

A Hospital-Based Survey on Food Allergy in the Population of Kolkata, India

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Key Words

Food allergy · Questionnaire · Skin prick test · Allergens · Age group

Abstract

Background: Food allergy is increasing worldwide, and Asian countries are not the exception. Still, ample data are lacking in India. We conducted a cross-sectional study in a metropolis of Eastern India to record the presence of food allergy among the local population. **Methods:** The prevalence of food allergy was investigated among patients reporting to The Institute of Child Health and Mediland Diagnostics in Kolkata, India. A total of 5,161 patients were subdivided into 3 age groups and surveyed accordingly. The evaluation was conducted via a questionnaire and a skin prick test. **Results:** Among the 5,161 patients tested, 4,160 showed a positive response to one or more food items. Banana (32%), brinjal (29%), wheat (22%), and egg (23%) were found to be dominant allergens. Sixty-three percent of patients with a family history of allergy showed either a sudden or an insidious mode of onset, whereas the remaining 37% suffered insidious allergic symptoms with no record of a family history of allergy. Skin rashes, cough, and sneezing were the major symptoms observed. Patients in the age group of 15–40 years were the most susceptible. **Conclusion:** It has been observed that certain specific foods consumed in specific regions cause allergies that are unique to their respective populations. In the present study, the most commonly consumed foods in the studied area, e.g. banana, brinjal, wheat, and egg, had severe effects on the local population.

Complementary studies in other countries as well as in other parts of India will allow us to gain further insight into this fact. Some other influencing factors were found to be genetics, cultural habits, and occupation. Avoidance of the allergy-causing food is the best way to deal with food allergy.

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Introduction

Food allergy is the consequence of the immune system's reaction to some harmless food proteins. Food allergy is of two types: class 1 and class 2. Food proteins that are stable after digestion cause class 1 food allergy, whereas class 2 food allergy is caused by sensitization via the respiratory route by pollen proteins sharing common epitopes with the food items [1]. Food allergy affects up to 6% of children and 4% of adults [2].

Tremendous progress has been made in our understanding of food-based allergic disorders over the last half decade [3], but not much is known about the prevalence of food allergy outside of North America and Europe. Few records have been found in Asia, Middle Eastern Africa, and South America [2]. The prevalence of food allergy in Asia is soaring, but it is still relatively lower (particularly for peanut and tree nut allergies) than in urbanized Western populations [4]. Differences also exist within Asian countries.

D.D. and N.G. contributed equally to this study.

Over the last 4 decades, an increase in the prevalence of various allergic diseases (i.e. from 10 to 30%) has been observed in India [5]. The aim of the present study was to investigate the impacts of some common food allergens on the local population of Kolkata, a megacity of India. This study also includes the possible and probable risk factors for food allergy, e.g. demographic factors, family history, and food habits. The prevalence of common allergic symptoms within the population was estimated as well.

Materials and Methods

Study Subjects

A cross-sectional study was conducted for 5 years from August 2008 to July 2013 among 5,161 patients (2,786 males and 2,375 females) of all age groups who were followed up in the Allergy Unit of The Institute of Child Health and Mediland Diagnostics, Kolkata, with a history of common allergic symptoms. These patients were screened for food hypersensitivity using a standard questionnaire and a skin prick test (SPT). The exclusion criteria were: perennial or severe asthma, pregnancy or lactation, malignancy, and other severe systemic diseases during skin testing. Corticosteroids and antihistamines were prohibited to avoid masking of severe symptoms.

Patients were categorized into 3 groups: group A, aged below 15 years (total number of patients tested: 347 males and 392 females); group B, aged 15–40 years (tested: 1,213 males and 1,278 females), and group C, aged above 40 years (tested: 1,226 males and 705 females). Sixty healthy individuals from the city belonging to the same age group were also selected as control subjects and their status was confirmed by a negative skin reaction. This study was approved by the ethics committee of the hospital, and informed consent was obtained from the subjects before their participation.

Questionnaire

The survey was conducted using a set of questionnaires based on the questionnaire followed by Obeng et al. [6] and another questionnaire of the Chittaranjan National Cancer Institute and Calcutta University, Government of West Bengal, India. The questionnaire was divided into two sections. The first part comprised questions on demographics, the living environment, and the occurrence of any allergic reaction either persistently or within 0.5 h of eating any specific food item. Patients with positive results progressed to part 2 of the questionnaire. It contained queries on food habits, the family history of atopic diseases, the nature and time of the onset of allergic reactions, duration, any change in occupation or living environment linked to the appearance of allergic symptoms, and description of the present symptoms, among others. In cases of infants, the questionnaire was completed by the parents.

Preparation of Extracts for SPT

After defatting in diethyl ether, protein was extracted from foodstuffs using 1:20 w/v 0.1 M phosphate buffer (pH 7.2) for 8 h at 4°C. Centrifugation was done at 12,000 g for 20 min; the clear supernatant was passed through a 0.22-µm Millipore filter (Millipore Corp., Bedford, Mass., USA) and used for SPT.

Skin Prick Testing

SPT is a trustworthy method to diagnose IgE-mediated allergic diseases. SPT was performed on the sensitive patients with antigenic extracts of 50 commonly consumed foodstuffs (1:10 w/v) following the standard method [7]. Twenty microliters of PBS extracts (1:10 w/v) of these allergens were placed on the ventral side of the forearm and the skin was pricked with a 26-gauge hypodermic needle without inducing bleeding. Histamine diphosphate (1 mg/ml) and PBS (0.01 M, pH 7.2) were used as positive and negative controls, respectively. The skin response was determined after 20 min by measuring the wheal diameter and it was graded according to Stytiš et al. [8]. A wheal diameter ≥ 3 mm was recorded as a positive response.

Results

Out of 5,161 allergy sufferers, 4,680 patients (90.7%) showed positive skin reactions in SPT with various foodstuffs. Patients in age group B (15–40 years) showed the highest rate of sensitization (48.3%) to different food items among the three tested groups. Age groups A and B had a higher proportion of female patients (age group A: 298 males and 313 females, age group B: 1,067 males and 1,198 females), whereas age group C had a higher number of males (1,178 males and 626 females).

Different Dimensions of Food Allergy Identified via the Questionnaire

The reported symptoms of adverse food reactions were mainly skin rash, anaphylaxis, and abdominal pain (online suppl. fig. 1; for all online suppl. material, see www.karger.com/doi/10.1159/000365629). Most of the patients showed more than one symptom. From the questionnaire it was evident that out of 4,680 allergic patients 2,957 (63.18%) had a family history of allergy and the nature of the onset of allergic reactions was either sudden (23.47% of patients) or insidious (76.52% of patients); on the other hand, 1,723 (36.82%) patients did not have a family history of allergy and in all of the cases there was an insidious onset of allergic reactions.

Sensitization Profile to Different Food Allergens Detected by SPT

The sensitization profiles of patients to different food allergens were tabulated (online suppl. table 1). Food items were divided into 5 major categories: fruits, pulses, vegetables, cereals, or animal protein. All of the patients were positive to more than one allergen. Among the different fruits, the highest rate of sensitization was found for bananas (32.4% of patients showed a positive response). Similarly, lentils (10.34%) among pulses, brinjal

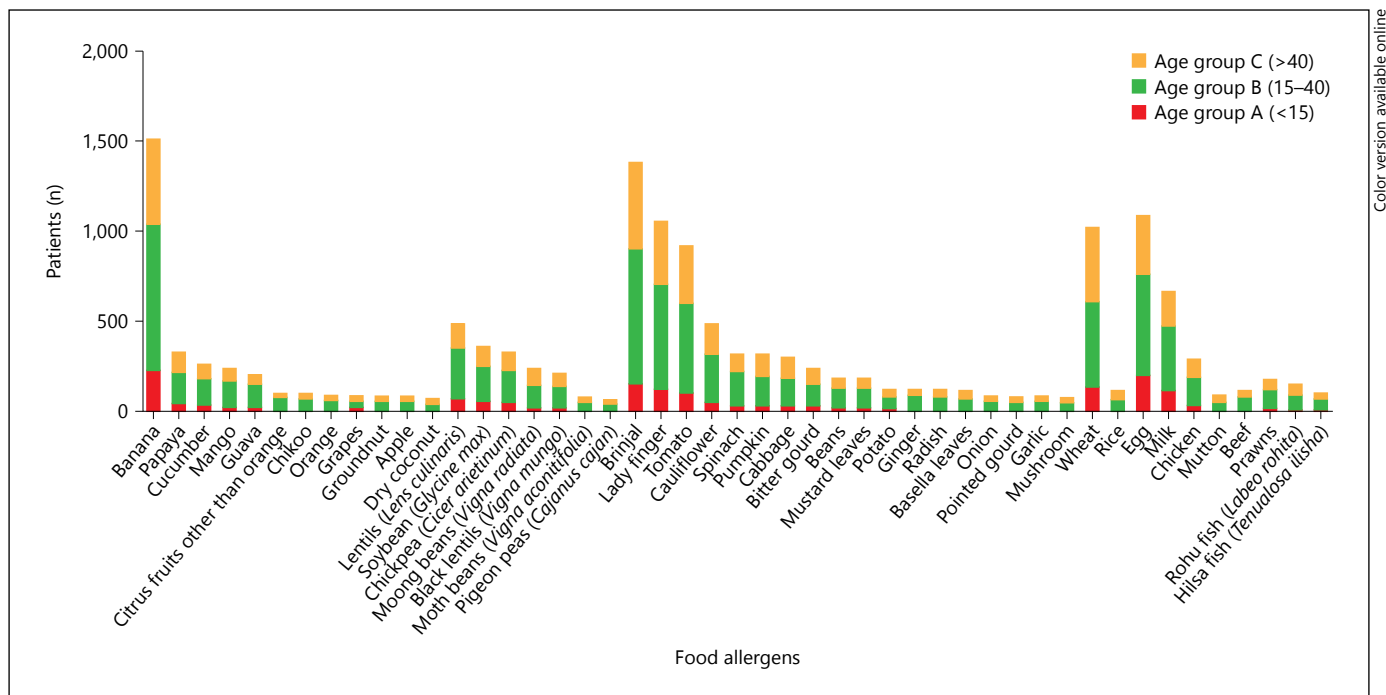


Fig. 1. Relative frequency of patients positive to each food allergen by age group (graph plotted using Graph Pad Prism software). Detailed information is provided in online suppl. table 1.

(29.42%) among vegetables, wheat (21.77%) among cereals, and eggs (23.18%) among animal proteins showed the highest positive results. The relative frequencies of sensitivity to different food items shown by the three age groups are shown in figure 1. The highest number of sensitive patients was found in age group B (15–40 years) for banana.

Discussion

Food allergy is an increasing problem worldwide. Ninety percent of food allergies are caused by peanuts, milk, egg, wheat, nuts, soybeans, fish, crustaceans, and shellfish [9]. Beside these foods, beef in China [9], rice in Thailand [10], sesame in Singapore [2] and Israel [11], pork, seafood, and peaches in Korea [12], bananas in Saudi Arabia [13] and Egypt [14], apples, tomatoes, and crab in Zimbabwe [15], peanuts and pineapples in Ghana [6], shrimp and oranges in Mexico [16, 17], and corn in Brazil [2] are important food items that cause allergy. This variation in food items that provoke allergic reactions depends on the food habits, genetic factors, and culture of the inhabitants of that particular area [18]. The Indian population has varied and distinctive dietary habits. Several stud-

ies on food allergy have been conducted in different parts of India, e.g. Delhi [19], Bangalore, Mysore [20], Bikaner [21], and Kolkata [18]. These studies depict the prevalence of different legumes, brinjal, cucumbers, lady fingers, papaya, pomegranate [22], and bananas [18], among other foods, as major causes of food allergy (aside from wheat, milk, and eggs, which are well-known allergens). According to a previous Kolkata-based study, the top 5 allergenic food items in this area are prawns, brinjal, bananas, lady fingers, and eggs. The current study reported more or less the same type of statistics, with a slight change in the arrangement of the allergens, i.e. banana is at the top, followed by brinjal, eggs, lady fingers, and wheat.

The present study showed that allergies to bananas, eggs, milk, soybeans, cucumbers, chickpeas, and grapes were prevalent among the patients in age group A (<15 years), which shows parity with the situation in other countries. Allergy to cereals such as wheat and rice was highest among age group C (>40 years), and all of the other allergens showed the maximum response among the patients in age group B (15–40 years). At the same time, an almost equal number of patients was found in cases of allergy to papaya, potatoes, and dry coconut.

Although a US-based study [23] showed that wheat allergy is extensive among children, our report suggests

that it is more common among patients aged more than 40 years, which is similar to previous results reported by Mandal et al. [18]. Most Indians are vegetarian and most of the tested vegetables are native to India and thus are mostly uncharted (except for apples, oranges, grapes, and groundnuts; all other fruits are indigenous). Studies have suggested that profilin and lipid transfer protein are important allergens found in fruits. Excluding bananas, grapes, papaya, and dry coconut, all of the 8 fruits tested showed conclusive positive results among patients in age group B.

Food allergy is mediated by IgE antibodies or the non-IgE-mediated pathway [24]. The subjects of the current study showed positive responses in SPT, which implies an IgE-mediated response to allergens. As nod1 (nucleotide oligomerizing domain receptor) polymorphism is linked to IgE-mediated food allergy [24], it is inheritable. Ac-

cording to our questionnaire, 63.18% of patients had a family history of allergy, which includes all of the patients with an insidious onset of allergy. Thus, it can be concluded that in these cases the allergy is due to a genetic predisposition. Among the individuals with a sudden onset of allergy and a family history of allergy, 23.47% were assumed to have a genetic predisposition and show allergic symptoms due to a change in place or occupation, which is linked to changes in food habits or a greater exposure to allergens. In cases of others with no such genetic correlation, allergy may be due to other causes, such as exposure to new allergenic products early in life or reduced microbial exposure early in childhood as described in the hygiene hypothesis [25]. It is very difficult to comment on the cause of food allergy based on survey type studies such as this one, as allergy is a complex polygenic disorder influenced by gene-environment interactions.

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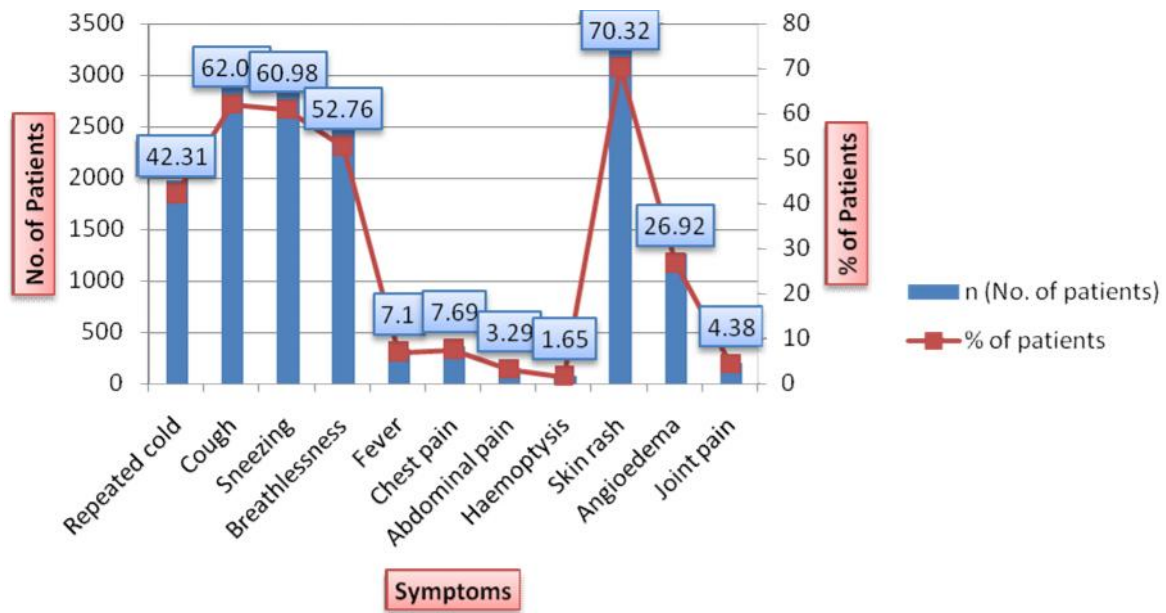


Fig S1. Number and percentage of patients having symptoms due to food allergy.

Table 1. Age group-wise distribution of patients showing sensitivity to different food allergens

Allergen	Below 15, n = 611 (M:F = 298:313)				15–40, n = 2,265 (M:F = 1,067:1,198)				Above 40, n = 1,804 (M:F = 1,178:626)			
	M	F	Total	%	M	F	Total	%	M	F	Total	%
<i>Fruit</i>												
Banana	156	78	234	38.3	391	408	799	35.3	260	223	483	26.8
Papaya	18	27	45	7.4	90	82	172	7.6	66	47	113	6.3
Cucumber	25	18	43	7.03	65	74	139	6.1	43	39	82	4.5
Pumpkin	9	21	30	4.9	62	103	165	7.3	66	51	117	6.5
Mango	16	11	27	4.4	70	76	146	6.4	35	36	71	3.9
Guava	11	13	24	3.9	56	73	129	5.7	35	17	52	2.9
Grapes	14	3	17	2.8	23	21	44	1.9	18	9	27	1.5
Citrus fruits other than orange	5	4	9	1.5	33	35	68	3	13	11	24	1.3
Orange	4	5	9	1.5	23	30	53	2.3	16	15	31	1.71
Groundnut	5	3	8	1.3	34	18	52	2.3	18	5	23	1.3
Coconut dry	5	2	7	1.14	20	21	41	1.8	9	12	21	1.16
Chikoo	3	3	6	0.98	34	30	64	2.8	18	12	30	1.7
Apple	2	2	4	0.65	30	21	51	2.3	17	10	27	1.5
<i>Pulses</i>												
Lentil (<i>Lens culinaris</i>)	46	27	73	11.9	127	150	277	12.23	74	60	134	7.4
Soybean (<i>Glycin max</i>)	38	23	61	9.98	98	88	186	8.2	70	41	111	6.1
Chick pea (<i>Cicer arietinum</i>)	22	25	47	7.7	99	84	183	8.07	71	29	100	5.5
Moong bean(<i>Vigna radiata</i>)	13	8	21	3.4	56	71	127	5.6	52	35	87	4.8
Black lentil (<i>Vigna mungo</i>)	10	10	20	3.3	57	63	120	5.3	44	24	68	3.8
Pigeon pea (<i>Cajanus cajan</i>)	3	1	4	0.65	9	29	38	1.7	14	10	24	1.3
Moth bean (<i>Vigna aconitifolia</i>)	1	0	1	0.16	20	24	44	1.9	18	15	33	1.8
<i>Vegetables</i>												
Brinjal	87	71	158	25.9	347	397	744	32.8	248	227	475	26.3
Lady's fingure	65	55	120	19.6	273	316	589	26	194	153	347	19.2
				4								
Tomato	57	51	108	17.7	230	263	493	21.8	172	142	314	17.4
Cauliflower	27	22	49	8.01	135	142	277	12.2	94	69	163	9.03
Cabbage	16	19	35	5.7	86	69	155	6.8	70	42	112	6.2
Spinach	16	17	33	5.4	79	111	190	8.4	64	29	93	5.1
Bitter gourd	13	13	26	4.2	57	68	125	5.5	43	43	86	4.8
Mustard leaves	12	8	20	3.2	62	46	108	4.8	36	21	57	3.2
Beans	10	8	18	2.9	51	56	107	4.7	40	22	62	3.4
Potato	10	7	17	2.8	33	32	65	2.9	25	17	42	2.3
Radish	8	2	10	1.64	36	34	70	3.09	26	15	41	2.3
Onion	7	2	9	1.5	21	25	46	2.03	14	18	32	1.7
Pointed gourd	3	5	8	1.3	18	28	46	2.03	20	12	32	1.7
Basella leaves	3	4	7	1.15	33	31	64	2.8	26	20	46	2.5
Garlic	3	2	5	0.82	29	24	53	2.3	18	9	27	1.5
Mushroom	2	3	5	0.82	25	21	46	2.03	13	15	28	1.5
Ginger	2	2	4	0.65	44	45	89	3.9	20	9	29	1.6
<i>Cereals</i>												
Wheat	70	63	133	21.8	170	306	476	21.01	281	129	410	22.7
Rice	9	4	13	2.1	33	23	56	2.5	31	21	52	2.9
<i>Animal Protein</i>												
Egg	120	83	203	33.2	263	298	561	24.8	186	135	321	17.8
Milk	62	56	118	19.3	166	190	356	15.7	107	86	193	10.7
Chicken	26	13	39	6.4	66	87	153	6.8	64	33	97	5.4
Prawn	8	13	21	3.4	46	57	103	4.5	25	28	53	2.9
Raohu fish(<i>Labeo rohita</i>)	9	7	16	2.6	31	43	74	3.3	31	26	57	3.1

Hilsa fish(<i>Tenua</i> <i>losa ilisha</i>)	4	6	10	1.6	31	28	59	2.6	18	17	35	1.9
Mutton	5	5	10	1.6	23	17	40	1.8	25	15	40	2.2
Beef	2	2	4	0.65	40	39	79	3.5	23	11	34	1.9
