post-test #3
Group B (n=10)
Pre-test
Full intervention
Post-test #1
Post-test #2
Post-test #3
Group C (n=10)
Initial food escalation
Transfer to food equivalents
M0
M1
M2
M3
M4
B
Competency at week 4
Practical exam score
100
50
0
No intervention (n=10)
Counselling alone (n=10)
Full intervention (n=10)
Combined group A and C (n=20)
Baseline
Post full intervention
After 4 weeks
After 12 weeks
Group B (n=10)
Baseline
Post counselling alone
After 4 weeks
Adding documents (at 4w)
After 12 weeks

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Assessed for eligibility
(n = 47)
Excluded (n = 7)
- Did not speak French (n = 3)
- Excluded allergens (n = 3)
- Refused to participate (n = 1)
Subjects screened
(n = 40)
OIT treatement discontinued
(n = 2)
Subjects randomized
(n = 38)
Group A
(n = 13)
Group B
(n = 11)
Group C
(n = 14)
Consent
withdrawal
(n = 1)
Visit 1
(n = 13)
Visit 1
(n = 11)
Visit 1
(n = 13)
Lost to
follow-up
(n = 3)
Lost to
follow-up
(n = 1)
Lost to
follow-up
(n = 3)
Visit 2
(n = 10)
Visit 2
(n = 10)
Visit 2
(n = 10)
Lost to
follow-up
(n = 3)
Lost to
follow-up
(n = 1)
Lost to
follow-up
(n = 6)
Visit 3
(n = 7)
Visit 3
(n = 9)
Visit 3
(n = 4)


My needs with regards to whole food alternatives have been met
Prior to intervention
After full intervention
After counselling alone
(without written documents)
10
5
0
20
10
0
10
5
0
Strongly disagree
Disagree
No opinion
Agree
Strongly agree

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Impact of a dietitian-led counselling program to support transition to whole foods during oral immunotherapy

Online Repository Material

Needs assessment

Individual interviews were conducted with ten parents of children undergoing OIT having already began the use of whole food doses at home, to assess parents' perspective and needs with regards to the selection of appropriate allergen forms. Semi-structured interviews were conducted exploring parents' experience with OIT related to food alternatives, their specific needs for professional support and the best approach to meet those needs. Interview transcripts were manually reviewed by two assessors for content analysis of underlying themes, with any discordance resolved by discussion.

Content analysis of needs assessment interviews

All families participating to the interviews reported dosing with the same type of food every day. The extent to which the lack of food variety was perceived as a problem was variable. While some children liked the taste of their food or of the vector in which it was given (e.g. yogurt), some children did not like it, which resulted in apprehension:

> *'She really doesn't like the taste of peanuts. It's a fight every time... and now she is already anticipating the next appointment because she knows she's going to have to eat even more.'* (Mother of 8 y-o girl desensitized to peanut)

Some identified this as a potential threat to treatment success over time:

> *'I think most people are going to want to stay with the winning formula, you sort of become a parent-expert… you know what to expect. But if it ever gets more difficult, I would be happy to have a plan B… cause if you have to fight with the child, it becomes negative and he will register it as a negative experience. Because*

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it's recurrent everyday, it needs to stay positive' (Mother of 7 y-o girl and 5 y-o boy both desensitized to peanut)

None of the participants had experimented with food alternatives spontaneously. They reported not knowing how to calculate food alternative doses or of being uncomfortable with the risk of error.

'I wouldn't dare try this by myself… I'm already of anxious nature and I wouldn't want to be responsible for triggering a reaction' (Mother of 2 y-o boy desensitized to milk, soy and wheat)

All participants viewed a professional consultation to teach alternative dosing options positively. The advantages ranged from preventing aversion, ensuring greater diversity in diet, increasing confidence in ability to manage doses themselves, as well as greater freedom and practicality:

'During traveling, it would be really useful! It's bothersome having to drag peanut butter everywhere. It's big, sticky, messy and with the second child I need to be careful to wash everything perfectly. It's not practical to measure when we're not at our house.' (Mother of 7 y-o girl and 5 y-o boy both desensitized to peanut)

The supporting document was viewed as something useful that would increase confidence and decrease risk of error. It would also facilitate knowledge transfer to spouse, family or other guardians and was perceived by teenagers as a road to self-management:

'Yeah, I'd like that! That way I could just chose myself what I want to use, you know and I wouldn't need anything else than what's on the sheet.' (15 y-o girl desensitized to milk)

To be useful, participants thought it was important for the supporting document to be simple and rapid to use. It should include pre-calculated options using measures in volume rather than weigh, always indicating the protein equivalents as with OIT doses in clinic. It should include a

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variety of products and recipes to maximise its impact on diet diversity. It should also be visually attractive:

> *'You just put it on the fridge and just by looking, with the images and big titles I know right away how much I need to give, you know… One page for each allergen… that way I just show it to grandma when she comes to the house.'*
> (Father of 6 y-o boy desensitized for wheat, milk and egg)

Development of the intervention

A counselling program was developed based on interview contents by two registered dietitians (RD) with specific experience in OIT at the Sainte-Justine University Hospital Center allergy clinic in Montreal, Canada. The personalized counselling session was provided by the OIT clinic's dietitian to each patient and their parents, 2 weeks after they transferred to whole food. This counselling included monitoring of nutritional status as well as guidance and teaching about the use of food alternatives at home.

In addition, supporting written documents were created for the eleven allergens most commonly used in the OIT clinic (peanut, wheat, milk, almond, cashew, walnut, pecan, hazelnut, pistachio, sesame and soy). These documents listed the equivalent amount of each food alternative to be used at each dosing step. For example, specific amounts needed at each treatment step were indicated for whole roasted peanuts, peanut butter or a peanut-flour muffin prepared with a predetermined recipe. The protein contents used were based on nutritional values from the *Canadian Nutrient File* and the *United States Department of Agriculture Food Composition Databases*. In some cases, companies were directly contacted to get more precise information about the protein content of their products (e.g. exact fraction of protein content from sesame in a specific hummus brand). Brands from companies that did not want to share information were not included. The written documents were validated by the allergists at the OIT clinic.

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EXAMPLE OF PRACTICAL EXAM FOR PEANUTS

1) How much **Kraft peanut butter** should you eat to replace a daily dose of 6 peanuts?

Answer : _____

2) How much **PB2 peanut butter powder** should you eat to replace a daily dose of 6 peanuts?

Answer : _____

3) Another possibility is to make a muffin recipe, by replacing some of the usual wheat flour by peanut butter flour.

How much **Peanut Butter flour from Nuts.com** should you use in a recipe of 12 muffins, so each muffin represents one daily dose of 6 peanuts?

Answer : _____

SCORE : ☐ 0 % ☐ 33 % ☐ 66 % ☐ 100 %

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FIGURES LEGENDS

Figure E1. Flow diagram of the study

Figure E2. **Parent's satisfaction with intervention.** Comparing participants satisfaction toward support with food dosing at baseline (n=30), after the full intervention (n=20) or after counselling without supporting written documents (n=10). The Y-axis indicates the number of participants that chose each Likert scale option.

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