

An Epidemiological Survey on Food-dependent Exercise-induced Anaphylaxis in Kindergartners, Schoolchildren and Junior High School Students

Satoshi Tanaka

Asia Pac J Public Health 1994 7: 26

DOI: 10.1177/101053959400700105

The online version of this article can be found at:

<http://aph.sagepub.com/content/7/1/26>

Published by:



<http://www.sagepublications.com>

On behalf of:



[Asia-Pacific Academic Consortium for Public Health](http://www.aph.sagepub.com)

Additional services and information for *Asia-Pacific Journal of Public Health* can be found at:

Email Alerts: <http://aph.sagepub.com/cgi/alerts>

Subscriptions: <http://aph.sagepub.com/subscriptions>

Reprints: <http://www.sagepub.com/journalsReprints.nav>

Permissions: <http://www.sagepub.com/journalsPermissions.nav>

Citations: <http://aph.sagepub.com/content/7/1/26.refs.html>

>> [Version of Record](#) - Jan 1, 1994

[What is This?](#)

Abstract

A questionnaire survey was conducted on Food-dependent Exercise-induced Anaphylaxis (FEA) among 11,647 children in 11 kindergartens. Eleven elementary schools and five junior high schools of a city with the cooperation of school personnel. The incidence of FEA was 0% in the kindergartens, 0.06% in the elementary schools and 0.21% in the junior high schools. If severe urticaria is included in the criteria for FEA, the latter appears to be more common than has been reported up till now. The longest intervals between eating and onset of the symptoms, and between the start of exercise and the onset of the symptoms were three and half hours, and fifty minutes, respectively. Therefore, attention should be paid for three to four hours after eating, when children exercise. Since only 31.1% of the teachers had heard of FEA, more information about FEA should be given to them. *Asia Pac J Public Health* 1994;7(1):26-30.

Keywords: Exercise, food allergy, food-dependent exercise-induced anaphylaxis, kindergartner, student.

An Epidemiological Survey on Food-dependent Exercise-induced Anaphylaxis in Kindergartners, Schoolchildren and Junior High School Students

Satoshi Tanaka MD, DMS, MS

Department of Public Health
Hamamatsu University School of Medicine

Introduction

In 1979, Maulitz et al¹ reported a disease exhibiting the symptoms of anaphylaxis, including urticaria, dyspnea, and consciousness disturbance, which was brought on by exercise after eating. A 31-year-old male long-distance runner developed symptoms of anaphylaxis, i.e. facial edema, urticaria, and respiratory obstruction whenever he ate shrimp or oysters and had exercise, but no symptoms of anaphylaxis developed when he only ate shrimp or oysters, or when he only exercised. Later, in 1983, Kidd et al² reported two cases of anaphylactic symptoms after eating celery and exercising, and the disease classification of Food-dependent Exercise-induced Anaphylaxis (FEA) came into being. In Japan, FEA was first reported by Akutu³ as a result of eating wheat, and with only 25 cases reported as of 1990⁴, FEA was claimed to be a relatively rare disease.

Taking advantage of the opportunity provided by the Board of Education of the city where the author lived, a questionnaire survey was conducted on allergic diseases among the public kindergarten, elementary and junior high school students. The report below is based on the results, especially with respect to the FEA patient assessment and incidence.

Subjects and Methods

The city of Iwata is located in western Shizuoka Prefecture about 25 km east of Hamamatsu City. It is a small city made up of industrial and residential areas and has a population of slightly more than 80,000 people. The city has a total of 11 public kindergartens, 11 public elementary schools and five junior high schools. Their enrollments as of April 1, 1992 are shown in Table 1. The questionnaire survey was administered to all of the "home-room" teachers of the various schools, i.e. to 59 kindergarten teachers, 291 elementary school teachers and 178 junior high school teachers who served as subjects. The survey was conducted in June 1992, and the questions concerned 1) the number of kindergartners and students with allergic diseases, including asthma, atopic dermatitis, allergic rhinitis/conjunctivitis, etc.; 2) whether or not the teacher had heard of FEA; 3) whether or not the teacher had experienced a student who exhibited FEA; and 4) detailed reports on cases of FEA which had occurred at the school within the past year, etc. In order to avoid duplicate reporting of the same case, they had to report the real names of the students. In addition, whenever possible, we obtained a copy of the patient's record from the

Address for Reprints: Dr Satoshi Tanaka,
3-2-11 Kinoshita, Iwata City, Shizuoka Pref
438 Japan.

Table 1. Kindergartners and students enrolled

	Boys	Girls	Totals
Kindergartens	575	573	1,148
Elementary Schools	3,429	3,317	6,746
Junior High Schools	1,930	1,823	3,753

medical institution where the student had been diagnosed (six cases) and administered a second questionnaire to the parents or guardians inquiring about symptoms, food, and physical condition on the day FEA occurred. Evaluations were based on the statements of the teachers, parents or guardians, and physicians considered as a whole.

The definition of FEA in the survey to teachers was the appearance of anaphylaxis-like symptoms such as urticaria of general body, hoarseness, respiratory distress, malaise, edema, cold sweating, and/or unconsciousness, etc., on physical exercise after the ingestion of any food or of specific foods, where no such symptoms had been identified before starting physical exercise. In the questionnaire to teachers inquiring about the prevalence of asthma, atopic dermatitis and allergic rhinitis/conjunctivitis of their students, those diseases were defined as ones diagnosed by school doctors and/or reported by parents or guardians at the beginning of an academic year. The response rate of the teachers in the survey was 100%.

Results

1. The Prevalence of FEA

The prevalence of allergic diseases among kindergartners and students

according to type of school is shown in Table 2. As the results of various investigators have indicated, the prevalence of asthma and atopic dermatitis decreased with age, whereas the prevalence of rhinitis/conjunctivitis increased. While the results obtained by different investigators regarding prevalence have differed according to the methods they employed, and comparisons cannot be made, there was little difference between the results of this study and the results of other epidemiological surveys (1%-5.6%)⁵⁻⁹ regarding the prevalence of asthma in elementary schoolchildren.

2. Incidence of FEA

The number of cases of FEA which occurred during the previous year among the kindergartners and students of the city were as follows: kindergarten 0, elementary school 4, junior high school 8. The FEA onset rate was 0.06% (95% CI: 0.00-0.12%) in elementary school and 0.13% (95% CI: 0.01-0.25%) in junior high school; the rate of onset in junior high school being approximately twice that in elementary school. When calculated on the basis of number of occurrences in junior high school, the incidence was 0.21% (95% CI: 0.06-0.36).

Table 3 shows a summary of individual cases of FEA provided by teachers, parents or guardians. If the

double or triple episodes of the same person are counted as one case in Table 3, the incidence of FEA by sex is twice as high for males, with six cases occurring in males and three in females. Although up till now FEA has been regarded as a rare disease, to the authors' knowledge no reports have been made on its incidence either in Japan or abroad. In this study, cases believed to be caused by — food allergy, exercise-induced asthma or cholinergic urticaria were excluded, and in the questionnaire administered to parents or guardians it was confirmed that the symptoms had not developed after exercising alone or after eating alone. Hence, we considered these cases close to confirmed even though IgE values, RAST scores, etc., had not been determined and no skin tests, exercise tests, etc., had been performed.

3. Degree of teacher awareness of FEA

Of the 528 teachers who served as subjects for the questionnaire survey, 165 or 31.1% had heard of FEA. Those who had experienced a student with FEA amounted to a mere 18 or 3.4%. The proportion of those who had heard of it amounted to 5.1% of kindergarten teachers, 29.3% of elementary school teachers, and 44.0% of junior high school teachers, with the rate being particularly low among kindergarten teachers.

4. FEA case reports

From Table 3 the following results were obtained:

- 1) According to month, there were three occurrences in January; two in May, one each in April, June, September, November and December; and the month of occurrence was unknown in two cases.
- 2) The earliest age of onset was nine years.
- 3) The interval between eating and onset was 30 minutes or less in one elementary school child (25%) and four junior high school students (50%), and tended to be shorter in the junior high students. Nevertheless, there was also a report of an interval of 3½ hours in one jun-

Table 2. Rates of Allergic Diseases in Kindergartners and Students

	Kindergartens	Elementary Schools	Junior High Schools	Totals
No. enrolled	1,148	6,746	3,753	11,647
Asthma	6.3%	4.6%	3.0%	4.2%
Atopic Dermatitis	11.0%	9.7%	6.2%	8.7%
Allergic Rhinitis/ Conjunctivitis	4.8%	11.3%	16.2%	12.2%
FEA	0.0%	0.06%	0.21% (0.13) [†]	

([†]) Excluding those with an elementary school history

Table 3. Cases of FEA

Elementary School

Name	Sex	Age	Month of Onset	After eating	After starting exercise	Food	Exercise	Chief symptoms
IM	F	11	Dec	30 m	20 m	Shrimp	Outdoor play	Malaise, Urticaria
GD	M	9	May	1 h	35 m	Rice	Tag	Airway Obstruction Dyspnea, Paresthesia
HT	M	12	Nov	1 h 40 m	50 m	Meat	Outdoor play	Urticaria
ST	M	12	—	1 h 30 m	30 m	Chicken	Dodge ball	Urticaria, Dyspnea

Junior High School

ST	M	13	Jan	30 m	10 m	Peach	Soccer	Urticaria
ST	M	13	Jun	50 m	40 m	Squid	Soccer	Facial Edema, Dyspnea
HT	M	13	Apr	3 h 30 m	5 m	Meat	Running	Dyspnea, Loss of Consciousness
MT	F	15	Jan	25 m	5 m	Shrimp	Volleyball	Unsteadiness, Loss of Consciousness
KK	M	14	Jan	—	—	Shrimp	Outdoor play	Urticaria
SS	M	15	Sep	25 m	10 m	Shrimp	Soccer	Malaise, Urticaria
SM	F	14	—	—	—	—	Endurance running	Urticaria, Dyspnea
KO	M	14	May	30 m	—	Fish	Basketball	Urticaria

h: Hour(s), m: minute(s)

ior high school students, and confirmation of this tendency is impossible because of the small number of cases. The shortest and longest intervals between eating and onset of the symptoms were 20 minutes and 3½ hours, respectively.

- 4) The interval between the start of exercise and onset of the symptoms was 5 minutes in two junior high school students and 10 minutes in two others, while the shortest interval among the elementary schoolchildren was 20 minutes (one case), and here again onset tended to occur sooner in junior high school students. Since the junior high school students whose onset was rapid were engaging in vigorous exercise, soccer, running, etc., whereas the elementary schoolchildren with the shortest interval till onset were doing nothing more than playing at noon recess time, it was impossible to find any correlation between the intensity of the exercise and onset of the symptoms was 5 minutes, and the longest interval was 50 minutes.
- 5) Since seroimmunological testing was not performed in most cases, it

was necessary to rely on the questionnaire survey to identify the food responsible. However, even in the one case (HT) in which testing was performed, no rise in serum antibodies to chicken or beef was detected despite the fact that meat was clearly the cause based on the patient interview, etc. The foods believed to have been the cause in other cases were shrimp in four, meat in three, and fish, squid, rice and a each in one case each, pointing to protein as the principal factor.

- 6) Although FEA occurred during more vigorous exercise in the junior high school students, as mentioned above, no correlation was found between the intensity of the exercise and the interval until onset. Even in the two cases, HT and ST, in which FEA occurred twice or more, there was no definite relationship between the intensity of the exercise, interval until onset, and symptom severity.
- 7) Symptoms ranged from urticaria to loss of consciousness. When listed in decreasing order of frequency, they were: urticaria in eight instances, dyspnea in five,

malaise in two, loss of consciousness in two, sensation of air way obstruction, oral paresthesia, and facial edema in one each. It was rare for these manifestations to occur singly. In most cases, the patient initially complained of urticaria or malaise and went on to develop more serious symptoms later. It should be noted that one elementary school child and two junior high school students went on to develop serious symptoms without any prior signs of illness such as urticaria or facial edema. Fortunately, because of proper treatment there were no fatalities. However, because of the possibility of sudden death in cases of onset in the absence of any visible evidence of illness, caution is required.

- 8) The measures taken following the onset consisted of first taking the student to the health care room (9/12), which was used as a key station, and then, depending on their symptoms, they were sent to a hospital (4/12) or clinics (3/12), sent home (1/12), or told to rest until completely well (1/12). When symptoms were relatively mild,

the students were made to rest at the site of onset until they recovered completely (2/12), and the procedure followed in the other case is unknown (1/12). Long-term instructions consisted of two of the nine students being forbidden to engage in exercise after eating that food, and there is no record of specific instructions in the remaining four cases.

Discussion:

1) Regarding the incidence of allergic diseases

The fact that the asthma rate among the kindergartners and students in the city was almost identical to the rates reported by other investigators⁵⁻⁹ suggests that the city is not located in some special environment giving rise to asthma. However, the rates of atopic dermatitis and allergic rhinitis/conjunctivitis in this survey were higher than reported by others¹¹⁻¹³. Atopic dermatitis is difficult to diagnose because of its variety of clinical manifestations in the skin lesion involved. Therefore the prevalence rate of the disease in our survey obtained from the questionnaire to teachers, including reports from parents or guardians, seems to be inappropriate for comparison with the results of other studies. Since the rate of allergic rhinitis in our survey includes allergic conjunctivitis, comparing them with other findings would also be difficult. Nevertheless, the fact that the age-related change in the rates of all three of the above diseases match those contributed by others,^{6-8,11,12} seems significant in terms of corroborating the reliability of this survey.

2) Regarding the incidence of FEA

There have been no reports on the incidence of FEA, and it has simply been referred to as rare^{1,3,14,15}. In this study, however, we discovered that it occurred at an annual rate of one in 500 junior high students. The symptoms of some of our cases seemed milder, compared with those of the cited literature, because only urticaria was included as a symptom of FEA. But in the questionnaire to teachers it

was commented that the urticaria must cover the general body and be a severe one. In Table 3, both HT & ST in Elementary School who only experienced urticaria, had different episodes with more anaphylaxis-like symptoms which were more severe than urticaria at different times. If those cases may be counted as FEA, the incidence would appear to be much more common than has been reported until now.

The results showing an incidence that was twice as high in males as in females were in agreement with the results of the analysis of cases by Watanabe et al⁴. The finding that the incidence was twice as high among junior high school students as for elementary schoolchildren would seem to be in part explained by the differences in opportunities for exercise. According to Murata et al¹⁴, most cases of FEA occur in adolescence, and Watanabe et al⁴ also reported frequent occurrence below 20 years of age, while in this study the youngest case was in a nine-year-old.

The most common month of onset in this study was January with three cases. However, since there were so few cases it was impossible to define it as the month with the highest incidence. Onagawa¹⁶ reported a 13-year-old girl who suffered multiple occurrence in the high-temperature summer season, and Watanabe et al⁴ also recommended reduced amounts of exercise on hot, humid days.

The intervals between both eating and exercise and onset in these cases almost perfectly coincided with the results reported by other investigators,^{2-4,15,17,19} and caution is required especially during the three to four hours following a meal and the first hour of exercise.

3) Regarding causative foods

By far the most common causative food in this study was shrimp,^{1,4,14,15} and squid, shellfish,^{3,4,17,18} wheat, celery,² etc., have been cited in the literature. According to Suko et al²⁰, shellfish and Crustacea, including shrimp, squid, and abalone are the most common causative foods in patients under 20 years of age, while for those over 30 years of age wheat prod-

ucts often tended to precipitate attacks as well. In the paper by Watanabe et al,⁴ wheat products were implicated as causes in 13 of 25 cases, and although no such cases were found in our study, based on the fact that current dietary habits include the widespread use of wheat products, caution is required after the ingestion of foods which include wheat in elementary and junior high school students. Despite the fact that meat was clearly the cause of FEA in patient HT, the meat-specific IgE antibody levels were low. There are cases of FEA in which it is impossible to identify the causative food even though individual tests are performed¹⁹, and there are also cases in which food intake itself is the predisposing cause independent of the type of food consumed². In cases in which no IgE antibodies are detected, there may be an allergic reaction involving antigens other than IgE, e.g.^{4,20} IgG. Consequently, since there are causes for which school personnel have received no appropriate guidance from a physician, careful observation of the students every day is most important.

4) Regarding symptoms

Much regarding the mechanism of symptom development in FEA remains unknown, yet according to Miyake et al¹⁵, it appears that as a result of consuming allergenic food and then exercising: (1) an immediate-type allergic reaction occurs, at which time the mast cell and basophil degranulation threshold is lowered; (2) the distribution of antigens absorbed into the body changes and it becomes easy to react with the mast cell; (3) the digestion and absorption of ingested antigens changes; and (4) endocrine hormones and autonomic tones change, etc. When Watanabe et al⁴ fed patients shrimp as allergen and Nakagawa et al¹⁸ gave them wheat, and then subjected the patient to exercise, there was an initial rise in blood histamine concentration. This demonstrated that specific anaphylaxis did not occur as a result of consuming the allergen alone.

Among the 12 cases in our survey there were no more than two who, though transient, lost consciousness

and developed a shock-like state. In both cases, the onset occurred only five minutes after they started to exercise and, based on these cases, we think that measures appropriate to the circumstances should be taken, without wasting time transporting the patients to the health care room, etc. In the United States, patients with frequent episodes of FEA are allowed to self-inject themselves with epinephrine,⁴ and rapid treatment is necessary at the time of such severe shock.

Conclusion

We conducted an analysis based on questionnaire surveys of personnel and students' families concerning allergic diseases, principally FEA, among kindergartners and schoolchildren within the city, and on the records of medical institutions, and obtained the following conclusion.

The incidence of FEA appears more common than has been reported up till now. Only one-third of the teachers had heard of FEA. Therefore, it may be necessary to inform teachers of this disease, and advise them to be especially cautious if the schoolchildren exercise three to four hours after eating.

Acknowledgments

We wish to thank Superintendent of Education, Yasuhumi Isobe; Chairman of the Board of Education, Takeshi Oda; members of the Board of Education, Takako Yoshida and Kikuzo Takahashi; Head of the School Education Department, Masanori Suzuki; and all of the principals, teachers and doctors who cooperated in this survey.

References

- Maulitz RB, Pratt DS, Schocket AL. Exercise-induced anaphylactic reaction to shellfish. *J Allergy Clin Immunol* 1979;63(6):433-4.
- Kidd JM, Cohen ST, Sosman AJ, Fink JN. Food-dependent exercise-induced anaphylaxis. *J Allergy Clin Immunol* 1983;71(4):407-11.
- Akutu I, Motojima S, Ikeda Y, Fukuda T, Ikemori R, Makino S. Three cases of Food Dependent Exercise-induced Anaphylaxis. *Arerugih (Japanese Journal of Allergy)* 1989;38(3):277-84.
- Watanabe T, Sakamoto Y, Tomonaga T, Inuyama T, Sasayama H, Hara K. A Case of Food-dependent Exercise-induced Anaphylaxis. *Arerugih (Japanese Journal of Allergy)* 1990;39(11):1523-8.
- Idei M. Regarding Statistics on Diseases of Schoolchildren. *Japanese Journal of School Health*, 1990;32(10):460-7.
- Miyake T, Kawamori J, Yoshida T, Hirao T, Aisaka F, Matsuki H, et al. Analysis of wheezy children in elementary school. Prevalence of wheeze, bronchial asthma, and correlation between IgE levels, RAST score to mite and severity of respiratory systems. *Arerugih (Japanese Journal of Allergy)*. 1985;34(10):939-47.
- Kunitomi Y, Kotani N, Koino S. Survey of the prevalence of bronchial asthma in the schoolchildren of 4 districts of Okayama Prefecture. *Shohni Hoken Kenkyuh*, 1989;48(5):565-8.
- Takei T, Uemura T, Yamazaki T. Survey of prevalence of bronchial asthma among the children of Kagoshima Prefecture. *Shohni Hoken Kenkyuh*. 1988;47(3):411-5.
- Morishima I, Minowa Y, Sasanuma M, Tsukahara N. Results of a survey of bronchial asthma among the elementary school and junior high students of Kajima Cho - Summary of the past 10 years - *Syohnika Rinsyou (Clinical Pediatrics)* 1975;38(11):117-20.
- Daniel WW. Biostatistics. A foundation for analysis in the health science. 4th Edition. John Wiley & Sons, New York, 1987:148-9.
- Ueda H, Fujisawa Y, Teramura M, Inasaka H, Eika Y, Fukusima E, et al. Epidemiology of skin diseases in childhood. *Nihon Hifuka Gakkai Zasshi (Journal of Japanese Society of Dermatology)*. 1988;7(2):9-13.
- Matsumoto S, Eika Y, Mori C, Inasaka H, Abe M, Ueda H. An epidemiologic research on atopic dermatitis in schoolchildren. *Fujita Gakuen Igaku Zasshi (Medical Journal of Fujita Gakuen)*. 1986;10(2):97-101.
- Yoshinaga F, Hasegawa H. Results of a health survey of schoolchildren in Takehara City. *Hiroshima Igaku (Hiroshima Medical Journal)*. 1986;39(12):2-9.
- Murata K, Matsukuma K, Takagi S, Miyazaki S. A case report of Food-dependent Exercise-induced Anaphylaxis. *SRL Hohkan*. 1989;13(1):30-2.
- Miyake T, Kawamori J, Yoshida T. A pediatric case of Food-dependent Exercise-induced Anaphylaxis. *Arerugih (Japanese Journal of Allergy)*. 1988;37(1):53-6.
- Onagawa Y. Exercise-induced Anaphylaxis. *Shohnika (Pediatrics)*. 1988;29(8):861-8.
- Nakagawa N, Iwamoto I, Tomioka H, Yoshida S. Food-dependent Exercise-induced Anaphylaxis. *Kansen-Enshoh-Men-eki* 1991;21(1):39-43.
- Nakagawa N, Iwamoto I, Hirakuri M. A case report of Food-dependent Exercise-induced Anaphylaxis caused by wheat powder. *Arerugih no Rinsyoh (Clinical Allergy)*. 1990;10(5):37-9.
- Novey HS, Fairshier RD, Salnes K, Simon RA, Curd JG. Postprandial exercise-induced anaphylaxis. *J Allergy Clin Immunol* 1983;71(5):499-504.
- Suko M, Toyohira H, Miyamoto A, Nishimura H, Nobuta T. Exercise-induced Anaphylaxis. 1989;9(7):37-41.