



Original article

A workshop with practical training for anaphylaxis management improves the self-efficacy of school personnel



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ABSTRACT

Background: School personnel are required to guarantee a secure school environment for children suffering from severe food allergies. We organized a workshop for school personnel to learn the appropriate management of anaphylaxis that included practical training with an adrenaline auto-injector (AAI). The objective of this study was to evaluate the workshop in terms of the improvement of self-efficacy (SE) of participants to deal with anaphylaxis.

Methods: All 93 school nurses, 73 schoolteachers and 110 childcare workers participating in the study completed a questionnaire before and after the workshop. The SE of the participants was evaluated using an original 15-item questionnaire.

Results: Before the workshop, the SE of school nurses was the highest among the profession groups, and being involved with children prescribed an AAI was a common factor associated with a high SE. After the workshop, the SE increased in all groups, but most apparently in school nurses and those involved with children prescribed an AAI. The presence of an emergency plan was positively associated with the SE of schoolteachers only after the workshop, even though no such association existed beforehand.

Conclusions: Practical instruction of school nurses and school personnel involved with children prescribed an AAI resulted in dramatic improvement of the SE. These people are expected to play a central role in the development of an anaphylaxis management plan in their schools.

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Introduction

It is common for children with food allergies to experience accidental exposure to allergens and to develop allergic symptoms at school.^{1–3} An epidemiological study showed that 36% of 41 accidental reactions in children with a severe food allergy at their school involved two or more organ systems.² School personnel are required to be familiar with food allergies, and an action plan for allergic emergencies should be developed for every school.^{4,5}

Adrenaline is regarded as the first-line therapy for anaphylaxis. Nowak-Wegrzyn et al.² have shown that this drug has been administered to children in almost 15% of accidental cases in schools. Fatal anaphylaxis in school settings were often associated with a delay of treatment with adrenaline, generally because of an inadequate action plan against allergen exposure.^{1,2,6,7}

In Japan, an adrenaline auto-injector (AAI, Epipen[®]) became available for children in 2005. Despite this, a fatal accident of milk-induced anaphylaxis occurred at an elementary school in December 2012. This shocking event triggered a concentrated social effort to improve countermeasures against anaphylaxis within the school setting.⁸ As a part of this movement, many workshops for school personnel have been conducted on the management of children with life-threatening allergies.

The effective management of such children requires an appropriate behavior of the relevant person or people involved. According to a social cognitive theory, human behavior is based on personal knowledge and attitudes. Furthermore, self-efficacy (SE) is one of the most important antecedents of behavioral changes.⁹ SE refers to an individuals' belief in their own ability to organize and execute an appropriate action in a prospective situation.¹⁰ Those with a high SE have a tendency to take a favorable action, such as intense efforts to overcome problems in social situations. In recognition of the role of SE, the effects of a workshop should be evaluated not only by their contribution to participants' knowledge, but also by their ability to improve SE.

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We conducted a series of workshops for school personnel on appropriate countermeasures against anaphylaxis at school. In this study, we evaluated the SE of attendees before and after the workshop, and analyzed the factors associated with the improvement of the SE.

Methods

Subjects

The subjects enrolled in this study were participants at the workshops regarding the management of anaphylaxis at school. The workshops were held eight times between June and September 2013 at Aichi Children's Health and Medical Center in cooperation with the non-profit organization, Allergy Support Network (Nagoya, Japan). These workshops were announced on the websites of the Allergy Support Network and our institute. A total of 759 participants attended the workshops, with no repeat attendees.

An anonymous, self-administered questionnaire was conducted before and after each workshop. Respondents working out of Aichi prefecture were excluded, leaving a sample of 110 school nurses, 78 schoolteachers working in public elementary or junior high school, and 120 childcare workers in nurseries. Of these, 93 school nurses (84.5%), 73 schoolteachers (93.6%) and 110 childcare workers (91.7%) returned fully completed questionnaires. The job categories of participants excluded in this study are shown in [Supplementary Table 1](#).

The purpose and design of the research, the level of data protection and the voluntary nature of participation were clearly stipulated in the opening statement of the questionnaire. It was also explicitly written that submission of the questionnaire sheet would be considered as consent to participate in the research. This study was approved by the institutional ethics committee.

Table 1
Self-efficacy questionnaire for anaphylaxis management.

Please check the most appropriate response to each item using the scale: 1 = completely lacking confidence, 2 = lacking confidence, 3 = somewhat lacking confidence, 4 = undecided, 5 = somewhat confident, 6 = confident, 7 = completely confident.	
Item no.	How confident are you that
1	You can identify children with a documented risk of anaphylaxis at your school?
2	You can have a preliminary talk with family about the care of a child with a documented risk of anaphylaxis?
3	You can recognize anaphylactic symptoms in children within the school?
4	You know the initial action to take following recognition of anaphylaxis?
5	You know when to call an ambulance in the event of an anaphylactic emergency?
6	You could properly explain an anaphylactic emergency during an emergency call?
7	You know when to consider administration of the adrenaline auto-injector, Epipen®?
8	You know when to administer the adrenaline auto-injector, Epipen®?
9	You know the steps to take to prepare the adrenaline auto-injector, Epipen®, for use?
10	You know the correct site for administration of the adrenaline auto-injector, Epipen®?
11	You know the duration of effectiveness of adrenaline used in the treatment of anaphylaxis?
12	You can instruct someone in the correct care of anaphylactic symptoms?
13	You can instruct someone in the correct administration of the adrenaline auto-injector, Epipen®?
14	You could hold a leadership position for the correct care of anaphylactic symptoms in your school?
15	You can provide life support to children with anaphylactic symptoms in your school?

Workshop

The workshop consisted of three sessions: a presentation of anaphylaxis, practical training about AAI administration using trainer devices (Pfizer Japan Inc., Tokyo, Japan) and a question-and-answer session. We used original educational material based upon the experience of experts. All of the lecturers had extensive experience with oral food challenges, the treatment of anaphylaxis, patient education and AAI prescription.

The lecture topics included the mechanisms, signs and symptoms of food allergy, prevention of accidental allergen exposure and the medical treatment of adverse reactions. We also emphasized the systematic workflow of the school personnel, including the individual roles in an emergency situation.

Of note, we presented some actual cases in which an AAI was administered by the patients or school nurses.

During the practical training, all participants were advised to use a training device, and some representative participants tried administering a real AAI on the thigh of the model doll.

Bandura¹⁰ previously identified the four main sources of SE, and our workshops provided three of them. Mastery of experience refers to positive cognition developed from successful past experience, which was achieved through the practical training of AAI administration. Social modeling refers to an observation of a successful performance by someone whose capabilities are considered similar to their own. This source was enhanced through the presentation of the real cases and live demonstrations of AAI administration. Social persuasion is defined as the internalization of appreciation given by respected persons, such as an instructor or leader. This was provided through verbal feedback during the practical training. In providing feedback, instructors adopted realistic and positive commentary, and were careful to use positive correction if incorrect handling was observed. The last source of SE, physiological and emotional states, depends on the individual conditions in a given situation.

Questionnaire items

The questionnaire identified the personal characteristics of the subjects, such as their job title, experience with allergic events, number of children prescribed an AAI in their workplace and presence of a dedicated emergency action plan for allergic reactions. The individual experience with food-related allergic events was divided into two groups. The severe group included subjects who had ever used a medication to deal with the situation. The mild group included those who had never dealt with cases requiring medication.

The SE was measured using an original 15-item questionnaire that was administered before and after the workshop ([Table 1](#)). The items were created by our staff, including pediatric allergists, public health physicians and dietitians, with reference to Bandura's theory and previous reports.^{9,11} A preliminary questionnaire draft was tested and reviewed by school nurses, schoolteachers and childcare workers. Based on their feedback, some items were adjusted in order to improve the face validity. None of these reviewers took part in the study itself.

A 7-point Likert-scale was used in which subjects were asked to rate their confidence level for each of the 15 items: 1 = completely lacking confidence, 2 = lacking confidence, 3 = somewhat lacking confidence, 4 = undecided, 5 = somewhat confident, 6 = confident, 7 = completely confident. The SE was evaluated using a total cumulative score with a possible range of 15–105 points. The Cronbach's alpha, an index for internal consistency, of the scale was 0.965. The reliability was assessed using the split-half method with the odd-even system ($\rho = 0.983$).

Statistics

Continuous data were analyzed using Mann-Whitney's *U* test or the Steel-Dwass test. Paired data were analyzed using the Wilcoxon signed-rank test. Multiple comparisons of proportions were tested using Tukey's WSD test. Factors contributing to the SE were analyzed using a logistic regression analysis. Age (dichotomized between thirties and forties), individual experience (years, allergic reaction responses, and workshop attendance) and the school situation (documented plans and enrollment of children prescribed an AAI) were designated as independent variables. SE scores higher than the median value were assigned to the dependent variable. The data were analyzed using EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for the R software program (The R Foundation for Statistical Computing, Vienna, Austria, Ver. 2.13.0).¹² A value of $p < 0.05$ was considered to be significant.

Results

Individual characteristics and school situation

There were no significant differences in the age or job duration among the groups (Table 2). The male-to-female ratio of schoolteachers was higher than that for both school nurses and childcare workers. School nurses had experienced allergic accidents and participated in relevant workshops more frequently than had schoolteachers and childcare workers. Nearly half of schoolteachers (49.3%) and childcare workers (44.5%) had no experience with either allergic reactions or attendance at workshops. There were fewer childcare workers involved with children prescribed an AAI (14.5%) than the other two groups. Only one schoolteacher had previous experience with using an AAI in a school setting.

SE before the workshop

The distributions of the SE scores before the workshop are shown in Fig. 1. School nurses had significantly higher SE scores than did the other two groups ($p < 0.001$), and previous participation in allergy-related workshops was shown to be a positive contributing factor to the SE (Table 3, $p = 0.046$). Number of subjects responding ≥ 5 (somewhat confident) for each questionnaire item are shown in Supplementary Table 2.

Table 2
Individual characteristics and school situation.

	School nurses (<i>n</i> = 93)	Schoolteachers (<i>n</i> = 73)	Childcare workers (<i>n</i> = 110)
Age [<i>n</i> (%)]			
20s	28(30.1)	11(15.1)	27(24.5)
30s	14(15.1)	12(16.4)	24(21.8)
40s	23(24.7)	19(26.0)	36(32.7)
50s	28(30.1)	31(42.5)	23(20.9)
Men [<i>n</i> (%)]	3(3.2) [†]	24(32.9) [‡]	7(6.4) [†]
Years [median (25 %tile, 75 %tile)]	20(4, 29)	24(8, 31)	14(6, 26)
Symptom [<i>n</i> (%)]	57(61.3) [‡]	11(15.1) [‡]	44(40.0) [‡]
Workshop [<i>n</i> (%)]	58(62.4) [‡]	27(37.0) [‡]	39(35.5) [‡]
Precaution plan [<i>n</i> (%)]	48(51.6) ^{‡‡}	33(45.2) [‡]	72(65.5) [†]
Emergency plan [<i>n</i> (%)]	51(54.8)	29(39.7)	60(54.4)
Prescribed children [<i>n</i> (%)]	45(48.4) [†]	35(47.9) [†]	16(14.5) [‡]

Different superscript symbols represent significant difference (Tukey's WSD test, $P < 0.05$). Years, job duration; Symptom, experience of allergic reactions involving in food allergies; Workshop, attendance of workshops on food allergies or anaphylaxis; Precaution plan, development of a documented plan for avoidance of accidental allergen ingestion; Emergency plan, development of a documented plan for the care of allergic symptoms; Prescribed children, enrollment of children prescribed with the adrenaline auto-injector, Epipen®.

The enrollment of children prescribed an AAI was a significant factor associated with a high SE in all groups (Table 3), which was most pronounced for schoolteachers (odds ratio (OR), 20.5; $p < 0.001$). However, the SE of schoolteachers involved with such children was significantly lower than that for comparable school nurses (Fig. 2, $p < 0.001$). In the subjects without children prescribed an AAI, a lower SE was apparent for both schoolteachers and childcare workers compared to school nurses ($p < 0.001$).

The subjects who had ever dealt with severe cases tended to have a higher SE than those with the mild cases in all job categories [severe vs. mild (median); school nurses, 69 vs. 56 ($p = 0.018$); schoolteachers, 51 vs. 40 ($p = 0.548$); childcare workers, 51 vs. 41 ($p = 0.440$)].

SE after the workshop

As shown in Fig. 1, the workshop significantly improved the SE of the respondents in all groups ($p < 0.001$). Despite the comparable increase in the median scores in schoolteachers and childcare workers, the statistical superiority of SE in school nurses remained intact after the workshop ($p < 0.001$).

An association between the enrollment of prescribed children and SE, which was found before the workshop, was lost in school nurses and childcare workers, but remained in schoolteachers (Table 3, OR, 16.7; $p < 0.001$). No significant differences were seen among all of the groups with children prescribed an AAI (Fig. 2).

The presence of an emergency plan at school was not associated with the SE of schoolteachers ($p = 0.530$, Table 3) before the workshop, but became positively associated after the workshop (OR 8.48, $p = 0.022$).

The SE in sub-groups based on the severity of cases that they had dealt with became close to the same for all job categories [severe vs. mild (median); school nurses, 82 vs. 87 ($p = 0.139$); schoolteachers, 76 vs. 75 ($p = 0.796$); childcare workers, 77 vs. 78 ($p = 0.794$)].

Discussion

All schools should be ready for the occurrence of an allergic emergency,¹³ because a substantial number of allergic reactions have occurred in children without any previous history of food allergies. Many fatal cases of anaphylaxis have been later attributed to an initial delay in treatment, often caused by a general failure to recognize allergic exposure or the early signs of anaphylaxis.^{6,7,14}

In this study, many subjects had limited experience with anaphylaxis and demonstrated a poor SE before the workshop. This finding is consistent with those of previous studies,^{11,15} and was a reason why they participated our workshop.

There have been some reports showing the efficacy of workshops on the management of anaphylaxis.^{11,16,17} In the present study, as well as in one of the previous reports,¹¹ the effects of the workshop were evaluated based on the SE, rather than the knowledge of attendants. According to Bandura's theory,¹⁰ when trying to achieve a difficult task, knowledge is not enough, but people with a high SE will try to engage in instrumental action and will apply strong efforts in pursuit of a solution. In this study, we showed that there were differences in the acquisition and improvement of SE of the subjects based on job titles, which was not determined in the previous report¹¹ which had focused on school nurses.

The questionnaire items used for the measurement of the SE were introduced for the first time in this study. The high Cronbach alpha and the split-half testing support the reliability of our questionnaire. The finding that school nurses scored the highest among all evaluated job types supports the construct validity of the

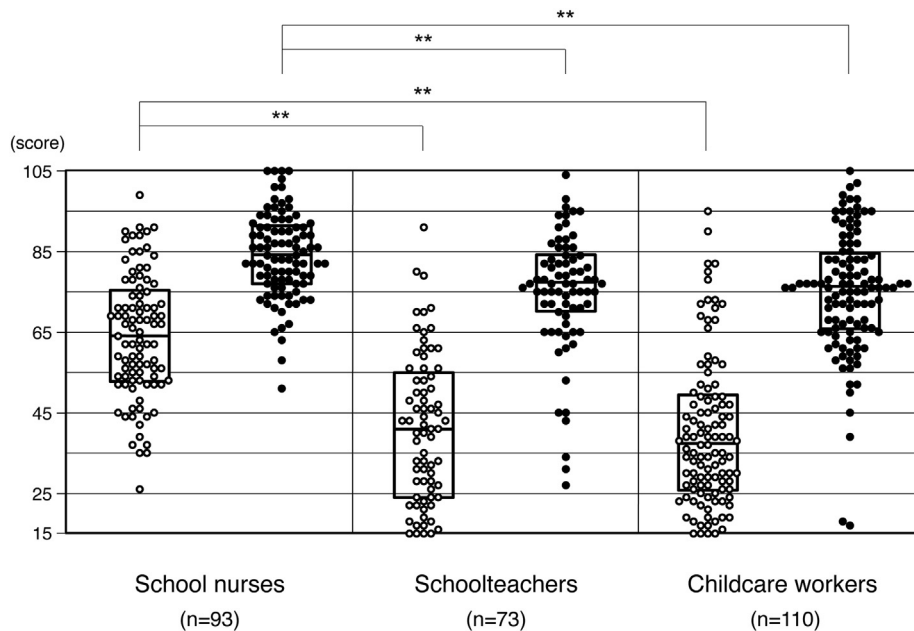


Fig. 1. Distribution chart of self-efficacy scores before and after the workshop. Subjects were asked to rate their confidence level for each of the 15 questionnaire items using a 7-point Likert-scale before (open dots) and after (closed dots) the workshop. SE was evaluated using total cumulative score with a possible range of 15–105 points. The box in each column represents the mean value and the interquartile range. ** $p < 0.001$ (Steel–Dwass test).

Table 3
Multiple logistic analyses for self-efficacy.[†]

Independent factor [‡]	School nurses				Schoolteachers				Childcare workers			
	Before		After		Before		After		Before		After	
	Odds ratio	<i>P</i>	Odds ratio	<i>P</i>	Odds ratio	<i>P</i>	Odds ratio	<i>P</i>	Odds ratio	<i>P</i>	Odds ratio	<i>P</i>
Age	2.01 [0.21, 19.8]	0.548	0.56 [0.07, 4.66]	0.588	0.55 [0.06, 5.39]	0.607	1.22 [0.16, 9.43]	0.847	2.31 [0.59, 9.01]	0.228	2.81 [0.75, 10.6]	0.126
Years	1.00 [0.91, 1.11]	0.951	1.04 [0.95, 1.13]	0.450	1.01 [0.93, 1.10]	0.741	0.96 [0.89, 1.04]	0.331	1.02 [0.96, 1.09]	0.447	0.97 [0.92, 1.03]	0.291
Symptom	1.67 [0.63, 4.48]	0.305	1.79 [0.72, 4.46]	0.211	0.35 [0.05, 2.38]	0.283	3.29 [0.45, 24.2]	0.243	0.46 [0.16, 1.31]	0.145	1.10 [0.44, 2.73]	0.836
Workshop	2.71 [1.02, 7.24]	0.046	2.28 [0.91, 5.72]	0.080	2.55 [0.61, 10.7]	0.201	0.31 [0.07, 1.34]	0.118	2.30 [0.81, 6.56]	0.118	0.85 [0.35, 2.10]	0.727
Precaution plan	0.93 [0.26, 3.37]	0.910	0.58 [0.17, 1.97]	0.380	5.63 [0.76, 41.9]	0.091	1.52 [0.24, 9.70]	0.655	0.48 [0.08, 2.96]	0.432	1.44 [0.27, 7.80]	0.673
Emergency plan	2.81 [0.76, 10.4]	0.122	2.42 [0.69, 8.49]	0.167	0.55 [0.08, 3.61]	0.530	8.48 [1.36, 53.0]	0.0222	2.42 [0.50, 11.8]	0.276	0.64 [0.14, 2.96]	0.567
Prescribed children	2.71 [1.04, 7.05]	0.041	0.99 [0.40, 2.45]	0.985	20.5 [4.41, 95.6]	<0.001	16.7 [3.48, 79.9]	<0.001	8.59 [1.01, 73.3]	0.049	1.36 [0.41, 4.49]	0.615

[†] Odds ratios are represented as median value [95% confidence interval].

[‡] Age, dichotomized between thirties and forties; Years, job duration; Symptom, experience of allergic reaction involved in food allergy; Workshop, attendance of workshops on food allergies or anaphylaxis; Precaution plan, development of a documented plan for avoidance of accidental allergen ingestion; Emergency plan, development of a documented plan for the care of allergic symptoms; Prescribed children, enrollment of children prescribed with the adrenaline auto-injector, Epipen®.

questionnaire. Subjects who had dealt with severe cases also scored higher than those who had dealt with only mild cases before the workshops. This result provides additional support for the construct validity of our questionnaires, as individuals with some practical experiences are expected to have a greater SE.

The workshops described in previous reports^{11,16,17} consisted of a presentation on anaphylaxis and practical training with trainer devices, which were similar to our workshop. However, as a novel aspect of our curriculum, we enhanced the social modeling through the presentation of some actual cases in which a school nurse had used an AAI as an emergency medical treatment. Any non-professional person will likely experience hesitation and anxiety when using an AAI.^{8,14,17} Our curriculum was effective to relieve such concerns, which was expressed as an improvement of the SE.

A multiple logistic regression analysis showed no association between the SE and an individual's career or experience with the management of allergic reactions throughout the job categories. This suggested that prior personal experiences were generally insufficient to improve the SE. Cabana et al.¹⁸ reported an informative observation that experience as a physician was not associated with a high SE for providing smoking cessation counseling to parents, but that formal training significantly boosted the

physicians' SE in this area. In conjunction with our study, the SE for an additional or infrequent behavior did not depend on the personal experiences or professional career.

The positive association between the existence of an emergency plan and the SE of schoolteachers was observed only after the workshop. This suggested that the mere existence of an emergency plan is insufficient to help individuals deal with an emergency situation, and hands-on training provides a synergistic effect to improve the SE.

The post-workshop increase in the SE was evident in school nurses and the participants involved with children prescribed an AAI, suggesting an intense interest in anaphylaxis among these participants. School nurses play a central role in child welfare and safety in schools.¹⁹ Ideally, all school personnel could learn from competent medical experts, but this may be unrealistic in terms of the human resources and other practical limitations. In order to improve the efficacy of workshops, we therefore encourage medical experts to educate school nurses and school personnel regarding the care of children prescribed an AAI. Once trained, these personnel may then assume the responsibility for educating others in their workplace.

There were some limitations associated with the present study. No control group was used and the workshop program and some

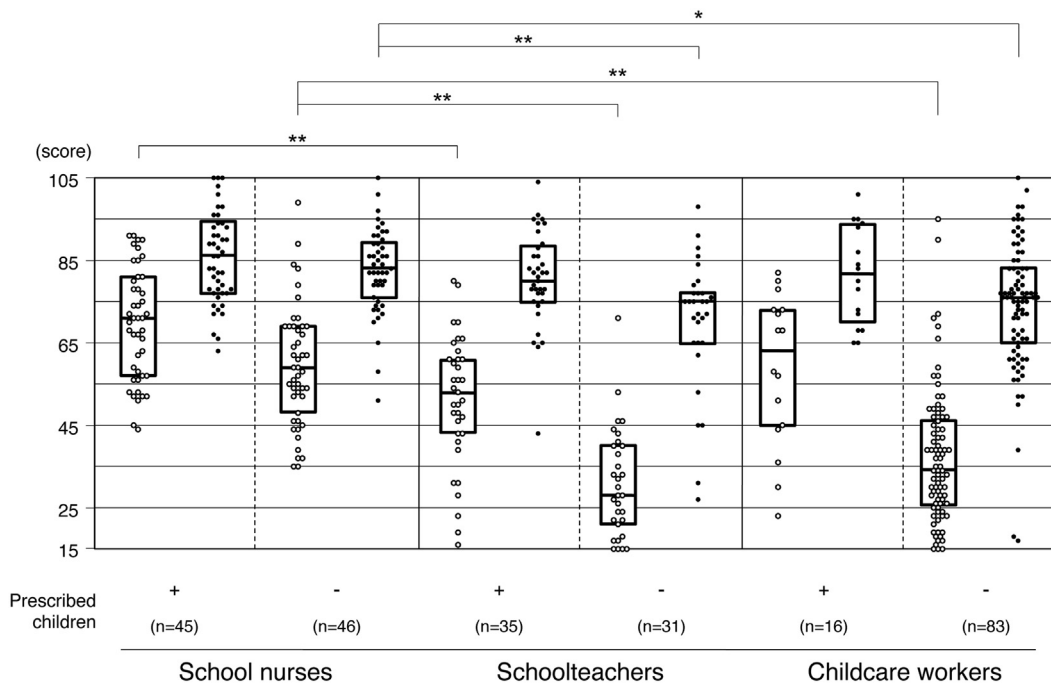


Fig. 2. Distribution chart of self-efficacy scores of subjects with and without children prescribed with an adrenaline auto-injector. Subjects were asked to rate their confidence level for each of the 15 questionnaire items using a 7-point Likert scale before (open dots) and after (closed dots) the workshop. SE was evaluated using total cumulative score with a possible range of 15–105 points. The box in each column represents the mean value and the interquartile range. ** $p < 0.001$; * $p < 0.01$ (Steel–Dwass test).

questionnaire items for the measurement of SE were introduced for the first time in this study. The subjects were voluntary participants in the workshop. They were working within a limited geographical area, which might indicate that there was a regional bias such as that due to an intensity of official educational programs. We did not evaluate the long-term preservation of the SE following the workshop, which is an area that needs further study. Future research should address these issues before the results of this study can be generalized.

In conclusion, we developed an effective workshop curriculum to improve the SE of school personnel to handle children with a high risk of anaphylaxis caused by food allergies. School nurses and school personnel involved with children prescribed an AAI were especially receptive and showed a dramatic increase in SE post-training. We trust that these participants are now more able to play a central role in anaphylaxis management in each region and school.

Acknowledgments

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Conflict of interest

The authors have no conflict of interest to declare.

Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.alit.2014.10.005>.

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