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Accidental ingestion of food allergens: A nationwide survey of Japanese nursery schools

To the Editor,

The accidental ingestion of food allergens is an important problem in preschool-aged children with food allergy (FA).¹ However, reports regarding accidental ingestion in nursery school children are limited. This nationwide questionnaire-based survey determined the incidence of accidental ingestion in this population and identified the associated risk factors.

Data were gathered using a nationwide questionnaire survey² dispatched by post to all childcare facilities in Japan (Table S1).

Accidental ingestion was defined as unintended accidental allergen exposure leading to allergy symptoms. Data were expressed as n (%) or means (standard deviation). This study was approved by the ethics committee of Jikei University. The detailed methods of the survey administered to nursery schools, and the regulations in Japan are described in Appendix S1.

Questionnaire responses were received from 15 722 (48.8%) of 32 210 institutions. A total of 1 390 481 children were enrolled in the survey (Figure S1). Among 51 531 children with FA, 408 and 5317 were excluded owing to missing data and nursery center information, respectively. Finally, 45 806 children with FA met the inclusion criteria; their characteristics are shown in Table 1. The mean age of the children was 2.3 ± 1.6 years (median: 2.0 years). Egg allergy was the most common FA (74.8%). A person accountable for FA was identified in 65.6% of nursery schools. Adrenaline auto-injectors (AAIs) were prescribed to 5123 (11.2%) children, 1154 (2.5%) of whom brought them to their nursery school. Of 4853 children with a history of anaphylaxis, 1450 (29.9%) had been prescribed AAIs, 784 (16.2%) of whom brought them to their nursery school. Overall, 3497 (7.6%) children had experienced accidental ingestion

with symptoms in the current fiscal year, 44 (0.1%) of whom required hospitalization. Only, 11 children (0.02%) had used an AAI in their nursery school. Data on symptom severity were obtained from 2113 children, but were unknown in 2155 children. Severe (requiring hospitalization), moderate (requiring doctor treatment), and mild symptoms (not requiring treatment) were observed in 44, 303 and 1766 children, respectively. There were no cases of mortality.

Significant associations with accidental ingestion were observed for sex, age, history of anaphylaxis to causative food, milk allergy, wheat allergy, fish allergy, number of eliminated foods, number of children in the nursery center, and the absence of a person accountable for FA (Table 1). The incidence of accidental ingestion was highest in children younger than one year of age (9.7%) and gradually decreased with age (P -value for trend: <0.001 ; Figure S2). Larger facilities with more children had a lower incidence of accidental ingestion, while the incidence increased in smaller nursery schools (P -value for trend: <0.001 ; Figure S3).

The factors significantly associated with accidental ingestion were assessed for crude odds ratios (ORs) and adjusted ORs (aORs; Table 2). These factors were categorized as related to either children or nursery centers. The significant risk factors in children were male sex (male; aOR: 1.115), younger age (per one-year increase; aOR: 0.893), history of anaphylaxis to causative foods (aOR: 2.199), current milk allergy (aOR: 1.239), current wheat allergy (aOR: 1.266), and current fish allergy (aOR: 1.191). The number of eliminated foods was significant only in univariate analysis (crude OR: 1.126). The significant factors associated with accidental ingestion in nursery centers were fewer children (per 10-fold increase; aOR: 0.703)

TABLE 1 Characteristics of the children with food allergy and the nursery centers

	Total (N = 45 806)	Accidental ingestion (n = 3497)	No exposure or no symp- toms due to accidental ingestion (n = 42 309)	P-value
Children characteristics				
Sex (male) (n, %)	28 090 (61.3)	2243 (64.1)	25 847 (61.1)	<0.001
Age (y) (mean, SD)	2.3 (1.6)	2.1 (1.6)	2.3 (1.6)	<0.001
History of anaphylaxis to causative food (n, %)	4853 (10.6)	687 (19.6)	4166 (9.8)	<0.001
Egg allergy, current (n, %)	34 285 (74.8)	2607 (74.5)	31 678 (74.9)	0.671
Milk allergy, current (n, %)	12 857 (28.1)	1207 (34.5)	11 650 (27.5)	<0.001
Wheat allergy, current (n, %)	3661 (8.0)	424 (12.1)	3237 (7.7)	<0.001
Peanut allergy, current (n, %)	3236 (7.1)	247 (7.1)	2989 (7.1)	0.997
Fish allergy, current (n, %)	2527 (5.5)	331 (9.5)	2196 (5.2)	<0.001
Number of eliminated foods (mean, SD)	1.7 (1.3)	2.0 (1.5)	1.7 (1.3)	<0.001
Nursery center characteristics				
Number of children in the nursery center (mean, SD)	122.5 (59.7)	116.8 (56.9)	123.0 (60.0)	<0.001
Lunch box eliminating causative foods by nursery center (n, %)	44 738 (98.5)	3430 (98.7)	41 308 (98.5)	0.551
Absence of a person responsible for managing food allergies (n, %)	15 780 (34.4)	1292 (36.9)	14 488 (34.2)	0.001

Note: Accidental ingestion was defined as unintended accidental allergen exposure leading to allergic symptoms. At least 83.3% of the children submitted documents with details about their food allergies and the related instructions, written by their doctors, to their nursery school.

Abbreviation: SD, standard deviation.

and the absence of a person accountable for FA (aOR: 1.128). The risk factors for severe reactions were similar (Table S2).

Our study covered two-thirds of preschool children who attend nursery school in Japan (Appendix S1). While few children were prescribed AAI, only one-fifth of these children brought them to nursery school. Our results indicated that younger children had a

greater risk of accidental ingestion. Younger children are more likely to share another child's meal, as indicated in our previous report in which 16.9% of nursery school children shared meals with other children.² Male sex was also a risk factor, which may be due to gender differences in infant behavior,³ although further study is required to determine the cause of this finding.

TABLE 2 Risk factors for accidental ingestion among children with symptoms in the current fiscal year

	Accidental ingestion with food allergy symptoms			
	Crude OR (95% CI)	P-value	Adjusted OR ^a (95% CI)	P-value
Patient characteristics				
Sex (male)	1.139 (1.060-1.224)	<0.001	1.115 (1.037-1.199)	0.003
Age (y)	0.909 (0.889-0.930)	<0.001	0.893 (0.873-0.914)	<0.001
History of anaphylaxis to causative food	2.238 (2.047-2.448)	<0.001	2.199 (2.005-2.411)	<0.001
Current milk allergy	1.387 (1.290-1.492)	<0.001	1.239 (1.142-1.346)	<0.001
Current wheat allergy	1.665 (1.495-1.855)	<0.001	1.266 (1.115-1.438)	<0.001
Current fish allergy	1.910 (1.692-2.156)	<0.001	1.919 (1.681-2.191)	<0.001
Number of eliminated foods (continuous)	1.126 (1.102-1.151)	<0.001	1.013 (0.983-1.044)	0.399
Information about the nursery center				
Log (total number of nursery school children) (continuous)	0.638 (0.550-0.740)	<0.001	0.703 (0.604-0.818)	<0.001
Absence of an accountable person for food allergy	1.125 (1.047-1.209)	0.001	1.128 (1.049-1.213)	0.001

Note: Odds ratio of "age"; per one-year increase. Odds ratio of "number of eliminated foods"; per one-item increase. Odds ratio of "total number of nursery school children"; per 10-fold increase.

Abbreviations: CI, confidence interval; OR, odds ratio.

^aOR was adjusted using the significant variables in Table 1: sex, age, history of anaphylaxis to causative food, milk allergy, wheat allergy, peanut allergy, fish allergy, number of eliminated foods, total number of children in nursery centers, and the absence of a person responsible for managing food allergies.

A history of anaphylaxis to causative food was also a risk factor for accidental ingestion. This finding is supported by those of another study.⁴

Our results indicated that milk, wheat, and fish allergies were major risk factors for accidental ingestion. These are the second, third, and ninth most common allergens in Japan.⁵ Other studies have indicated that cow's milk, but not wheat, is a common cause of anaphylaxis in preschool children in Europe.⁶ Wheat allergy is a primary cause of anaphylaxis in Japan.⁵ Wheat allergy may be more common in Asian countries than in European countries and in the United States.⁷ The prevalent allergens differ between countries partly due to differences in the foods commonly consumed.⁸ Fish products are used in traditional Japanese seasoning in many meals and are difficult to eliminate from all foods in Japan. For example, "dashi" stock is commonly used to flavor food both at home and in schools. This may lead to a higher incidence of an accidental ingestion of fish. Similarly, the number of eliminated foods was a risk factor for accidental ingestion only in the univariate analysis in our study; it may be more difficult to prevent accidental ingestion in schools because the staff would need to eliminate more causative foods.

School staff should be trained to respond appropriately to accidental ingestion.⁹ Among factors related to nursery schools, the absence of a person accountable for FA was an independent risk factor in the present study. Since it is not possible to eliminate other risk factors such as age, history of anaphylaxis to causative food, and allergy to causative food, an effective management strategy for FA in nursery schools must be developed. A team or person accountable for FA would play an important role in improving the management of FA in nursery schools and, consequently, may help to prevent accidental ingestions. These results indicate the critical need for individuals to monitor FA in all nursery schools.

Our study had several limitations. Although most children were diagnosed with food allergy by a medical doctor, this questionnaire-based survey study has the potential for study bias. The response rate was around 50%, which may indicate a selection bias. Finally, complications such as atopic dermatitis and bronchial asthma, which affect the severity of allergic reactions, were not considered in this survey.

In conclusion, accidental ingestion in nursery schools is common. The risk factors included male sex, younger age, history of anaphylaxis, milk allergy, wheat allergy, fish allergy, fewer children in the nursery school, and the absence of a person accountable for FA. Furthermore, children who were prescribed AAls rarely brought them to nursery school. Thus, while nursery schools must appoint a school official accountable for FA management, both schools and parents should collaborate to ensure child safety.

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CONFLICTS OF INTEREST

M. Ebisawa serves on the DBV Technologies Scientific Advisory Board. All other authors have no conflicts of interest to declare.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Children in the nursery school in Japan
n = 1,390,481

Response rate 48.8%

Children with food allergy
n = 56,121

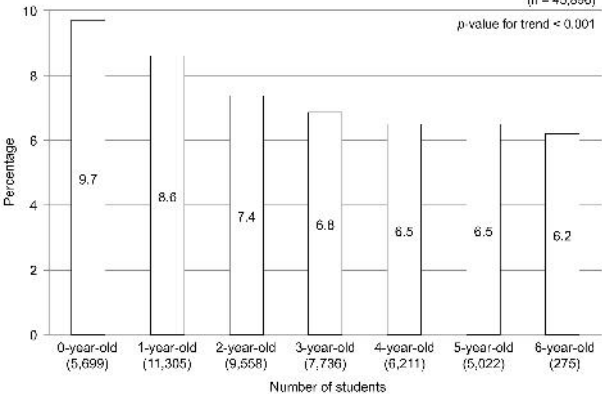
Children without food allergy
n = 1,334,360

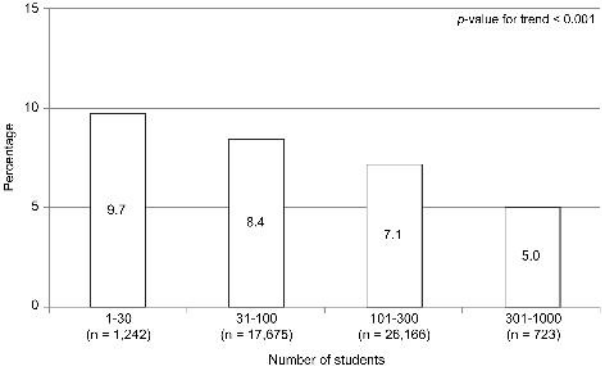
Children with food allergy
on the online database
n = 51,531

Excluded due to paper data
n = 4,590

Included in the analysis
n = 45,806

Excluded due to
missing nursery center information
n = 5,317
insufficient children's data
n = 408

p -value for trend < 0.001



Risk factors for accidental ingestion: A nationwide survey of Japanese nursery schools

Supplementary information:

Methods

Data were gathered using a questionnaire entitled “Survey on allergic disease status of children admitted to nursery schools and allergy measures at nursery schools.”

The survey was fully funded by the 2015 National Treasury Subsidy Consultation for

Research Projects to Promote Research on Child and Child Care Support, Ministry of

Health, Labour and Welfare Japan^{S1}. Investigations were conducted using a survey

request form distributed to childcare facilities across Japan (Table S1). The survey

forms were dispatched to all childcare facilities in Japan by post.

The survey questions were concerned with how the childcare facilities dealt

with FA, details of FA in children at each facility, and details about accidental ingestion

between April 2015 and February 2016. The survey questionnaires were completed

between February and March 2016.

Definitions of terms

Food allergies were diagnosed by doctors and written evidence of each IgE-mediated food allergy was submitted to the nursery school. Accidental ingestion was defined as unintended accidental allergen exposure leading to allergic symptoms. If children experienced multiple episodes of accidental ingestion, the most severe episode was investigated. The symptoms were classified based on their severity as follows; severe (requiring hospitalization), moderate (requiring doctor treatment), and mild (no treatment required). The absence of a person accountable for FA was defined as the absence of a team or person responsible for planning the management of FA and educating staff about the condition.

Statistical analyses

Data were expressed as n (%) or as arithmetic means (standard deviations). We compared children with and without allergic reactions using the Mann–Whitney U or Fisher’s exact tests, with p -values < 0.05 considered statistically significant. For the comparison of more than three items, Bonferroni correction was used. Logistic regression was used to perform univariate and multivariate analyses. IBM SPSS Statistics for Windows, version 24.0 (IBM Corp., Armonk, NY, United States) was used for all statistical analyses.

37

38 **Ethical Consideration**

39 This study was approved by the ethical committee of Jikei University (approval
 40 number: 27-235[8120]). Details of the survey were provided to the guardians of the
 41 children with an option to opt out of the study. Informed consent from the guardians of
 42 the participating children was not required because no personal data that identified the
 43 participants were obtained.

44

45 **Japanese educational system of preschool aged children**

46 In Japan, there are two types of facilities where preschool children receive
 47 childcare service; namely, kindergarten and nursery school. The differences between
 48 those facilities are as follows.

49

	Kindergarten	Nursery school
Operation	public or private	public or private
Target age	3,4 and 5 years old on April 1 st .	0-6 years (prior to starting primary school)
Requirement to enter	Children living in the city of the kindergarten.	Children whose parents cannot care for them due to various reasons. The most frequent reason is that both parents are working.
Authorization of admission	Kindergarten	Government of city (most cases)
Time for the facility	Around 8:30 a.m. to around	Around 7 a.m. to around 8

	2:30 p.m. (times vary by facility)	p.m. (times vary by facility)
Holiday	Saturday; Sunday; Japanese holidays; summer, winter, and spring vacations	Saturday, Sunday, and Japanese holidays
Actual number of children in Japan	Around 1,300,000 children	Around 2,100,000 children
Fee	0-25,000 JPY (Depends on family income and number of siblings)	0-60,700 JPY (Depends on family income and number of siblings)
Regulatory laws	Law School Education Law (Articles 1 and 77)	Child Welfare Law (Articles 7 and 39)
Teacher qualification certificate	Regular certificate of kindergarten teachers	Certificate of nursery teacher
Lunch box	No need for facility for lunch box. Lunch boxes are provided in some kindergartens.	Facility for lunch box is needed. Lunch boxes are provided every day.
Number of children per teacher	35 per class	3 (0 year), 6 (1 to 2 years), 20 (3 years), and 30 (4 years or older)
Supervisory authorities	Ministry of Education, Culture, Sports, Science and Technology	Ministry of Health, Labour and Welfare

50 The number of Japanese aged 0-5 years was 6,009,000 in 2016 (Japanese government
51 survey).

52

53 **Frequent causative foods of allergies in Japan**

54 A Japanese nationwide survey of immediate-type food allergies was conducted
55 in 2011^{S2}. The most frequent causative foods were hen's egg (1153 cases, 39.0%), cow's
56 milk (645 cases, 21.8%), and wheat (347 cases, 11.7%).

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63 Food Allergy TJSoPA, Clinical Immunology TJSoA. Japanese guidelines for
64 food allergy 2017. Allergol Int 2017;66:248-264.
65

66 **Table S1.** Questionnaire

Screen 1: Provide information about your institution's approach to food allergy

Question 1: Institution number for the survey (11 digits).

Question 2: Facility name

Question 3: Institutional organization (private, public, NPO etc.)

Question 4: Authorization (authorized by city, by prefecture, unauthorized etc.)

Question 5: Separately provide the total number of staff members (excluding the head of the facility) as of the date of this survey to avoid duplication.

Question 6: Provide the total number of regular members of your facility and the total number of children at the time of study entry.

Question 7: Do you allow children with food allergy to enroll?

Question 8: In Question 7, if answer was "Do not accept children with food allergy to enroll," please answer the following question:

What are your reasons for not allowing children with food allergy to enroll?

(multiple answers allowed)

Question 9: Do you allow children who have previously experienced anaphylaxis due to food allergy to enroll?

Question 10: In Question 9, please provide the reason why you "Do not allow children to enroll."

What is your reason for not allowing children with food allergy to enroll?

(multiple answers allowed)

Question 11: Select all foods provided at your facility.

(multiple answers allowed)

☐ School meals (lunch or supper) ☐ Sub-meals ☐ Snacks ☐ Do not provide ☐ Others

Question 12: Select the appropriate food preparation method.

- ☐ Cooked inside the facility's kitchen where meals are prepared only for the facility.
- ☐ Center-style meals cooked in shared kitchens.
- ☐ Prepared meals from a public company that delivers to facilities and schools.
- ☐ Do not provide meals but children bring prepared meals from home (not depending on food allergy).
- ☐ Do not provide.
- ☐ Others.

Question 13: How do you provide meals to children with food allergies at your facility?

- ☐ Mainly by providing food substitutions.
- ☐ Mainly by providing an eliminated diet.
- ☐ Not applicable (each child brings their own lunch)
- ☐ Others.

Question 14: Do you hand out menus which contains information on ingredients for meals, supplements, and snacks in advance?

(multiple answers allowed)

Question 15: After the menus are handed out, who checks if any raw ingredients should be removed?

Question 16: How do you provide baby food at your facility?

(multiple answers allowed)

Question 17: What do you consider challenging when handling food allergy?

(multiple answers allowed)

Question 18: Who acts as the main contact person regarding handle food allergy?

Question 19: Please answer following questions related to forms which you use to understand and confirm children with food allergies. Do you use "The School Life Management and Guidance Sheet"?

Question 20: If you answered that you use "The School Life Management and Guidance Sheet" provided by the Ministry of Health, Labour and Welfare" in

Question 19, please answer the following:

Is it easy to use?

Question 21: At what intervals do you re-distribute “The School Life Management and Guidance Sheet”?

Question 22: In Question 19, if you reported the use of “Other list than The School Life Management and Guidance Sheet provided by the Ministry of Health, Labour and Welfare” or “This is done verbally” please answer the following:

Why you do not use The School Life Management and Guidance Sheet provided by the Ministry of Health, Labour and Welfare?

Question 23: Are you aware of the “Guide for Actions against Allergy at Nursery Schools” published by the Ministry of Health, Labour and Welfare?

Do you use this guideline?

Question 24: Select the allergy response guidelines and manuals available at your site.

(multiple answers allowed)

Question 25: Have you held trainings or study sessions this year at your facility to provide information about food allergy to staffs?

Question 26: Have prefectural and municipal governments provided information about food allergies and conducted training sessions?

Question 27: Have any of staff members participated in trainings and study sessions organized by prefectures, municipalities, and other sectors in during the current fiscal year?

Question 28: If you answered yes to Question 27, who attended the trainings and study sessions?

Question 29: If you answered “No staff participated in training” to Question 27, please answer the following:

What were the reasons for not participating?

(multiple answers allowed)

Question 30: Have you established a committee team with members to review and share understanding of food allergy responses at your facility, or do you include a person who is not part of the team?

Question 31: Are you sharing information about children with food allergy with a contact physician using The School Life Guidance and Management Sheet provided by the Ministry of Health, Labour and Welfare?

Learning 32: Do you share information about children with food allergy with the elementary school they will be entering?

(multiple answers allowed)

Question 33: Do you share information about food allergy with the children attending school?

(multiple answers allowed)

Question 34: Do you have any problems with sharing information about school-aged children with food allergy with the elementary schools they will be entering?

(multiple answers allowed)

Question 35: Have you developed a system to prevent accidental ingestion and misdistribution of food (knowledge mastery, awareness reform, role sharing, coordination, etc.) to prevent food allergy at your facility?

Question 36: Is this system reviewed and shared?

Question 37: What measures do you implement at your facility to prevent accidental ingestion or misdistribution of food?

(multiple answers allowed)

Question 38: Have there been any errors in food allergy management without symptoms during the current fiscal year?

Question 39: Have any children experienced food allergies during the current fiscal year due to accidental ingestion or misdistribution?

(including mild symptoms)

Question 40: If you answered “yes” to Question 38 or Question 39, please answer the following:

What was the cause of accidental ingestion or misdistribution?

(multiple answers allowed)

Question 41: Do you have knowledge about anaphylaxis?

Question 42: Have any children in your facility developed food-related anaphylaxis during the current fiscal year?

Question 43: If you answered “There were children who experienced anaphylaxis” in Question 42, please answer the following question:

When did he/she develop anaphylaxis?

How did you handle the situation?

(multiple answers allowed)

Question 44: If you answered “There were children who experienced anaphylaxis” to Question 42, please answer the following:

Do you think you could smoothly manage anaphylactic reactions if you made a self-assessment?

Question 45: If you answered “Yes” or “I was able to handle the situation properly” to Question 44, please the following:

What was helpful about your handling of the symptoms of anaphylaxis?

(multiple answers allowed)

Question 46: In Question 44, please answer the following questions: "No, I was not able to handle the situation properly."

What were the reasons why you were not able to do so?

(multiple answers allowed)

Question 47: Do you know how to use an epinephrine auto-injector such as an EpiPen®?

Question 48: Do you accept children prescribed an EpiPen® at your facility?

Question 49: How many children are prescribed an EpiPen® at your facility?

Question 50: If you answered “accept” in Question 48, please answer the following:

Does your facility keep EpiPens®?

Question 51: How many children have received an EpiPens® at your facility?

If none, select 0.

Question 52: In Question 51, if you answered that more than one child has received an EpiPen®, please answer the following:

In the current fiscal year (from April 1, 2015 to the date of completion), did you have any experience that required judgment as to whether the EpiPen® should be administered?

Did you use an EpiPen® at that time?

Question 53: If you answered that you were able to decide and use the EpiPen® in Question 52, please answer the following:

Did you respond appropriately and use the EpiPen® at the onset of anaphylaxis?

Question 54: Can you use the EpiPen® at your facility at your discretion?

Question 55: Do you feel there is a need for a system that allows emergency consultation at any time to determine whether the EpiPen® should be administered?

Question 56: Do you know about the “Emergency Response Form?”

Question 57: Do you know about your child's condition at night (after 5 p.m., depending on the prefecture) and the child's emergency telephone number (#8000) for consultation regarding the child's condition?

On Screen 2: Please enter the details of each child who was diagnosed with food allergy on April 2015 (around the beginning of the fiscal year).

Question 1: Which age group does this child belong to?

Question 2: What is the first letter of his/her name?

Question 3: What is the child's sex?

Question 4: What are the children's allergens?

(multiple answers allowed)

☐Hen's egg ☐Milk (and dairy products) ☐wheat ☐peanuts ☐crabs and shrimps (shellfish)

☐buckwheat ☐salmon roe (fish roe) ☐Walnut and other nuts ☐Soy beans ☐Kiwi fruits ☐Banana ☐Other fruits ☐Fish ☐Sesame ☐Others

Question 5: Has this child experienced food-related anaphylaxis?

(regardless of whether it was inside or outside the nursery school)

Question 6: Is emergency medicine available?

Question 7: Has this child experienced food allergies with symptoms in nursery school this year?

Question 8: If you answered "yes" to Question 7, please answer the following:

If you answered "Do not know", go to the column for the following questions:

What was the causative food of this event?

(enter the time when the strongest allergy occurred in the event of multiple allergies)

☐Hen's egg ☐Milk (and dairy products) ☐Wheat ☐Peanuts ☐Crabs and shrimp (shellfish)

☐Buckwheat ☐Salmon roe (fish roe) ☐Walnuts and other nuts ☐Soy beans ☐Kiwi fruits ☐Banana ☐Other fruits ☐Fish ☐Sesame ☐Others

Question 9: Were you able to identify the foods that caused the allergy?

Question 10: Did this child visit a medical institution after a food allergy occurred?

Question 11: How severe was the induced allergic symptom?

☐Required hospitalized. (Severe)

☐Required medication, intravenous drip (IV) treatment at a medical institution (Moderate)

☐Visited medical institution, but not necessary for any treatment. (Mild)

☐Symptom eased, so did not visit a medical institution. (Mild)

☐Don't know.

Question 12: Have you followed the manual and guidelines for the occurrence of food allergy?

Question 13: Did you use an EpiPen® when a food allergy occurred?

Question 14: If you answered yes in Question 13, please answer the following:

Who used EpiPen®?

67

68 The survey form can be accessed by childcare facilities at URL: <http://www.jikei.ac.jp/univ/pdf/report.pdf>. The details of the survey items

69 can also be accessed using the same URL (Written in Japanese).

70

71 **Table S2.** Risk factors for accidental ingestion among children with severe symptoms within the current fiscal year

		Severe reaction requiring hospitalization			
		Crude OR (95% CI)	<i>p</i> -value	Adjusted* OR (95% CI)	<i>p</i> -value
Patient characteristics	Sex (male)	1.213 (0.620–2.372)	0.572	0.945 (0.479–1.864)	0.870
	Age (years)	0.892 (0.723–1.101)	0.287	0.800 (0.643–0.996)	0.046
	History of anaphylaxis to causative food	153.024 (36.833–635.740)	<0.001	127.272 (30.254-535.397)	<0.001
	Current milk allergy	3.528 (1.852–6.720)	<0.001	1.795 (0.868–3.718)	0.114

	Current wheat allergy	12.856 (6.794–24.324)	<0.001	5.158 (2.428–10.958)	<0.001
	Current fish allergy	0.951 (0.229–3.954)	0.945	0.661 (0.143–3.052)	0.596
	Number of eliminated foods (continuous)	1.359 (1.227–1.505)	<0.001	0.987 (0.813–1.197)	0.891
Information about the nursery center	Log (total number of children in the nursery center) (continuous)	0.658 (0.169–2.565)	0.546	0.901 (0.220–3.692)	0.885
	Absence of an accountable person for food allergy	1.541 (0.813–2.922)	0.185	1.934 (1.006–3.718)	0.048

72 OR, odds ratio; CI, confidence interval.

73 *OR was adjusted using the significant variables in Table 1: sex, age, history of anaphylaxis to causative food, milk allergy, wheat allergy,
74 peanut allergy, fish allergy, number of eliminated foods, total number of children in nursery centers, and absence of a person responsible for
75 managing food allergies.

76 **Figure legends**

77 **Figure S1:** Study design and eligibility criteria.

78 Among 51,531 children with food allergy, 408 were excluded due to a lack of detailed
79 data and 5,317 were not included because of missing data.

80

81 **Figure S2:** Percentages of children who developed symptoms of food allergy in their
82 nursery school in the previous year.

83 This figure shows the percentage of children who developed symptoms of food allergy
84 in their nursery school between April 2015 and February 2016.

85

86 **Figure S3:** Total number of nursery school children included in the survey.

87 Larger facilities with more children had a low incidence of accidental ingestion (*p*-value
88 for trend: < 0.001).