

ORIGINAL ARTICLE

Multidisciplinary education improves school personnel's self-efficacy in managing food allergy and anaphylaxis

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Abstract

Background: Despite a relatively high risk for allergic reactions, including anaphylaxis, schools are not sufficiently trained and confident in handling children suffering from food allergy. This study aimed to measure the improvement of school personnel's self-efficacy in managing food allergy and anaphylaxis at school after a specific multidisciplinary training course.

Methods: A total of 592 teachers and school caretakers completed the School Personnel Self-Efficacy-Food Allergy and Anaphylaxis Questionnaire (S.PER.SE-FAAQ) before and after the course. The median difference, along with I quartile and III quartile, in scores between baseline and post-intervention assessment was calculated. A conditional regression tree was fitted for each outcome measured after the educational intervention.

Results: At baseline, school personnel reported low self-efficacy in anaphylaxis management (AM), especially in recognizing anaphylaxis symptoms and administering proper drugs. After the specific multidisciplinary training course, all scores improved. AM scores particularly showed a significant increase. School personnel's post-training self-efficacy was found to be related to initial levels. Some indicative threshold values emerged. Remarkably, participants with a low self-efficacy at baseline seemed to particularly benefit from the training.

Conclusions: Results highlighted the effectiveness of specific multidisciplinary training courses in improving teachers' and school caretakers' self-efficacy in managing food allergy and anaphylaxis. The S.PER.SE-FAAQ is confirmed to be an easy and helpful tool to assess the level of food allergy and anaphylaxis management in the school staff and training effectiveness.

KEYWORDS

anaphylaxis, children, education, food allergy, management, school, self-efficacy, training

1 | INTRODUCTION

Food allergy (FA) affects up to 4%-7% primary school children in Europe.¹ The lifetime prevalence of parental perceived allergic

reactions to food was 10.5% in Italian school-aged children.² The European Anaphylaxis Registry reported that 9% of anaphylactic cases occurred at school.³ A French study found that 7% of school principals reported a total of 60 allergic reactions during 1-year study period.⁴ These reactions occurred in 23% of the cases in nursery, 30% in primary, 28% in middle and 18% in high schools. Of the 60

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allergic reactions, 92% were highly suspected to be food-related and 50% occurred in children who were not known to be allergic to food.⁴ While management of FA is primarily avoidance, the frequency of reactions at school, including anaphylaxis, makes it crucial for schools to be prepared to recognize and treat food-induced allergic reactions.⁵ However, previous study has identified some major limitations on FA and anaphylaxis management in the school settings, such as failures in recognizing allergic signs and in implementing proper management plans.⁶⁻⁹ FA fatalities have been also reported at school.¹⁰ Many fatal cases of anaphylaxis have been attributed to an initial delay in treatment, often caused by a general failure to recognize early symptoms of reaction and/or by reluctance to administer adrenaline auto-injector (AAI).¹⁰⁻¹² Despite a relatively high risk for anaphylactic events, school and kindergarten staff is not sufficiently trained and confident in handling children suffering from FA.^{5,13,14} We previously showed important shortcomings in Italian school personnel knowledge and attitudes on food-allergic students' management, emphasizing the need for specific educational interventions.¹⁵ Attitudes of school personnel is one of the most important factors for ensuring proper treatment of children at risk of severe allergic reactions.¹⁶ The beliefs people hold about their efficacy to exercise control over events influence the choices they make, their aspirations, efforts, perseverance and performance accomplishments. According to social cognitive theory, perceived efficacy is the foundation of human agency.^{17,18} Many studies support the role of self-efficacy in different domains of functioning including health management and education.¹⁹⁻²² In a previous study, we showed that school personnel had a lower self-efficacy when asked to manage anaphylaxis, especially in recognizing symptoms and administering proper drugs.²³

A Japanese study involving school nurses, teachers and childcare workers found that training with practical instruction of school personnel involved with children prescribed an AAI resulted in significant improvement of the self-efficacy.²¹

It is worth mentioning that there are no school nurses among school staff in Italy, so the management of students with FA weighs on lay school personnel. The present study aimed to measure the improvement of school personnel's self-efficacy in managing FA and anaphylaxis at school after a specific multidisciplinary training course.

2 | METHODS

2.1 | Participants

A total of 592 Italian schoolteachers and school caretakers, who voluntarily attended free courses on FA and anaphylaxis management, took part in the study. School caretakers include support staff in charge of supervising students before and after lessons and during breaks, and giving assistance during meals in school canteens, in collaboration with teachers. Participants worked in schools in the Veneto Region, from nursery to high school level. Curricular education of school personnel generally includes first aid courses. However, no specific training is provided on FA and anaphylaxis management.

Key message

About 9% of anaphylaxis occurred at school in Europe. However, school staff have been found to be poorly prepared to manage food allergy, especially recognizing and properly treating allergic reactions.

This study demonstrates that a specific multidisciplinary training course can significantly improve teachers and school caretakers' self-efficacy in managing food allergy and anaphylaxis and offers a validated and easy instrument to measure baseline self-efficacy and intervention effectiveness. Results empower the development of food allergy training programmes to guarantee a safe school setting for an increasing number of children and adolescents.

2.2 | Instrument

Participants completed the School Personnel Self-Efficacy-Food Allergy and Anaphylaxis Questionnaire (S.PER.SE-FAAQ) before and after the course. The S.PER.SE-FAAQ is a brief and validated instrument to assess school personnel's self-efficacy in managing students with FA.²³ It consists of 8 questions and comprises two main factors: Anaphylaxis Management (AM) and Food Allergy Management (FAM). The tool revealed good internal consistency.²³ Answers were provided on a scale from 1 ('cannot do at all') to 5 ('highly certain can do').

2.3 | Procedure

Participants completed S.PER.SE-FAAQ anonymously before and after attending the course. They were advised that their data would be used for research aims, also explaining the main objective of the study. The study was performed in respect of the Italian regulation and according to the World Medical Association Declaration of Helsinki Ethical Principles for Medical Research Involving Human Subjects.

We assessed in total six courses free of charge organized by the Food Allergy Centre in Padua, in collaboration with the National Patients' Association 'Food Allergy Italia', over a 12-month period.

2.4 | Multidisciplinary training course

The course was organized according to regional law (LR n26; 26/11/2004) recommending FA and anaphylaxis training at all school levels in order to prepare school personnel to manage FA needs and emergencies both from a practical and from a psychological point of view.

Each course consisted of one 2-hour intensive session conducted by an allergist and a psychologist with extensive expertise in FA, and a lawyer. Each course included the following:

- A presentation of FA and anaphylaxis, with descriptions of allergic mechanisms, signs and symptoms, practical instructions for preventing and treating allergic reactions, explanation of a detailed emergency action plan and practical demonstrations on how to use an AAI with the help of training devices. Each participant was provided with an AAI training device and was recommended to try it at least twice.
- A presentation of national and regional regulation on life-saving drug administration in the school setting, with particular reference to FA.
- A discussion of psychosocial issues of FA, with case presentations of critical situations in the school settings, such as attending school canteen, school trips, laboratory, school parties and risk of bullying, and presentation of practical strategies of effective management. A discussion of psycho-emotional issues of FA, such as fear of reactions, reluctance in using AAI, children and parental food-related anxiety.

2.4.1 | Power analysis

The study was planned expecting the participation of at least 500 of subjects, each observed twice (before and after the intervention). We expressed the estimated effect in standardized terms (standard deviation units). If the true difference in the standardized mean response of matched pairs is assumed to be 1, we will be able to reject the null hypothesis that this response difference is zero with probability (power) $>.80$ if the standard deviation would not exceed by more than seven times the expected effect. The type I error probability associated with this test of this null hypothesis is 0.05.

2.5 | Statistical analysis

The median difference in total score, AM and FAM between baseline and post-intervention assessment is calculated along with I quartile and III quartile, stratifying by each covariate. Cronbach's alpha has been calculated to assess instrument reliability in this sample.

A conditional regression tree²⁴ was fitted for each of the following outcomes measured after the educational intervention: total score, AM and FAM. Type of school, age, gender, job, previous information on anaphylaxis, previous attendance to first aid courses, previous students with FA and the baseline score were included as potential covariates.

Given the observational nature of the study and the complex interactions expected among factors influencing school personnel capability of managing allergic episodes, standard techniques are applicable only at the price of adding several assumptions

and constraints to the analysis.²⁵ To overcome such limitations in standard modelling, a tree-based regression model has been constructed. Conditional regression trees are statistical techniques for partitioning the study population, on the basis of covariates, into distinct subgroups who share similar outcome values. Such models are natively capable to deal with complex interactions among explanatory variables and with the outcome. The key step in constructing decision trees is the *splitting step*, where the decision is made on how to partition the sample into two disjoint subsets according to covariate values. Splitting continues recursively down each branch until a *stopping rule* is satisfied. The set of terminal nodes defines a disjoint partition of the original sample. A conditional regression tree relies on the following statistical inference procedure in each splitting step: the association between each covariate and the outcome is quantified using the coefficient in a proper regression model, and a node is only chosen to be split if there is sufficient evidence to reject the global hypothesis that none of the covariates has a univariate association with the outcome. If the global null hypothesis is rejected, then the covariate that displays the strongest association with the outcome of interest is selected as a candidate for splitting. If the minimum *P*-value is larger than the multiplicity-adjusted significance threshold (in our case, .20), then no variable is selected for splitting and the node is declared a terminal node. Data on residual deviance have been presented as a goodness-of-fit measure.

R software²⁶ version 3.4.3 and ctree package were used for the analysis.

3 | RESULTS

A total of 592 participants attended the course. Most were female teachers (in line with the demographic composition of the school staff in Italy) working in nursery/primary school; previously, they attended first aid courses, received some information about anaphylaxis and worked with students with FA (Table 1). The questionnaire administered confirmed good psychometric properties also in this sample (Cronbach's alpha 0.86, 95% CI 0.86-0.88). The differences in total score, AM score and FAM score post- and pre-course (median and IQR) are shown in Table 1. Boxplots of baseline and post-course scores for each item are shown in Figure 1, while post-pre differences in each item score are shown in Table 2. There are larger post-pre differences in items defining the AM score than FAM score.

Variables retained by the conditional inference tree on total score are those appearing in Figure 2. By looking at the left branch at the top of the tree, it may be observed that 27 is a sensitive threshold of baseline score, which may impact the final score achievement. As common in non-randomized, observational studies, baseline values are providing useful information besides being a necessary adjustment factor. Participants with a baseline score ≤ 17 increased their final score to a median value of 25 (ICQ range 23-29), regardless of other covariates. People with a baseline

	N	Post-pre difference Total score	Post-pre difference AM score	Post-pre difference FAM score
Type of school				
Nursery	224	5 (2-8.25)	1 (0.67-1.67)	0.4 (0-1)
Primary	216	6 (3-9)	1 (0.67-1.67)	0.6 (0.2-1)
Middle	93	7 (2-9)	1 (0.67-1.67)	0.6 (0.2-1)
High	59	7 (3-10)	1 (0.50-1.67)	0.6 (0.2-1)
Gender				
Male	69	5 (2-8)	0.67 (0.33-1.33)	0.4 (0-1)
Female	523	6 (3-9)	1 (0.67-1.67)	0.6 (0.2-1)
Age				
19-41	163	6 (3-10)	1 (0.67-1.67)	0.6 (0.2-1)
41-49	151	6 (3-9)	1 (0.67-1.67)	0.6 (0.2-1)
49-55	147	5 (2.5-9)	1 (0.33-1.33)	0.4 (0.2-1)
55-69	131	6 (2-9)	1 (0.67-1.67)	0.6 (0.1-1)
Job				
Teachers	472	6 (3-9)	1 (0.67-1.67)	0.6 (0.2-1)
Caretakers	120	5 (1-9)	1 (0.33-1.67)	0.4 (0-1)
Previous first aid courses				
Yes	487	6 (3-9)	1 (0.67-1.67)	0.6 (0.2-1)
No	105	7 (4-10)	1.33 (0.67-2.00)	0.6 (0.2-1)
Previous information on anaphylaxis				
Yes	363	5 (2-8)	1 (0.33-1.33)	0.4 (0-0.8)
No	229	8 (5-12)	1.33 (0.67-2.00)	0.8 (0.2-1.2)
Previous students with food allergy				
Yes	306	5 (2-8)	1 (0.67-1.33)	0.8 (0.4-2.4)
No	286	7 (3.25-11)	1 (0.67-1.67)	0.7 (0.2-1.2)
Overall				
	592	6 (3-9)	1 (0.67-1.67)	0.6 (0.2-1)

TABLE 1 Post minus pre difference in total score, AM score and FAM score (median and IQR)

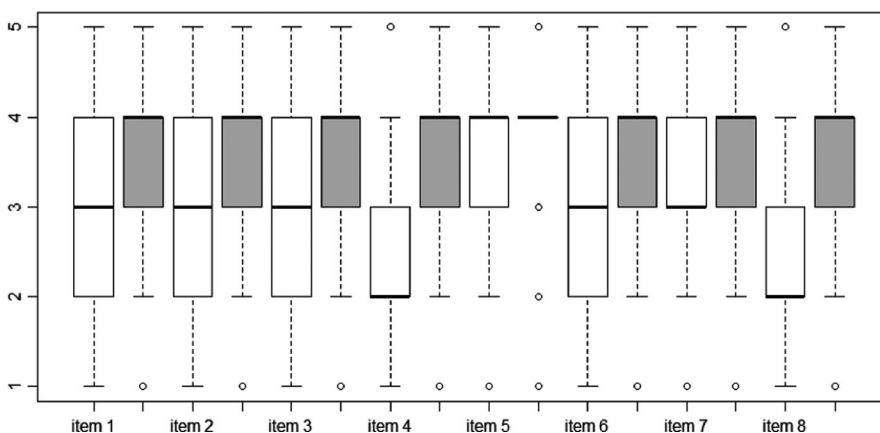


FIGURE 1 Boxplots of baseline and post-course (in grey) scores for each item

score between 17 and 27 increased their final score to a different extent depending on their age (P -value = .036) and profession (P -value = .026): up to a median value of 31 (ICQ range 30-35) under 33 of age and up to 29 (ICQ range 25-31) above 33 of age and caretaker as job. A further significant distinction (P -value = .048) is observed for baseline values between 17 and 23 (final score = 30,

ICQ range 26-32) and between 23 and 27 (final score = 31, ICQ range 29-32) in teacher job.

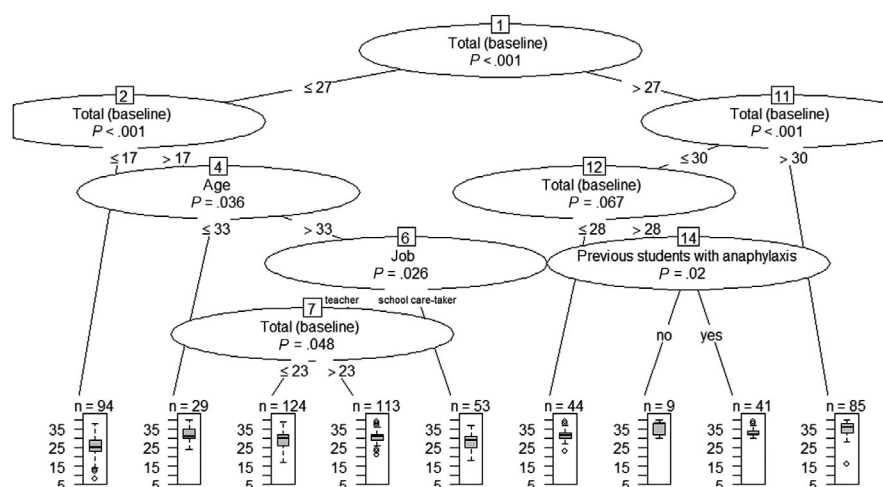
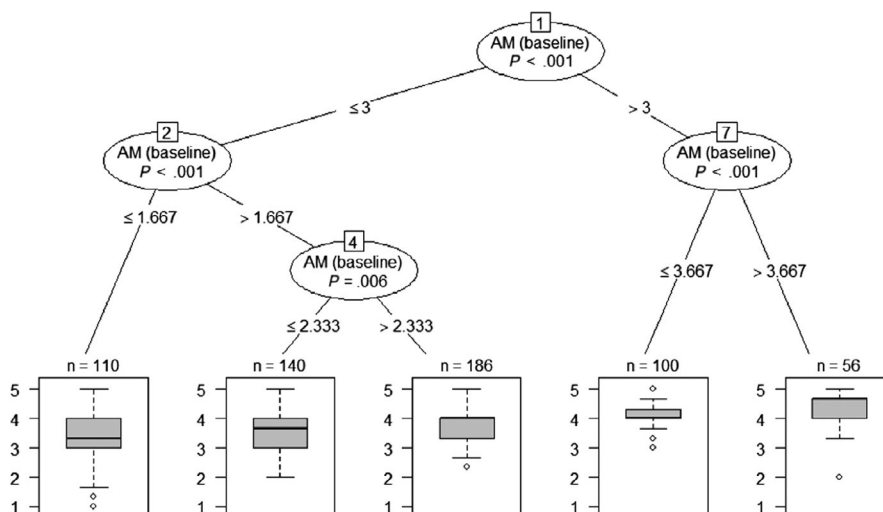
By looking at the right branch, it may be observed among baseline values >27 (node 11), 30 is an important threshold. People with a baseline score >30 increased their final score to a median value of 36 (ICQ range 33-38), while it was lower for a baseline value

TABLE 2 Post minus pre difference in each item score

Items	I quartile	Median	Mean	III quartile
1. Assure a safe school setting for students with food allergy (FAM)	0.00	0.00	0.61	1.00
2. Put in place a personalized care plan for the management of students' food allergy	0.00	1.00	0.84	1.00
3. Manage a student at risk of allergic reactions to food (AM)	0.00	1.00	0.88	1.00
4. Recognize anaphylaxis symptoms (AM)	0.00	1.0	1.1	2.0
5. Co-work with other professional and families in food allergy management at school (FAM)	0.00	0.00	0.52	1.00
6. Manage allergens avoidance (eg reading labels, avoiding contaminations) (FAM)	0.00	0.00	0.58	1.00
7. Guarantee full participation to all school activities to students with food allergy (eg attending school trips) (FAM)	0.00	0.00	0.47	1.00
8. Administer drugs (eg adrenaline auto-injector) to a student having a severe and sudden reaction (AM)	1.0	1.0	1.3	2.0

Note: Statistically significant differences are in bold ($P < .05$).

Abbreviations: AM, Anaphylaxis Management factor; FAM, Food Allergy Management factor.

FIGURE 2 Conditional inference tree on total score (post-intervention). Residual mean deviance: 16.12**FIGURE 3** Conditional inference tree on Anaphylaxis Management (AM) score (post-intervention). Residual mean deviance: 0.35

of 28 (final score = 31, ICQ range 30-33). Among subjects with a baseline value of 29 or 30, a significant difference (P -value = .02) exists depending on the information on anaphylaxis: median value of 38 (ICQ range 32-38) in final score for participants who had not previous information and 32 (ICQ range 32-34) for those who had, respectively.

Concerning AM score (Figure 3), the graph shows that the final score depends only on its baseline values before the educational intervention: below 1.667: median 3.33 (ICQ range 3-4); from 1.667 to 2.333: median 3.66 (ICQ range 3-4); from 2.333 to 3: median 4 (ICQ range 3.33-4); from 3 to 3.667: median 4 (ICQ range 4-4.33); and above 3.667: median 4.67 (ICQ range 4-4.67).

Conditional inference tree on FAM score post-intervention is shown in Figure 4. By looking at the left branch, it may be observed that 3.4 is an important threshold ($P < .001$) of baseline score, which impacts on final score. Participants with a baseline score ≤ 2 increased their final score to a median value of 3 (ICQ range 2.75-3.65), regardless of other covariates. People with a baseline score between 2 and 3.4 increased their final score to a different extent depending on whether this value is greater than 3.2 (P -value = .022) and on their job (P -value .171): up to a median value of 4 (ICQ range 3.6-4) in baseline values from 3.2 to 3.4 and between 3.4 (caretaker) and 3.6 (teacher) in baseline values below 3.2. A further significant distinction is observed for baseline values from 3.4 to 4 and above 4 ($P \leq .001$): for baseline values from 3.4 to 3.8, the median final score is 4 with ICQ range 3.8-4.2; for values between 3.8 and 4, it is 4 with ICQ range 4-4.4; and for values above 4, it is 4.6 with ICQ range 4.4-5.0.

4 | DISCUSSION

Food allergy and anaphylaxis management in schools is a growing crucial challenge. A comprehensive approach to FA training, ensuring all staff can prevent, recognize and initiate treatment of allergic reactions, has been recommended.¹ School personnel should be informed on food allergen avoidance strategies, allergic

and anaphylactic symptoms, how to respond to allergic reactions, local regulation and school policy and the psychosocial impact the diagnosis of FA may have on children and families.⁹ Practical instruction, simulation and case presentation have been recognized as an essential part of FA education to improve patients' safety.²⁷ Social cognitive theory provides a theoretical framework in which behavioural, cognitive and motivational factors related to learning interplay.^{17,18} According to Bandura's theory when trying to accomplish a difficult task, knowledge is not enough, but people with a high self-efficacy will try to engage in instrumental action and will apply strong efforts in pursuit of a solution. This study found that, at baseline, school personnel had moderate self-efficacy in FAM such as assuring a safe school setting for students with FA, co-working with other professional and families, managing allergens avoidance, guaranteeing full participation to activities to students with FA and putting in place a personalized FA care plan. However, consistent with literature data⁶⁻⁹ they reported low scores in AM, especially in recognizing anaphylaxis symptoms and administering proper drugs. After the specific multidisciplinary training course, all scores improved. Self-efficacy related to FA care plan management and AM particularly showed a significant increase. The effectiveness of simulation and practical trainings in improving FA and anaphylaxis management has been demonstrated for nurses and other health professionals,^{27,28} but only two previous studies focused on school personnel self-efficacy.^{21,22} The present study is the first led on a large sample of teachers and school caretakers from nursery to high school level. As in previous research,²⁹ school personnel's post-training self-efficacy was found to be related to initial levels of self-efficacy. As shown in figures, some indicative thresholds emerged for AM, FAM and total scores. Participants with a low self-efficacy at baseline seemed to particularly benefit from the training, in line with the literature.²⁹ Specifically for AM, participants who scored ≤ 1.667 at baseline (19%) after the course doubled their score, registering the largest increase (median 3.33; ICQ range 3-4). Concerning total score, participants with a baseline score < 17 increased their final score to a median value of 25, regardless of other covariates. People with a baseline score between

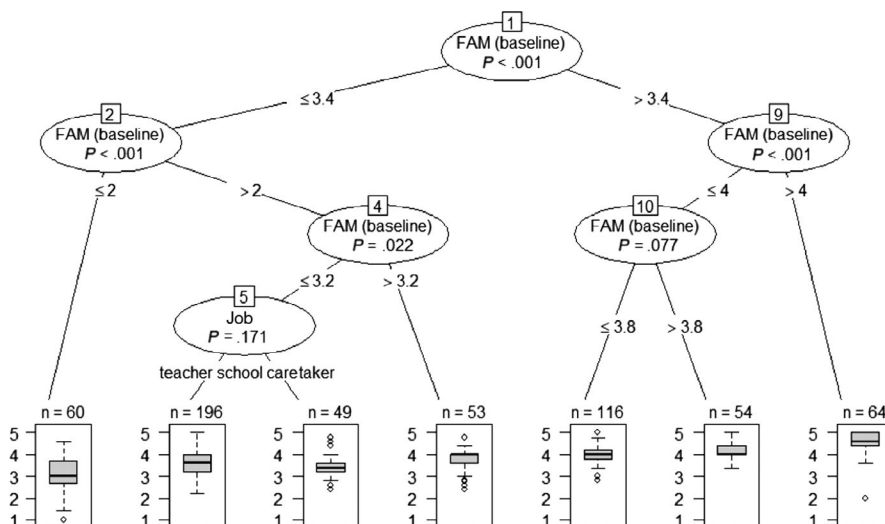


FIGURE 4 Conditional inference tree on Food Allergy Management (FAM) score (post-intervention). Residual mean deviance: 0.37

17 and 27 increased their final score to a different extent depending on their age and profession, as shown in Figure 2. Among school personnel with a baseline value of 29 or 30, participants who had not previous information on anaphylaxis scored significantly higher after the course. It is possible that people with poor information on anaphylaxis, or less professional experience, entered the course with a higher achievement motivation that supports self-efficacy.²⁹ The presence in the course of a specific module on psychosocial issue represents a novelty in the field of FA and anaphylaxis education. Some of our previous research^{15,23} has shown that psycho-emotional factors are important in ensuring appropriate management of children with FA at school. Further studies could analyse the particular contribution of this in raising self-efficacy of the participants.

There are some limitations associated with this study. Participants attended the course voluntarily: it has been hypothesized that trainees who chose to take a course are more likely to develop increased self-efficacy since they may be more motivated to learn.²⁹ Further studies should clarify whether mandatory courses could achieve the same positive effect. This interventional study was within subjects, but further research using a control group should be considered to confirm results. National and regional differences in school policy do not allow generalization of findings. However, it can be useful comparing different approaches for managing FA and anaphylaxis in order to improve regulations and guidelines for schools. Participants completed the questionnaire right after the course. However, the observed effect might decrease as time goes on. In addition, the thresholds identified as discriminating achievements after course, although sensitive and in line with the experience, are sample-driven, and this deserves attention in generalizing them. Further research should explore the persistence of findings.

Collective effort is required to keep children with FA safe at school. School personnel is increasingly expected to recognize allergic reactions and promptly initiate treatment. A poor baseline preparedness to manage anaphylaxis at school was found. However, results highlighted the effectiveness of specific multidisciplinary training courses in improving teachers' and school caretakers' self-efficacy in managing FA and anaphylaxis. The S.PER.SE-FAA Questionnaire is confirmed to be an easy and helpful tool to assess the level of FA and anaphylaxis management in the school staff and training effectiveness.^{22,23}

An education network is crucial in ensuring that children are identified, the school staff alerted and trained, and specific allergy management plans initiated.¹ Allergists and paediatricians play an important role in coordinating collaborations with families, schools and other professionals in order to support effective education on FA and anaphylaxis, guaranteeing a safe school setting for an increasing number of students.

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CONFLICT OF INTEREST

The authors have no conflict of interest relevant to this article to disclose.

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