
Clinical features of legume allergy in children from a Mediterranean area

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Background: Lentils, chickpeas, beans, and peas are the most common consumed legumes in the Mediterranean area. However, there is little information about allergy to these legumes.

Objectives: To describe the clinical features of a Spanish pediatric population allergic to legumes (lentils, chickpeas, peas, white beans, and peanuts), to evaluate the clinical allergy to several legumes, and to determine which legume extract is most appropriate to use in the diagnosis of legume allergy by skin tests.

Methods: Fifty-four children with allergic reactions after exposure to legumes were studied. The diagnosis of legume allergy was confirmed by positive skin prick test results with legume extracts and food challenges or a recent convincing history of severe reactions.

Results: The onset of allergic reactions was at approximately the age of 2 years (median, 22 months). Skin prick test results were positive for at least 3 legumes in 38 children (70%). Positive results were more frequent to boiled extracts than to raw extracts in children with a positive oral challenge. Allergy to lentil was the most frequently diagnosed legume allergy (43 children [80%]), followed by allergy to chickpea (32 children [59%]). Oral challenges with more than 1 legume (median, 3 legumes) were positive in 37 children (69%). The most frequent induced symptoms on challenge were respiratory (rhinitis and/or asthma) and cutaneous.

Conclusion: In this population, lentils and chickpeas are the legumes that cause most allergic reactions, clinical allergy to more than 1 legume is common, and boiled legume extracts are most appropriate to discriminate between allergic and tolerant sensitized children.

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INTRODUCTION

Legumes are an important source of proteins. They are common ingredients in the Mediterranean diet, which is characterized by a large consumption of cereals, legumes, olive oil, fresh fruits, and vegetables. In Spain, where the Mediterranean diet is common, lentils, chickpeas, beans, and peas are the most common consumed legumes.¹ The consumption of legumes in Spain is estimated to be 4.8 kg per person per year: 1.8 kg corresponds to chickpeas, 1.6 kg corresponds to beans, and 1.4 kg corresponds to lentils.² Among Spanish children, the consumption of legumes starts at approximately the first year of age and at school age they eat legumes about once a week. In children younger than 5 years, sensitization to these legumes is the fifth cause of food allergy.³ Legume allergy is also prevalent in some Asian countries, such as India, where chickpea is a major food allergen.⁴ In contrast, in the United

States and in some European countries, the consumption of legumes other than peanuts or soybeans is uncommon. In these countries, peanuts are often introduced in early life via peanut butter, baked goods, and other products adulterated with peanuts. Peanut allergy is, therefore, quite common in these countries; however, clinical allergy to legumes other than peanuts is rare.^{5–9} Furthermore, serologic cross-reactivity among legumes has been demonstrated.^{10,11} However, clinical allergy to more than 1 legume is rare among North American children.¹² Symptoms of food allergy are mainly caused by ingestion, but allergic reactions by contact or inhalation of steam from cooked legumes have also been described.^{13–15} There is little information about the value of skin prick tests with raw extracts compared with boiled ones to predict legume allergy. In a recent study,¹⁶ skin tests with raw or roasted peanuts provided similar diagnostic information. Skin prick tests with boiled lentil extracts show greater diagnostic values than those with raw extracts¹⁷; also, in vitro, boiled extracts from chickpea¹⁸ and lentil¹⁹ retain their allergenicity.

There is little information about allergy to legumes, such as lentils, chickpeas, peas, and beans, in pediatric patients. The objectives of this study were to describe the clinical features of a cohort of pediatric patients in Spain allergic to the most commonly consumed legumes, to evaluate the clinical reactivity to several legume species, and to inves-

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tigate whether the use of raw or boiled extracts in skin tests adds additional information for predicting clinical legume allergy.

METHODS

Patient Population and Inclusion Criteria

This study was performed at the Allergy Department, Niño Jesús University Hospital, Madrid, Spain. To be included in the study, patients had to fulfill the following inclusion criteria: (1) be aged between 1 and 15 years, (2) have a history of previous allergic reaction (by ingestion, contact, and/or inhalation) to at least 1 legume (lentils, chickpeas, peas, white beans, or peanuts), (3) have a positive skin test and/or serum-specific IgE result to legumes, and (4) have a positive oral legume challenge or a recent history of severe allergic reaction to the legume that the patient is sensitized to.

During the first visit, a complete clinical history was obtained and a physical examination was performed. Previous to inclusion in the study, the parents or person responsible signed the appropriate consent forms. Fifty-four children were included in the study.

This study was performed with the approval of the Ethics Committee of Niño Jesús University Hospital.

Legume Extracts

Lentils, chickpeas, peas, and white beans (100 g) were ground in a blender for 3 minutes and extracted in 2 L of a 0.85% sodium chloride solution in a shaker for 16 hours at 4°C, separately. Afterward, 2 types of extracts of each legume were prepared following the methods previously described.^{17,18} Briefly, half of the legumes remained raw and the other half was boiled for 60 minutes. After these steps were completed, all extracts were centrifuged at 10,000 rpm for 15 minutes and the supernatants were sterile filtered. The protein concentration in all legume extracts was estimated by the Lowry method (Sigma Diagnostics, St Louis, Missouri), following the manufacturer's instructions. After lyophilization, 2 types of skin prick test solutions of each legume (raw and boiled) were prepared. Freeze-dried material, 5 mg/mL, was reconstituted in a solution containing 50% glycerine, 0.5% phenol, and phosphate-buffered saline, 0.01M.

Skin Tests

All patients underwent skin prick tests with ALK lancet (ALK-Abello, Madrid) on the volar surface of the forearm with commercial legume extracts, including lentil, chickpea, pea, white bean, green bean, soybean, and peanut (at 10 mg/mL; Laboratorios LETI, SL, Madrid), and a battery of common aeroallergens, including *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, *Lolium perenne*, *Olea europea*, *Artemisia vulgaris*, *Betula alba*, *Alternaria tenuis*, and cat and dog dander (ALK-Abello). Furthermore, 47 of these patients underwent skin tests with raw and boiled lentil, chickpea, pea, and white bean extracts. All skin tests were performed according to the European Academy of Allergol-

ogy and Clinical Immunology guidelines.²⁰ A result was considered positive when the mean diameter of the wheal was at least 3 mm longer than the wheal of the negative control. Histamine, 10 mg/mL, and 50% glycerinated isotonic sodium chloride solution were used as positive and negative controls, respectively.

Oral Food Challenges

Oral food challenges were performed with cooked or roasted (peanuts) legumes in an open fashion, as previously described.¹⁷ Children were challenged with lentils, chickpeas, peas, white beans, and peanuts if they had a history of adverse reactions with 1 or more of these legumes (no recent severe reaction) or if they did not know their tolerance. Briefly, the legumes were given in increasing amounts, which were doubled every 30 minutes until the children presented convincing symptoms or until the standard dietary dose for their ages was reached. A positive challenge was defined as cutaneous (urticaria and/or angioedema) and/or respiratory symptoms (rhinitis, conjunctivitis, and/or asthma) as single manifestations or associated with other signs and symptoms of anaphylaxis. When the results of the open food challenges were not conclusive (mild and/or equivocal or ambiguous symptoms), a double-blind, placebo-controlled, oral food challenge was performed. Up to 8 g of a boiled and lyophilized legume extract was administered in orange juice. As a placebo, only orange juice was used, because its taste and texture were not altered with the lyophilized food. Doses were gradually increased every 30 minutes. Food challenges were performed by trained personnel (M.M.S.I. and M.D.I.) under continuous observation. Equipment to treat anaphylactic reactions was readily available.

Statistical Analysis

The primary end point was to estimate the prevalence of legume allergy. The quantitative variables were summarized by the median and range, and the qualitative variables were described as percentage of the total sample. To verify the normal distributions of quantitative variables, the Kolmogorov-Smirnov test was used. χ^2 Yate correlation and Fisher exact tests were used for qualitative variables, and the Mann-Whitney test was used for quantitative variables. $P = .05$ (2-tailed test) was considered statistically significant. The sensitivity, specificity, positive predictive value, and negative predictive value of skin tests as a predictor of a positive challenge were calculated. Analyses were performed using SPSS 11.0 (SPSS Inc, Chicago, Illinois) for calculations.

RESULTS

The clinical features of children allergic to legume are given in Table 1. There were 43 boys and 11 girls. All patients tolerated green bean in the diet. Lentils and chickpeas were responsible for most allergic reactions. Forty-two patients (78%) reported allergic reactions to 2 or more legumes. The first allergic reactions with legumes occurred at approxi-

Table 1. Clinical Features of the 54 Children Allergic to Legumes in This Study^a

Feature	Total (N = 54)	Lentil (n = 43)	Chickpea (n = 32)	Pea (n = 27)	White bean (n = 6)	Peanut (n = 18)
Age, y	5 (1–15)	4 (1–15)	7 (1–15)	5 (1–15)	3 (1–9)	6 (2–15)
Male to female ratio	43:11	36:7	28:4	23:4	5:1	11:7
No. with other atopic diseases (A/AD/R)	38/29/35	30/26/27	24/16/22	21/16/17	3/2/2	14/10/11
Sensitization to pollen, No. (%)	43 (80)	34 (79)	25 (78)	20 (74)	4 (67)	14 (78)
Age of onset, mo	22 (4–192)	15 (4–84)	18 (8–108)	36 (9–168)	28 (18–60)	36 (12–192)
No. of implicated legumes per child ^b	3.0 (1–5)	3.0 (1–5)	3.0 (1–5)	3.0 (2–5)	3.5 (1–5)	2.0 (1–5)
No. of reactions per child	2.0 (1–10)	3.0 (1–10)	2.5 (1–10)	1.0 (1–5)	1.5 (1–5)	1.0 (1–8)
Children with symptoms at first known exposure, No. (%)	41 (76)	27 (63)	19 (59)	8 (30)	4 (67)	9 (50)
Exposure route, No. (%)						
Ingestion	53 (98)	36 (84)	31 (97)	14 (52)	5 (83)	9 (50)
Contact	24 (44)	10 (23)	12 (38)	1 (4)	1 (17)	9 (50)
Inhalation	19 (35)	13 (30)	11 (34)	5 (19)	0	4 (22)

Abbreviations: A, asthma; AD, atopic dermatitis; R, rhinitis.

^a Data are given as median (range) unless otherwise indicated.^b Demonstrated by oral food challenges or a convincing history of a severe reaction.

mately the age of 2 years (median, 22 months; range, 4–192 months). Thirty children (56%) were allergic to another food: 15 to egg, 13 to fish, 11 to tree nuts, and 4 to shellfish (some were allergic to >1 food).

Skin Prick Tests

A total of 43 children (80%) were sensitized to pollen (39 [72%] to grass, 34 [63%] to olive, 20 [37%] to mugwort, and 16 [30%] to birch), 14 (26%) to molds, and 13 (24%) to mites. Thirty-eight children (70%) had positive skin prick test results with 3 or more commercial legume extracts. Forty-six (85%) were sensitized to lentils, 41 (76%) to chickpeas, 36 (67%) to peanuts, and 31 (57%) to peas. Green and white beans elicited a positive skin prick test result in 12 children (22%) and 19 children (35%), respectively. In children with positive food challenges, positive skin prick test results were more frequently found with the boiled extracts than with the raw extracts, except for white beans. Furthermore, in children with positive challenges, the mean diameter of the wheal sizes was significantly greater with boiled extracts than with raw extracts (lentils, 7.6 vs 4.6 mm [$P = .003$]; chickpeas, 5.4 vs 4.0 mm [$P = .001$]; peas, 8.0 vs 6.0 mm [$P = .003$] (Fig 1). Furthermore, sensitivity, specificity, positive predictive value, and negative predictive value were greater with the

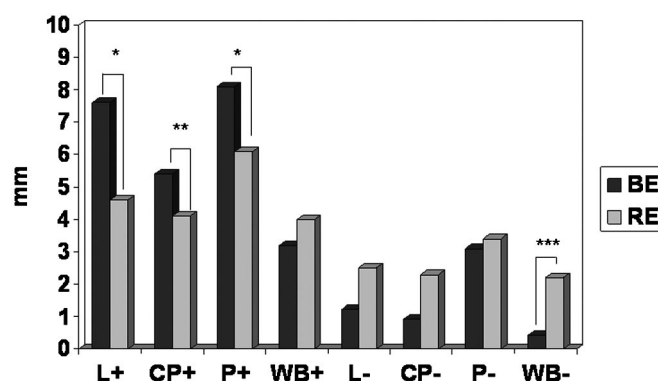


Figure 1. Mean diameter of the wheal sizes of skin prick test results performed with raw extracts (REs) and boiled extracts (BEs) of legumes in children with positive and negative oral challenges. CP+ indicates positive oral challenge to chickpea; CP–, negative oral challenge to chickpea; L+, positive oral challenge to lentil; L–, negative oral challenge to lentil; P+, positive oral challenge to pea; P–, negative oral challenge to pea; WB+, positive oral challenge to white bean; WB–, negative oral challenge to white bean; * $P = .003$; ** $P = .001$; *** $P = .01$.

boiled than with the raw extracts (except for the sensitivity and negative predictive value of white bean) (Table 2).

Table 2. Comparison of the Sensitivity, Specificity, and Predictive Values of Skin Testing With Different Extracts

Legume	Sensitivity			Specificity			Positive predictive value			Negative predictive value		
	RE	BE	CE	RE	BE	CE	RE	BE	CE	RE	BE	CE
Lentil	91	100	98	58	73	58	83	88	89	75	100	87
Chickpea	85	97	100	55	85	64	72	89	80	73	89	100
Pea	74	96	74	35	48	57	59	66	63	80	92	70
White bean	83	67	83	72	98	72	24	80	26	96	95	97

Abbreviations: BE, boiled extract; CE, commercial extract; RE, raw extract.

Oral Food Challenges

A total of 143 food challenges were performed on 51 children; 105 (73%) were positive. Three children were not challenged with any legume because they had a recent history of severe reaction with 1 legume (2 with peanuts and 1 with lentils) and reported good tolerance to the other legumes. Children with a recent history of severe reaction to a legume (defined as urticaria, wheezing and vomiting, and/or laryngeal edema after ingestion, contact, or inhalation) were not challenged with this legume. These included 6 patients with a reaction to lentils, 3 with a reaction to chickpeas, 3 with a reaction to peas, and 9 with a reaction to peanuts. All these children had positive skin prick test results to these legumes (mean wheal diameter, >5 mm). The results of oral food challenges to legumes are given in Table 3. In short, 43 children were allergic to lentils, 32 to chickpeas, 27 to peas, 18 to peanuts, and 6 to white beans. Thirty-nine children were challenged with 2 or more legumes. Twelve children were challenged with only 1 legume (6 with peanuts, 2 with white beans, 2 with lentils, and 2 with chickpeas) because they had a recent history of severe reaction with the other legumes or reported good tolerance. Six double-blind, placebo-controlled, oral food challenges were performed: 3 with chickpeas, 2 with lentils, and 1 with peas. Two of them were positive. Overall, 17 children (31%) were only allergic to 1 legume (7 to peanuts, 8 to lentils, 1 to white beans, and 1 to chickpeas) and 37 (69%) were allergic to 2 or more legumes (median, 3 legumes). The most frequent associations were allergy to lentil and chickpea (31 children [57%]), lentil and pea (29 children [54%]), and lentil, chickpea, and pea (23 children [43%]). Nine of the children allergic to peanut were also allergic to lentil, and 7 were allergic to peanut and pea. Seven children were allergic exclusively to peanuts, with good tolerance to other legumes. These patients represented 39% of the patients diagnosed as having peanut allergy. Only 8 children were allergic exclusively to lentils (19% of patients allergic to lentils).

Respiratory symptoms (rhinoconjunctivitis and/or asthma) were the most common symptoms observed during oral chal-

lenges, mainly associated with cutaneous reactions. Gastrointestinal complaints were observed less frequently. Oral allergy syndrome was present in 28 positive challenges. Eleven challenges resulted in *severe reactions*, defined as manifestations that affected 2 or more systems (cutaneous, respiratory, and/or gastrointestinal), that resolved immediately after administration of epinephrine and antihistamines. These manifestations were more frequent with peanut and chickpea. All of these children have an asthma history. No children had an exacerbation of atopic dermatitis during food challenges (Table 4).

DISCUSSION

In Spain, several varieties of legumes are consumed. This study describes the clinical characteristics of a cohort of Spanish children allergic to legumes, confirmed by oral challenges. Among Spanish children, legume allergy is the fifth most common cause of food allergy.³ In this study of 54 patients, we confirmed that lentils were the most common cause of legume allergy (80%), followed by chickpeas (59%) and peas (50%); green beans and white beans were the most frequently tolerated legumes. Despite the fact that peas are commonly consumed, few cases of pea allergy have been reported.^{12,21} In this study, we found that allergy to peas is also common among Spanish children and is frequently associated with lentil and chickpea allergies.

In our studied population, legume allergy started at approximately the age of 2 years and began earlier with lentils and chickpeas (median, 15 and 18 months, respectively) than with peas and peanuts (median, 36 months). This difference could be explained owing to the later introduction of peas and peanuts in the Spanish diet. Most children had their first reaction on their first known exposure to a certain legume. Other authors^{22,23} have reported similar findings with other food allergens. There is not a clear explanation for it, but it may be owing to prenatal sensitization (in utero exposure), in the postnatal period through the breast milk or by hidden ingestion.^{23,24} A total of 19 and 24 children reported symptoms after inhalation of steam from cooked legumes or skin contact with legumes, respectively. These symptoms were more frequent with lentils, chickpeas, and peanuts than with other legumes. Several studies^{15,22,25} have also reported cases of allergic reactions after skin contact with lentils, chickpeas, beans, and peanuts. Bronchial asthma after inhalation of steam from cooked legumes and after specific bronchial challenges with lentil and chickpea extracts has also been described.^{13,14,26,27} Most of our patients were male, were sensitized to pollens (80%), and had other allergic diseases. Sensitization to other foods was also common among our studied population, mainly to egg, fish, and tree nuts, the most frequent causes of food allergy in Spanish children older than 2 years.³ These findings showed that our cohort included highly atopic children. This could be a clinical characteristic of patients allergic to legume in Spain.

Lentils, chickpeas, peas, and beans are consumed after cooking. However, food extracts commonly used for skin

Table 3. Results of Oral Legume Challenges in 54 Children Allergic to Legumes and Final Diagnosis

Legume ^a	No. of children	Positive challenges ^b	Final diagnosis ^c
Lentil	39	37 (95)	43 (80)
Chickpea	39	29 (74)	32 (59)
Pea	32	24 (75)	27 (50)
Peanut	15	9 (60)	18 (33)
White bean	18	6 (33)	6 (11)

^a A total of 6, 3, 3, and 9 children were not challenged to lentils, chickpeas, peas, and peanuts, respectively, owing to a recent convincing history of severe reactions with these legumes.

^b Data are given as number (percentage) of the total number of children given in the second column for each legume.

^c Data are given as number (percentage) of the 54 children.

Table 4. Clinical Manifestations During Oral Challenges in Total Challenges and in Oral Challenges to Specific Legumes^a

Symptom	Total (N = 105)	Lentil (n = 37)	Chickpea (n = 29)	Pea (n = 24)	White bean (n = 6)	Peanut (n = 9)
Cutaneous	45 (43)	14 (38)	15 (52)	13 (54)	2 (33)	3 (33)
Gastrointestinal	20 (19)	4 (11)	3 (10)	3 (13)	2 (33)	2 (22)
Respiratory	60 (57)	12 (32)	17 (59)	11 (46)	0	4 (44)
Oral allergy syndrome	28 (27)	16 (43)	5 (17)	3 (13)	2 (33)	2 (22)
Severe reaction	11 (10)	3 (8)	4 (14)	2 (8)	0	2 (22)

^a Data are given as number (percentage) of the total of each group.

testing in clinical practice are prepared from crude materials.²⁸ In a previous study,¹⁷ boiled lentil extracts were reported to be significantly better than raw extracts for identifying clinically sensitive individuals. In that study, skin prick tests performed with boiled lentil extract at 0.5 mg/mL were positive in 31% (4/13) of the patients tolerant to lentil and in 96% (22/23) of the patients nontolerant to lentil, confirmed by oral challenges in children with adverse reactions to lentils. At the same concentration, skin prick tests performed with raw lentil extract were positive in similar frequencies in both groups.¹⁷ In the present study, skin prick test results with boiled extracts were more frequently positive in children with positive challenges than in tolerant children. Furthermore, the mean wheal diameter was significantly greater with boiled extracts than raw extracts for lentils, chickpeas, and peas in the nontolerant patients. In general, boiled extracts provide better predictive values than raw or commercial extracts. These results demonstrate that legume boiled extracts are the most appropriate for discriminating between allergic and tolerant sensitized children. Lentil and chickpea extracts maintain strong allergenicity after boiling.^{18,19} Heat treatment of lentil extract produces a strong increase in bands that correspond to major allergen Len c 1 in sodium dodecyl sulfate—polyacrylamide gel electrophoresis experiments.²⁹

Most of the children reported allergic reactions to more than 1 legume. We confirmed clinical allergy to 2 or more legumes (median, 3 legumes) by oral food challenges in almost 70% of the children (37 children). These results are in disagreement with the results obtained by Bernhisel-Broadbent and Sampson,¹² who reported the results of double-blind, placebo-controlled, oral food challenge to 5 legumes in 69 children sensitized to legumes. Only 2 (5%) of the 41 children with positive results had positive challenges to 2 legumes (both to peanut and soybean).¹² In that study, most of the children were allergic to peanuts, whereas in our study, most of the children were allergic to lentils. The difference in the sensitization pattern identified in the patient population sensitized to peanuts vs other legumes deserves further investigation, but we suggest that a different dietary exposure leads to a different clinical reactivity. In Spain, where the Mediterranean diet is common, more species of legumes such as lentils, chickpeas, peas, and beans are consumed and introduced early in life. In contrary, peanuts are introduced later in life. However, major allergens from lentil and pea

belong to the storage proteins of the vicilin family, which have homology with the peanut allergens, such as Ara h 1.³⁰

Respiratory symptoms were the most commonly observed symptoms during legume challenges, mainly rhinitis and/or conjunctivitis, followed by cutaneous symptoms, such as urticaria and angioedema. Atopic children frequently experience nasal symptoms during oral food challenges (30%–80% of positive challenges), mostly associated with cutaneous or gastrointestinal symptoms^{31,32} and more frequently observed in infants and young children than in adults.³³ In our study, many patients referred symptoms after inhalation of steam from cooked legumes. This is in agreement with the fact that legume allergens are thermostable and become aerosolized during the cooking process.

In summary, allergies to lentils and chickpeas were the most frequent legume allergies among our cohort of Spanish children, but these findings cannot be extrapolated to populations with different dietary habits. The most frequent symptoms observed during the oral challenges were respiratory and cutaneous. This study has demonstrated that skin prick tests with boiled legume extracts provide better information than raw extracts for the prediction of the outcome of a legume challenge in the population studied. Clinical allergy to more than 1 legume is common in our patient population.

REFERENCES

- Martínez San Ireneo M, Ibáñez MD, Fernández-Caldas E. Hypersensitivity to members of the botanical order Fabales (legumes). *J Invest Allergol Clin Immunol*. 2000;10:187–199.
- Ministerio de Agricultura, Pesca y Alimentación. La alimentación española en 2006: resumen de los datos más relevantes. Available at: <http://www.mapa.es/es/alimentacion/pags/consumo/resumen.htm>.
- Crespo JF, Pascual C, Burks AW, Helm RM, Esteban MM. Frequency of food allergy in a pediatric population from Spain. *Pediatr Allergy Immunol*. 1995;6:39–43.
- Patil SP, Niphadkar PV, Bapat MM. Chickpea: a major food allergen in the Indian subcontinent and its clinical and immunochemical correlation. *Ann Allergy Asthma Immunol*. 2001;87:140–145.
- Loza C, Brostoff J. Peanut allergy. *Clin Exp Allergy*. 1995;25:493–502.
- Burks AW, Sampson H. Food allergies in children. *Curr Probl Pediatr*. 1993;23:230–252.
- Warner JO. Peanut allergy: a major public health issue. *Pediatr Allergy Immunol*. 1999;10:14–20.
- Moneret-Vautrin DA, Rance F, Kanny G, et al. Food allergy to peanuts in France: evaluation of 142 observations. *Clin Exp Allergy*. 1998;28:1113–1119.
- Steinman HA. Hidden allergens in foods. *J Allergy Clin Immunol*. 1996;98:241–250.

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10. Bernhisel-Broadbent J, Taylor S, Sampson HA. Cross-allergenicity in the legume botanical family in children with food hypersensitivity, II: laboratory correlates. *J Allergy Clin Immunol*. 1989;84:701–709.
 11. Barnett D, Bonham B, Howden ME. Allergenic cross-reactions among legume food: an in vitro study. *J Allergy Clin Immunol*. 1987;79:433–438.
 12. Bernhisel-Broadbent J, Sampson HA. Cross-allergenicity in the legume botanical family in children with food hypersensitivity. *J Allergy Clin Immunol*. 1989;83:435–440.
 13. Martin JA, Compaired JA, de la Hoz B, et al. Bronchial asthma induced by chick pea and lentil. *Allergy*. 1992;47(pt 2):185–187.
 14. Martínez Alonso JC, Callejo Melgosa A, Fuentes Gonzalo MJ, Martín García C. Angioedema induced by inhalation of vapours from cooked white bean in a child. *Allergol Immunopathol (Madr)*. 2005;33:228–230.
 15. Kalogeromitros D, Armenaka M, Galatas I, Capellou O, Katsarou A. Anaphylaxis induced by lentils. *Ann Allergy Asthma Immunol*. 1996;77:480–482.
 16. Nolan RC, Richmond P, Prescott SL, et al. Skin prick testing predicts peanut challenge outcome in previously allergic or sensitized children with low serum peanut-specific IgE antibody concentration. *Pediatr Allergy Immunol*. 2007;18:224–230.
 17. Martínez M, Ibáñez MD, Fernández-Caldas E, Marañón F, Muñoz MC, Laso MT. The diagnostic value of crude or boiled extracts to identify tolerant versus nontolerant lentil sensitive children. *Ann Allergy Asthma Immunol*. 2001;86:686–690.
 18. Martínez San Ireneo M, Ibáñez Sandín MD, Fernández-Caldas E, Marañón Lizana F, Rosales Fletes MJ, Laso Borrego MT. Specific IgE levels to *Cicer arietinum* (Chick pea) in tolerant and nontolerant children: evaluation of boiled and raw extracts. *Int Arch Allergy Immunol*. 2000;121:137–143.
 19. Ibáñez Sandín D, Martínez San Ireneo M, Marañón Lizana F, Fernández-Caldas E, Alonso Lebrero E, Laso Borrego T. Specific IgE determinations to crude and boiled lentil (*Lens culinaris*) extracts in lentil-sensitive children and controls. *Allergy*. 1999;54:1209–1214.
 20. The European Academy of Allergology and Clinical Immunology. Position paper: allergen standardization and skin tests. *Allergy* 1993; 48(suppl):48–82.
 21. Pascual CY, Fernández-Crespo J, Sánchez-Pastor S, et al. Allergy to lentils in Mediterranean pediatric patients. *J Allergy Clin Immunol*. 1999;103:154–158.
 22. Fries JH. Peanut: allergy and other untoward reactions. *Ann Allergy*. 1982;48:220–226.
 23. Van Asperen PP, Kemp AS, Mellis CM. Immediate food hypersensitivity reactions on the first known exposure to the food. *Arch Dis Child*. 1983;58:253–256.
 24. Warner JO, Jones CA, Kiburn SA, Vance GHS, Warner JA. Pre-natal sensitization in humans. *Pediatr Allergy Immunol*. 2000;13:6–8.
 25. Igea JM, Fernández M, Quince S, de la Hoz B, Díez Gómez ML. Green bean hypersensitivity: an occupational allergy in a homemaker. *J Allergy Clin Immunol*. 1994;94:33–35.
 26. Roberts G, Golder N, Lack G. Bronchial challenges with aerosolized food in asthmatic, food-allergic children. *Allergy*. 2002;57:659–660.
 27. Niphadkar PV, Patil SP, Bapat MM. Chick-pea induced anaphylaxis. *Allergy*. 1997;52:115–116.
 28. Bernhisel-Broadbent J. Allergenic cross-reactivity of food and characterization of food allergens and extract. *Ann Allergy Asthma Immunol*. 1995;75:295–303.
 29. Sánchez-Monge R, Pascual CY, Díaz-Perales A, Fernández-Crespo J, Martín-Esteban M, Salcedo G. Isolation and characterization of relevant allergens from boiled lentils. *J Allergy Clin Immunol*. 2000;106:955–961.
 30. Sanchez-Monge R, Lopez-Torrejón G, Pascual CY, Varela J, Martín-Esteban M, Salcedo G. Vicilin and convicilin are potential major allergens from pea. *Clin Exp Allergy*. 2004;34:1747–1753.
 31. James JM, Bernhisel-Broadbent J, Sampson HA. Respiratory reactions provoked by double-blind food challenges in children. *Am J Respir Crit Care Med*. 1994;149:59–64.
 32. Sampson HA. Food allergy, part 1: immunopathogenesis and clinical disorders. *J Allergy Clin Immunol*. 1999;103:717–728.
 33. James JM. Respiratory manifestations of food allergy. *Pediatrics*. 2003; 111:1625–1630.
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