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# Oral allergy syndrome amongst young Mexicans: prevalence and associated factors

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## KEY WORDS

*prevalence; hypersensitivity; food hypersensitivity; young adult; oral allergy syndrome*

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## Introduction

The term oral allergy syndrome (OAS), also known as pollen-food syndrome, describes allergic reactions that primarily manifest in the oral cavity, including pruritus and edema on the lips, tongue or palate, immediately after food intake (1). OAS is caused when allergens found in fruits, vegetables and pollen react in a sensitized subject (2). Although symptoms are usually limited to the mouth, some patients may also have extra-oral complaints, including pharyngeal edema, changes in skin color, or respiratory symptoms (3,4).

The prevalence of OAS is influenced by several factors; among them, the patterns of allergic sensitization in each geographic region and the prevalence of allergic rhinitis (2). In the non-se-

## Summary

**Background.** Oral allergy syndrome (OAS) is the most common food allergy manifestation amongst adults. However, population studies aimed at estimating its prevalence and associated factors are scarce in Mexico. **Objectives.** To establish the prevalence of OAS in a sample of university students and to describe their clinical characteristics and its associated factors. **Methods.** From a sample group made up of 25,269 university students, the data corresponding to 1,200 students aged 18 to 25 was analyzed with a cross-sectional approach. A structured questionnaire was used to identify OAS, its symptoms and related foods, and the personal history of atopic diseases. The associations between variables were calculated through logistical regression analysis. **Results.** The prevalence of OAS was 3.4%, with a 95% confidence interval (95% CI) of 2.5 to 4.6. The main oral symptoms reported were lip pruritus, edema and the sensation of pharyngeal oppression. Among the extra-oral complaints were: reddish coloration of the skin, body pruritus, abdominal pain, and abdominal bloating. The foods that were most frequently associated with OAS were fruits (68.5%), vegetables (22.0%) and seafood (19.3%). Through multivariate analyses, allergy to pollen and latex were found to be associated with OAS, OR 3.29; 95% CI 1.53 to 7.10 and OR 5.53; 95% CI: 1.08 to 28.2, respectively. **Conclusions.** Notably, the prevalence of OAS varies according to the geographic area. Personal histories of allergy to pollen or latex were the main factors linked to OAS.

lected population, the prevalence of OAS has been estimated between 2.0% and 11.5% (5-9).

Among the foods that have been most commonly linked to OAS are specimens from different botanical families: a) *Rosaceae* (pear, apple, peach, plum, strawberry, and almond); b) *Lauraceae* (avocado, walnut, and cinnamon); c) *Musaceae* (banana); d) *Bromeliaceae* (pineapple); e) *Actinidiaceae* (kiwi), and f) *Anacardiaceae* (mango) (4,10-14).

Additional factors linked to OAS prevalence are female sex (11,15), and allergic sensitization to pollens (11,16). The latter also influences the intensity of nasal and ocular symptoms (17). The lack of studies that determine the frequency of OAS among the young-adult population in Mexico motivates this study. The objectives of this study were to establish OAS

prevalence in a sample of university students and to describe the clinical characteristics and associated factors.

## Methods

### Design

The methods were previously published elsewhere (18). This was a cross-sectional study involving 25,269 students enrolled in the Autonomous University of the State of Mexico, with a final sample size of 1,200 students, aged 18 to 25 years, male and female, born in the State of Mexico, Mexico. The recruitment period took place from February to May 2014.

### Questionnaire

Each participant filled out a questionnaire that helped us determine whether they were affected by OAS; it targeted demographic variables, their personal history of allergic diseases (asthma, allergic rhinitis, and atopic dermatitis), pollen or latex allergy, and the oral and extra-oral symptoms related to OAS, as well as the foods that caused it.

### Definitions

To identify OAS, participants were questioned about the presence of oral symptoms (oral pruritus or lip edema) that had occurred immediately after consuming any food. Then, students reported the symptoms affecting other organs.

### Ethics

The Ethics and Research Committee of the Center for Research in Medical Sciences of the Autonomous University of the State of Mexico approved our study (Registration No. 2014/05). To participate in the study, each student signed a consent form.

### Statistical analysis

The prevalence of OAS was determined by calculating its frequency; additionally, its 95% confidence intervals (95% CI) were estimated. The association between the consumption of certain foods and the onset of OAS was also assessed. Furthermore, multivariate analyses were performed to identify factors associated with OAS. Statistical significance was estimated at  $p \leq 0.05$ . Data processing was performed with the IBM SPSS software, version 20.0 for Windows (Armonk, NY, USA).

## Results

In total, there were 41 cases of OAS, with a prevalence of 3.4% (95% CI: 2.5 - 4.6); 3.2% amongst men and 3.6% amongst women ( $p = 0.719$ ).

The sample consisted of students with a median age of 20 for females and 19 for males ( $p = 0.419$ ) (table I). Among the subjects with OAS, 9.8% had asthma, 24.4% had allergic rhinitis and 14.6% had atopic dermatitis. There was no statistical difference between individuals of either sex, when it came to the personal history of asthma, allergic rhinitis, and

**Table I** - Characteristics of the study group ( $n = 41$ ).

	total n = 41	Sex		p
		male n = 16	female n = 25	
<b>Age (yr)</b>				
<b>median</b>	19	19	20	0.419 <sup>1</sup>
<b>lower-upper limits</b>	18 - 25	18 - 23	18 - 25	
<b>Personal clinical history of allergic disease, n (%)</b>				
<b>asthma</b>	4 (9.8)	2 (12.5)	2 (8.0)	0.637 <sup>2</sup>
<b>allergic rhinitis</b>	10 (24.4)	3 (18.8)	7 (28.0)	0.712 <sup>2</sup>
<b>atopic dermatitis</b>	6 (14.6)	2 (12.5)	4 (16.0)	0.999 <sup>2</sup>
<b>latex allergy</b>	2 (4.9)	1 (6.3)	1 (4.0)	0.999 <sup>2</sup>
<b>pollen allergy</b>	10 (24.4)	4 (25.0)	6 (24.0)	0.999 <sup>2</sup>
<b>Foods associated with OAS (n)</b>				
<b>median</b>	2	2	2	0.606 <sup>1</sup>
<b>lower-upper limits</b>	1 - 15	1 - 4	1 - 15	

<sup>1</sup> p value obtained by U de Mann-Whitney test, <sup>2</sup> p value obtained by Fisher exact test.  $p \leq 0.05$  was considered statistically significant. OAS, oral allergy syndrome.

atopic dermatitis; as was the case for the allergy frequency to latex and pollen. The median number of foods associated with OAS was 2.

The three most important oral symptoms in subjects with OAS were lip pruritus, lip edema and sensation of pharyngeal oppression (**table II**). Almost half of the subjects that were studied had extra-oral symptoms; mostly cutaneous (reddening of the skin and itchy skin) and abdominal (abdominal pain and abdominal distention) symptoms. Respiratory symptoms were the least prevalent (cough, rhinorrhea or wheezing).

The foods most frequently associated with OAS included fruits (peach, kiwi and avocado), vegetables (chili, tomato, and bell pepper), seafood (shrimp), nuts (walnut and cashews), and legumes (beans and lentils) (**table III**).

Through multivariate analyses, the personal history of allergy to pollen and latex were identified as factors that are strongly

**Table II** - Oral allergy syndrome clinical manifestations.

	n = 41	%
<b>Oral</b>		
lip pruritus	37	90.2
lip edema	23	56.1
pharyngeal oppression	11	26.8
<b>Extra-oral</b>		
skin reddening	17	41.5
skin itching	14	34.1
abdominal pain	11	26.8
abdominal bloating	8	19.5
skin rash	7	17.1
lacrimation	6	14.6
heartburn	5	12.2
diarrhea	4	9.8
sneezing	4	9.8
dyspnea	4	9.8
sweating	4	9.8
flatulence	3	7.3
cough	3	7.3
rhinorrhea	3	7.3
wheezing	1	2.4

**Table III** - Major foods related to oral allergy syndrome (n = 41).

Food	n	%
<b>Fruits</b>	28	68.5
peach	8	19.5
kiwi	8	19.5
avocado	7	17.1
mango	5	12.2
apple	5	12.2
strawberry	3	7.3
pineapple	3	7.3
coconut	2	4.9
melon	2	4.9
guava	2	4.9
<b>Vegetables</b>	9	22.0
chili	4	9.8
tomato	3	7.3
bell pepper	1	2.4
cauliflower	1	2.4
mushrooms	1	2.4
<b>Fish and shellfish</b>	8	19.3
shrimp	7	17.1
octopus	2	4.9
<b>Dairy products</b>	7	17.1
milk	6	14.6
yogurt	4	9.8
cheese	1	2.4
<b>Nuts and seeds</b>	7	17.1
walnut	5	12.2
cashews	4	9.8
almond	3	7.3
hazelnut	3	7.3
brazilian nut	2	4.9
peanut	1	2.4
sesame	1	2.4
pistachio	1	2.4
<b>Legumes</b>	2	4.9
bean	1	2.4
lentil	1	2.4

associated with OAS, OR 3.29 (95% CI: 1.53 - 7.10 and OR 5.53 (95% CI: 1.08 - 28.2), respectively (**table IV**). Similarly, a personal history of atopic dermatitis was found to be closely related to OAS, OR 2.48 (95% CI: 0.98 - 6.28). The frequency of the latex-fruit syndrome was 2/41 (4.9%), one of the cases was

related to kiwi and mango, and the other was linked to mango, melon, and papaya (**table IV**).

The pollen-food syndrome had a frequency of 10/41 (24.4%), where fruits were mainly involved; and women were more affected than men (ratio 1.5/1) (**table V**).

**Table IV** - Multivariate models of factors associated with oral allergy syndrome in young adults.

	Unadjusted model			Adjusted model		
	OR	95% CI	p	OR	95% CI	p
<b>age</b>	0.96	0.80 - 1.16	0.681	---	---	0.746
<b>sex</b>						
<b>female</b>	1					
<b>male</b>	1.02	0.53 - 1.97	0.941	---	---	0.901
<b>asthma</b>						
<b>no</b>	1					
<b>yes</b>	2.31	0.68 - 7.81	0.178	---	---	0.180
<b>allergic rhinitis</b>						
<b>no</b>	1					
<b>yes</b>	1.02	0.43 - 2.44	0.961	---	---	0.942
<b>atopic dermatitis</b>						
<b>no</b>	1			1		
<b>yes</b>	2.47	0.97 - 6.32	0.058	2.48	0.98 - 6.28	0.055
<b>pollen allergy</b>						
<b>no</b>	1			1		
<b>yes</b>	2.78	1.11 - 6.99	0.030	3.29	1.53 - 7.10	0.002
<b>latex allergy</b>						
<b>no</b>	1			1		
<b>yes</b>	5.53	1.05 - 29.23	0.044	5.53	1.08 - 28.2	0.040

**Table V** - Food related to pollen-food syndrome.

case	sex	age (yr)	foods
1	female	20	walnut, nutmeg
2	male	18	apple
3	female	19	banana, cauliflower, beans
4	female	20	coconut
5	female	22	kiwi
6	female	25	kiwi, mango
7	female	18	strawberry, kiwi, lime, lemon, orange, chili, tomato, pineapple
8	male	20	avocado
9	male	18	avocado, mango, walnut

## Discussion

In this study, we observed that the prevalence of OAS amongst Mexican young adults from a public university was less than 5%, of whom a significant number showed extra-oral symptom in addition to oral discomfort, and fruits were found to cause OAS symptoms, in most cases. In addition, both pollen and latex allergy were highly associated with OAS.

Population-based studies aimed at determining the prevalence of OAS on a global level are scarce. Instead, most studies are based in clinics or hospitals and primarily involve patients suffering from allergic rhinitis, especially if they are sensitized to pollens (4,11,15). In our study, which was based on a young-adult population sample, the prevalence of OAS was 3.4%. Skypala et al. (5), also included an unselected population from the United Kingdom, with an OAS prevalence of 2%, which is very similar to ours.

In the state of Jalisco (in Western Mexico), a study of 18-50 year-old adults partaking physical activities during weekends, in public spaces, reported an OAS prevalence of 6.2% (8). In Northwest Portugal, a sample of adults from Porto reported a higher prevalence of OAS-related events with a frequency of 11.5% (9). In Eastern Europe, a study involving five countries (Sweden, Denmark, Estonia, Lithuania, and Russia) showed that the average prevalence of OAS in adults was 7.7% (6). Lastly, in Colombia, the frequency of pruritus and lip edema after consuming food was 4.7% (7). These differences in the prevalence of OAS might suggest that food availability, especially OAS-related foods, consumption habits, accompanied by sensitization to the pollens of a given region, act as triggers of OAS. Approximately 30 years ago, Amlot et al. (19), described a group of 36 patients that reported oral discomfort after food consumption. Notably, half of them not only had symptoms confined to the mouth, but in addition, they had manifestations such as nausea, vomiting, abdominal pain, diarrhea, asthma, urticaria, and even anaphylaxis. In our study, the number of patients with extra-oral symptoms was consistent with the findings of this study. Amongst the most frequent symptoms found were skin problems, followed by gastrointestinal and respiratory problems. A study conducted in the United States by a group of allergists across the country, showed that up to 20% of patients with OAS and pollen allergy displayed extra-oral symptoms during food consumption (20). Another study, carried out in Mexican adult patients, who also had allergic rhinitis associated with pollen, showed extra-oral or systemic symptoms during fruit or vegetable intake with a rate of occurrence of almost 20% (4).

In Mexico, previous studies have documented that the main foods related to OAS are fruits and vegetables (4,10), which is consistent with reports in other parts of the world (11-14), being the most commonly associated factors with OAS the groups *Rosaceae* (peach, apple), *Lauraceae* (avocado, walnut), *Actinidiaceae* (kiwi), and *Anacardiaceae* (mango). However, among vege-

tables, chilies are more frequent in our study, likely because the Mexican diet includes them.

Interestingly, non-plant foods such as shellfish, milk and dairy products are also linked to OAS. It is likely that the initial symptoms are limited to the mouth, and then extra-oral or systemic manifestations are secondary features. Thus, it seems that there are two OAS phenotypes. The first one is limited to oral symptoms, mainly related to pollen sensitization and usually triggered by fruits and vegetables. The second phenotype not only expresses oral symptoms, but also includes various discomforts in other organs and systems that are similarly triggered by plant-origin foods; however, shellfish or dairy products can cause these as well. This group does not seem to meet the criteria for an anaphylactic reaction. In a conventional manner, they could be classified as OAS type I and OAS type II, respectively. More research is needed to clarify this point.

According to multivariate analyses performed in our study, sex was not related to OAS, and this same finding was observed in the Italian population (16). However, some studies report that sex is likely one main factor associated with OAS, since it is more prevalent in women (11,15). However, given the design of the studies with this conclusion, perhaps this difference does exist in a clinical setting, and this could be because women usually decide to go for medical care or perhaps the severity of their symptoms tends to be higher compared to men.

The factor most closely related to the onset of OAS is the sensitization to pollen grains from various plant species. In our study, the history of pollen allergy emerged as an element associated with OAS. However, we were unable to determine what type of pollen was involved. For example, birch pollen causes sensitization in subjects from large areas of Europe (16) and Japan (11), and more than 60% of patients that are sensitized to it, also manifest OAS. In our country, more than 50% of patients that were sensitized to pollen from the family *Oleaceae* (*Fraxinus*, *Ligustrum*, *Osmanthus*) express OAS (21).

Lastly, our study shows that a personal history of latex allergy is related to OAS. This is an unexpected finding since there were only two cases of latex-fruit syndrome. It is probably because in our study the foods most frequently associated with OAS were fruits, which have been widely known to share proteins that cross-react with latex (22,23). On the other hand, a cross-sectional study in patients with seasonal allergic rhinitis conducted in Split-Dalmatia indicated that the risk factors for OAS development were diabetes ( $p < 0.001$ ), severity of nasal symptoms ( $p < 0.05$ ), and severity of ocular symptoms ( $p < 0.001$ ). However, due to the characteristics of our study we were not able to confirm this finding (17).

Remarkably, our study also allowed us to estimate the frequency of pollen-food syndrome; in the total population analyzed (1,200 subjects), ten subjects had symptoms compatible with it, for a prevalence of 0.8%. In this respect, to define the diagnosis of pollen-food syndrome, the students in our sample were

questioned if they had been diagnosed with pollen allergy by a physician (data not shown). One case caught our attention, as it was a female who not only had allergy symptoms produced by plant-derived foods, but also by animal-derived foods (milk, cheese, yogurt, clam, shrimp, crab, lobster, oyster, fish, and octopus). If this fact was due to simultaneous presence of OAS and pollen allergy then it should be considered that there are more people with these two conditions. To our knowledge, this is the first time that pollen-food prevalence is reported in a young-adult population, in Mexico and Latin America.

The main limitation of this study is that it relies on the self-reported assessment from each patient, as we did not conduct OAS tests during a medical interview or an oral challenge test. Thus, there is difficulty in interpreting the results. There was no way to verify the sensitization to pollen and latex during the time of our study; in a general manner of speaking, this is the nature of cross-sectional studies that are based on the use of questionnaires. It is also recommended to interpret the results according to the feeding habits and vegetation characteristics of each geographic area, as these have a remarkable influence on the frequency of OAS.

In conclusion, the frequency of oral allergy symptoms amongst young adults in our country differs from reported findings in other parts of the world, as it appears to be less frequent in the State of Mexico. Even within regions of Mexico, differences were found in the States of Jalisco (Western) and Mexico (Center). It is expected to observe that allergy to pollen and latex emerged as two relevant factors associated with OAS. Population-based studies are needed to establish the prevalence of OAS.

Additionally, we would like to highlight the necessity to classify the OAS in two phenotypes observed in our population. OAS type I that is limited to oral symptoms and OAS type II, which expresses oral and extra-oral symptoms.

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### Conflict of interest

The authors declare that they have no conflict of interest.

### References

- Kondo Y, Urisu A. Oral allergy syndrome. *Allergol Int* 2009; 58:485-491.
- Katellaris CH. Food allergy and oral allergy or pollen-food syndrome. *Curr Opin Allergy Clin Immunol* 2010; 10:246-251.
- Mari A, Ballmer-Weber BK, Vieths S. The oral allergy syndrome: improved diagnostic and treatment methods. *Curr Opin Allergy Clin Immunol* 2005; 5:267-273.
- Bedolla-Barajas M, Morales-Romero J, Ortiz-Miramontes LR, et al. Frequency and clinical features of the oral allergy syndrome in Mexican adults with nasal pollinosis. *Rev Alerg Mex* 2013; 60:17-25.
- Skypala IJ, Bull SC, Deegan K, et al. Prevalence of pollen-related Oral Allergy Syndrome (OAS) in a UK population. *J Allergy Clin Immunol* 2010; 125:AB218-AB218.
- Eriksson NE, Möller C, Werner S, Magnusson J, Bengtsson U, Zolubas M. Self-reported food hypersensitivity in Sweden, Denmark, Estonia, Lithuania, and Russia. *J Investig Allergol Clin Immunol* 2004; 14:70-79.
- Marrugo J, Hernández L, Villalba V. Prevalence of self-reported food allergy in Cartagena (Colombia) population. *Allergol Immunopathol (Madr)* 2008; 36:320-4.
- Bedolla-Barajas M, Bedolla-Pulido TR, Camacho-Peña AS, González-García E, Morales-Romero J. Food hypersensitivity in Mexican adults at 18 to 50 years of age: a questionnaire survey. *Allergy Asthma Immunol Res* 2014; 6:511-516.
- Falcão H, Lunet N, Lopes C, Barros H. Food hypersensitivity in Portuguese adults. *Eur J Clin Nutr* 2004; 58:1621-1625.
- Rodríguez-Mireles KA, Gaspar-López A, López-Rocha EG, Del Rivero-Hernández L, Segura-Méndez NH. Oral allergy syndrome in adults of a third level hospital. *Rev Alerg Mex* 2014; 61:65-72. In Spanish.
- Gotoda H, Maguchi S, Kawahara H, Terayama Y, Fukuda S. Springtime pollinosis and oral allergy syndrome in Sapporo. *Auris Nasus Larynx* 2001; 28 Suppl:S49-52.
- Cuesta-Herranz J, Lázaro M, Figueredo E, Igea JM, Umpiérrez A, De-Las-Heras M. Allergy to plant-derived fresh foods in a birch- and ragweed-free area. *Clin Exp Allergy* 2000; 30:1411-1416.
- Bircher AJ, Van Melle G, Haller E, Curty B, Frei PC. IgE to food allergens are highly prevalent in patients allergic to pollens, with and without symptoms of food allergy. *Clin Exp Allergy* 1994; 24:367-374.
- Inomata N, Morita A, Kirino M, et al. Oral allergy syndrome due to plant-derived foods: a clinical review of 63 patients over a period of 6 years. *Arerugi* 2007; 56:1276-1284. (Abstract. In Japanese).
- Caliskaner Z, Naiboglu B, Kutlu A, et al. Risk factors for oral allergy syndrome in patients with seasonal allergic rhinitis. *Med Oral Patol Oral Cir Bucal* 2011; 16:e312-6.
- Asero R, Massironi F, Velati C. Detection of prognostic factors for oral allergy syndrome in patients with birch pollen hypersensitivity. *J Allergy Clin Immunol* 1996; 97:611-616.
- Ivičević N, Roje Ž, Kljajić Z, et al. Prevalence and risk factors for developing oral allergy syndrome in adult patients with seasonal allergic rhinitis. *Acta Clin Croat* 2015; 54:25-29.
- Puente-Fernández C, Maya-Hernández RL, Flores-Merino MV, et al. Self-reported prevalence and risk factors associated with food hypersensitivity in Mexican young adults. *Ann Allergy Asthma Immunol* 2016; 116:523-527.
- Amlot PL, Kemeny DM, Zachary C, Parkes P, Lessof MH. Oral allergy syndrome (OAS): symptoms of IgE-mediated hypersensitivity to foods. *Clin Allergy* 1987; 17:33-42.
- Ma S, Sicherer SH, Nowak-Węgrzyn A. A survey on the management of pollen-food allergy syndrome in allergy practices. *J Allergy Clin Immunol* 2003; 112:784-788.
- Morfin-Maciél BM, Flores I, Rosas-Alvarado A, Bautista M, López-López JR. Sensibilización a pólenes de la familia Oleaceae en un grupo de pacientes de la Ciudad de México. *Rev Alerg Mex* 2009; 56:198-203. In Spanish.
- Blanco C. Síndrome látex-frutas. *Allergol et Immunopathol* 2002; 30:156-163.
- Blanco C. Latex-fruit syndrome. *Cur Allergy Asthma Rep* 2003; 3: 47-53.