Original article

Prevalence of various types of allergens in ocular allergic conditions of patients from Pokhara, Nepal

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Abstract

Introduction: Ocular allergic conditions are mostly recurrent and the drugs prescribed, especially corticosteroids, have serious side effects. Therefore, when maximal tolerated topical and systemic medications are unable to control allergic conjunctivitis, a skin prick test for allergens should be conducted and patients should be taught to avoid these allergens. **Objective**: To find out the prevalence of common allergens inciting ocular allergic diseases in Nepal. **Subjects and methods**: A total of 13,376 skin prick tests were performed on 76 patients suffering from different chronic recurrent ocular allergic conjunctivitis with 176 common allergens (pollens, fungi, insects, dusts, danders, fabrics/ feathers, food, parthenium leaves, tobacco and mite). Buffer saline was used as a negative control while histamine acid phosphate was used as a positive control. Grading of the skin prick test reaction was done by comparison to the histamine positive control. Only markedly positive reactions were considered positive. Relevant data were entered into the excel spreadsheet and analyzed with the Stata-12 commercial package. The association between allergic conditions and socio-demographic, environmental and other co-variates were tested by the chi-square test. **Results**: The common offenders found in the study were mite (42.11 %) followed by fabrics/ feathers (20.39 %), dusts (18.18 %), pollen (17.05 %), non-juicy food (15.02 %), dander (13.60 %), juicy food (11.64 %) and fungus (9.87 %), and tobacco (6.58 %), parthenium leaves (5.26 %) and insects (3.17 %) were less common offenders. **Conclusions:** All ocular allergy patients should undergo skin prick tests to find out the allergens causing their allergy and then receive specific immunological treatment (SIT).

Keywords: Ocular allergy AKC, VKC, SAC, PAC, skin prick test (SPT), allergens, specific immune therapy (SIT)

Introduction

Based on clinical manifestations, there are six types of ocular allergies (Abelson, Torkildsen, & Udell, 2008; Chigbu, 2009; McGill, Holgate, Church, Anderson, & Bacon, 1998; Mishra, Tamboli, Jwala, & Mitra, 2011). These are (Alexander et al., 2005) summarized in Table 1 as SAC (seasonal allergic conjunctivitis), PAC (perennial allergic conjunctivitis), VKC (vernal kerato conjuctivitis), AKC (atopic kerato conjunctivitis), GPC (giant papillary

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conjunctivitis) and contact allergy. Ocular allergy affects 15 to 20 % of people worldwide (K. Singh, Axelrod, & Bielory, 2010) and the incidence is increasing and impacting the quality of life of affected patients. It is also causing immense burden to the national economy (Key, 2001). If not treated early, it can lead to asthma and to the ensuing complications such as chronic obstructive pulmonary disease, COPD (Sole, Camelo-Nunes, Wandalsen, Rosario, & Sarinho, 2011).

In Nepal, allergic conjunctivitis is one of the most common causes for which patients seek consultation in eye hospitals and private clinics. There are many drugs available now (Abelson et al., 2008; Blondin et al, 2003; Comstock & Decory, 2012; Dake et al., 2006; Daniell, et al, , 2006; Doan et al, 2007; el Hennawi, 1994; Gokhale et al, 2012; Kheirkhah et al, 2011; Leonardi, 1997; Mishra et al, 2011; Singh et al, , 2001) to treat these ailments, but these conditions are recurrent and the prescribed drugs, especially corticosteroids, have serious side effects. Therefore, when maximal tolerated topical and systemic medications are unable to control allergic conjunctivitis, skin tests for allergens should be conducted and patients should be taught to avoid these allergens. While many of the allergens like fabrics, feathers and food can be avoided by the patients, airborne allergens such as pollen, dust, dander and fungi cannot be avoided. Patients sensitive to these allergens should be treated with immunotherapy through subcutaneous injections of diluted allergens detected by the skin prick tests (Moote & Kim, 2011; Prakash & Murthy, 1992).

This hospital-based, cross-sectional study was therefore conducted to find out the prevalence of the common allergens inciting ocular allergic diseases in Nepal. No such information is available till this date. Ideally, cross-sectional, population-based studies should be conducted to obtain such information but these studies are time-consuming and expensive. Thus this study was conducted to gather and analyze preliminary data regarding the prevalence of these conditions with the hope that the results can then be used to conduct more meaningful population-based studies in the future.

Materials and methods

Participants

A total of 76 patients diagnosed to be suffering from recurrent and chronic ocular allergy at the Department of Ophthalmology at Manipal Teaching Hospital, Pokhara, Nepal between 9th May 2008 and 1st December 2010 underwent skin prick tests (SPT) at the Allergy Clinic, Omkar Polyclinc, Bagdol, Lalitpur, Nepal.

Ethical approvals for the study were obtained from the institutional review board at the Manipal Teaching Hospital. Informed consent was taken from all patients participating in this study.

Patients whose ocular allergy was not satisfactorily controlled after maximum tolerated topical and systemic medications were included in the study. Pregnant and lactating mothers were excluded. Children below 10 years of age and elderly debilitated patients were excluded. If being taken, oral antihistamines were stopped two days prior and oral corticosteroids for at least 15 days prior to the skin prick tests and topical antihistamines, mast cell stabilizers and steroids were stopped one week prior to the skin prick tests. Patients who had diffuse dermatological lesions were excluded from the study as the tests have to be conducted on normal skin. It was made sure that the study patients were not taking tricyclic antidepressants, antiemetics, steroids (in any form), B-blockers and angiotensin converting enzyme inhibitors as these can interfere with the skin test results.

Skin sensitivity test

All the skin prick tests were performed by one of the co-authors who is a specialist in allergy

and chest diseases. The antigens were obtained from ALCIT Pvt. Ltd., New Delhi. The antigens included 48 types of pollens, 18 types of fungi, 17 types of insects, 11 types of dusts, 6 types of dander, 6 types of fabrics/feathers, 41 types of non-juicy food, 26 types of juicy food, 2 types of miscellaneous items (parthenium leaves and tobacco) and 1 type of house dust mite. The skin prick tests were performed for a total of 176 allergens in each patient

A drop of each allergen (diluted by 1:5000) was placed 2 cm apart and then pricked with a 26 gauge needle. Buffer saline was used as a negative control while histamine acid phosphate (1 mg/ml) as a positive control. Grading of the skin prick test reaction was done by comparison to the reaction in the histamine positive control. A + grade was given to the reaction if it was equal to 25 % of area of the wheal induced by histamine, + + if it was equal to > 25 % to 50 % of the area of the wheal induced by histamine, + + + if it was equal to > 50 % to 100 % of the area of the wheal induced by the histamine and + + + + if it was equal to > 100 % to 200 % of the area of the wheal induced by the histamine.

Skin prick tests were considered positive only when the mean of the two wheal diameters was at least 3 mm greater than the negative control (saline). As there was a high incidence of 1+ reactions in the non-allergic persons, only 2+, 3+, and 4+ reactions were labeled as positive skin reactions. Emergency medications to tackle anaphylactic reactions including oxygen, adrenaline, antihistamines and steroids were kept ready at the skin prick test site. None of the participants, however, developed any adverse reactions.

Data entry, sample size and analysis

At the time of the skin prick test, the registration number, name, age, sex, ethnicity, diagnosis, date, address, negative control, positive control, skin prick test results, and duration of illness were entered into the Microsoft excel spreadsheet. Pokhara has a sub-tropical temperate climate, and five distinct seasons: winter (November to February), spring (March to April), summer (May to June), monsoon (July to August) and autumn (September to October). The participants' visit dates and months were coded into appropriate seasons. Similarly, the participants' ethnicity was coded as *dalit*, disadvantaged *janjatis*, disadvantaged non-*dalit terai* caste group, relatively advantaged janjatis, upper caste group or 'don't know' categories as defined in the national census. All the variables were later converted to tab-limited text files and analyzed with the commercial Stata-12 statistics package. The association between allergic conditions and season, socio-demographic, environmental and other co-variates were tested by the chi-square test. The *p*-value of < = 0.05 was considered highly significant, indicating an association between the variables analyzed.

There was no prior data available on the incidence or prevalence of ocular allergy in Nepal. Therefore, we estimated the sample size using the prevalence data of a study of similar nature conducted by Prasad R et al (2009) in India. Using the sample size algorithm suggested by Gorstein J el al (2007), and considering the prevalence of allergy and the number of antigens tested for pollen, dusts, fungi and insects, in our population, similar to that of Prasad R et al (2009), and using the precision as 0.05 % and the design effect as 2, we found that about 50 participants would be required to find enough marked positive (> + 2) reaction in our study.

Results

The patients in this study were between 10 to 76 years old. The majority of patients were between 15 and 35 years (59.19 %, Table 2) and the mean age was 30.63 years. There were more females (60.53 %) than males (39.47 %) (Table 3). About 72.37 % of the patients were suffering from vernal kerato conjunctivitis (VKC) as compared to 17.11 % of patients who were

suffering from seasonal or perennial allergic conjunctivitis (SAC or PAC) and 10.53 % of patients who had atopic kerato conjunctivitis (Table 3). The majority of the patients belonged to the upper caste group (59.21 %) followed by relative advantaged janjatis (21.05 %) and disadvantaged janjatis (11.84 %). There were very few patients from other ethnic groups (Table 4). The frequency of seasons in which these tests were conducted were equally distributed (Table 5).

Of the 76 patients participating in the study, none had a negative skin prick test to all the antigens tested. All the 76 had various grades of positive reactions when tested for skin sensitivity to various allergens. A total of 13,376 tests were performed with 176 common allergens known to incite allergic reactions in this geographical area. The results of the skin sensitivity reactions are summarized in Tables 6 to18.

The most common allergen-offenders found in the study were mite (42.11 %) (Tables 16,17 and18) followed by fabrics/feathers (20.39 %) (Tables 12 and 17), dusts (18.18 %) (Tables 10 and 17), pollen (17.05 %) (Tables 6,7 and 17), non-juicy food (15.02 %) (Tables 13,14 and 17), danders (13.60 %) (Tables 11 and 17), juicy food (11.64 %) (Tables15 and 17) and fungus (9.87 %) (Tables 8 and 17). Other allergens like tobacco (6.58 %), parthenium leaves (5.26 %) (Tables 16 and 17) and insects (3.17 %) (Tables 9 and 17) were less common offenders.

Of the pollen groups, the most common offenders were Suaeda fruticosa (common name: seepweeds or seablites, 28.95 %), Chenopodium murale (common name: Nettle leaved goosefoot, 27.63 %), Sorghum vulgare (Common name: Sorghum or jowar, 26.32 %), and Salvadora persica (common name meswak or tooth brush tree also known as datoowan locally, 25.00 %) (Table 6 and 7).

In the fungi groups, the most common offenders were Alternaria tenuis (22.37 %), Aspergillus fumigatus (17.11 %), Rhizopus nigricans (17.11 %), Curvularia lunata (14.47 %), Aspergillus niger (13.16 %) and Cladosporium herbarum (13.16 %) (Table 8).

Among insects, the honey bee was the most common offender (38.16 %). Other insects were not common offenders (Table 9).

House dust (46.05 %) was most common dust allergen, followed by hay dust (31.58 %), grain dust rice (25.00 %), cotton mill dust (23.68 %) and paper dust (22.37 %) (Table 10).

Of the danders (Table 12), dog dander (19.74 %) was the most common allergen followed by horse dander(17.11 %), human dander (15.79 %) and cow dander (11.84 %) (Table 11).

When feathers and fabrics as allergens were analyzed, the most common were Kapok cotton (27.63 %), pigeon feathers (25.00 %), mixed wool (22.37 %), sheep wool (21.05 %) and raw silk (15.79 %) (Table 12).

Among non-juicy foods, the most common antigens were baker's yeast (26.32 %), ground nut (26.32 %), Bengal gram (23.68 %), dal urad (22.37 %) and mustard (22.37 %) (Tables13 and 14).

Among the juicy foods, the most common offenders were apple (21.05 %), lemon (citrus) (17.11 %), mushroom (15.79 %), prawn (15.79 %) and radish (14.47 %). These were followed by ripe banana (13.16 %), coriander leaves (13.16 %), mustard leaves (13.16 %), onion (13.16 %), potato (13.16 %), egg white (13.16 %) and chicken (13.16 %) (Table 15).

Allergy with miscellaneous substances such as parthenium leaves (5.26 %) and tobacco (6.58 %) was not very common (Table 15).

When individual allergens were compared, the skin sensitivity test was most common with house dust (46.05 %) followed by house dust mite D. farinae (42.11 %), honey bee (38.16 %), hay dust (31.58 %), Suaeda fruticosa (common

name: seepweeds or seablites, 28.95 %), Chenopodium murale (common name: nettle-leaved goosefoot, 27.63 %), Kapok cotton (27.63 %), sorghum vulgare (Common name: sorghum or jowar, 26.32 %), baker's yeast (26.32 %), ground nut (26.32 %), Salvadora persica (common name meswak or tooth brush tree and also known as datoowan locally, 25.00 %), grain dust rice (25.00 %), pigeon feathers (25.00 %), Ailanthus excela (Neem tree, 23.68 %), Cassia occidentalis (coffee weed or stinking weed, 23.68 %), Cyperus tereticornis (23.68 %), Gynandropsis gynandra (African spider flower or cat's whiskers, 23.68 %), Ricinus communis (castor bean plant, 23.68 %), cotton mill dust (23.68 %), Bengal gram (23.68 %), Zee mays (corn, 22.37 %), Alternaria tenuis (22.37 %), paper dust (22.37 %), mixed wool (22.37 %), dal urad (22.37 %), mustard (22.37 %), sheep wool (22.37 %), almonds (22.37 %), chocolate (22.37 %), coriander (22.37 %), dal mansoor (22.37 %), and apple (22.37 %) (Tables 18).

Strong association of allergy with pollen was found with season ($p = 0.000$), sex ($p = 0.000$), age ($p = 0.003$) and ethnic groups ($p = 0.000$) (Tables 19 to 22). But with fungus, significant association was found only with sex ($p = 0.001$) (Table 32). There was no significant association between fungal allergy with season ($p = 0.188$), age ($p = 0.171$) and ethnicity ($p = 0.176$) (Table 23). Allergy with insects was not found to be associated significantly with season ($p = 0.772$), sex ($p = 0.482$), age ($p = 0.359$) or ethnicity ($p = 0.238$) (Table 32). It was surprising that allergy with dust was not associated with season ($p = 0.275$) (Table 32) but significantly associated with sex ($p = 0.001$), age($p = 0.019$) and ethnicity($p = 0.011$) (Table 32).

Significant association of season was found with danders ($p = 0.034$) and fabrics/feathers ($p = 0.004$, Table 23). There was no significant association found between these two groups of allergens (danders and fabrics/feathers) with sex, age and ethnicity (Table 23). While there was strong association of non-juicy fruits with season ($p = 0.010$), age ($p = 0.002$) and ethnicity ($p = 0.000$)), no association was found between juicy fruits with season, sex, age and ethnicity (Table 23).

Table 1: Characteristic symptoms and treatment options for allergic conjunctivitis

Allergic conditions	Cell types involved	Clinical features	Treatment
1. Seasonal allergic conjunctivitis(SAC) and perennial allergic conjuctivitis(PAC)	Eosinophil and mast cells are the major inflammatory mediators.	Mild itching redness, tearing, lid edema, micro chemosis, intermittent environmental trigger and rhinitis may be present.	Allergen avoidance, cold compression, antihistaminc, NSAIDs, mast cell stabilizers, corticosteroids
2. Vernal keratoconjunctivitis (VKC)	Lymphocytes,eosinophils and mast cells	Serious, seen in hot climate, young males; family h/o ptosis; ropy mucous discharge, photophobia, cobblestone papillae, Horner trantas dots, limbal nodules, superior pannus, shield ulcers, severe itching	Allergen avoidance, Cold compression, NSAIDs, antihistaminic, mast cell stabilizers, corticosteroids, immunomodulators

3. Atopic keratoconjunctivitis (AKC)	Lymphocytes, basophils, eosinophils and mast cells	Rare, chronic, conjunctival damage, severe ocular itching, redness, photophobia, ketatopathy, corneal ulcers, keratoconus, anterior polar cataracts, mucous discharge, atopic blephartitis	Antihistaminic and mast cell stabilizers, NSAIDs; in severe cases corticosteroids, immunomodulators, Tacrolimus 0.03 % ointments for blepharitis
4. GiantpPapillary conjunctivitis (GPC)	Mast cells and lymphocytes	Formation of giant papillae and mild ocular irritation due to contact lens, surgical sutures, barbs and ocular prosthesis	Remove irritating factors Mast cell stabilizers, Antihistaminic and NSAIDs.
5. Contact Dermatitis	Lymphocytes and dendritic cells	Erythema, edema, eczema of lid skin and mild ocular itching	Antihistaminic, NSAIDs, and mast cell stabilizers; Tacrolimus 0.03 % ointments for dermatitis

Table 2: Diagnosis versus age distribution

Diagnosis	Age in years					Total
	10-15	>15-25	>25-35	>35-45	>45	
AKC	0	3	0	1	4	8
	0.00	37.50	0.00	12.50	50.00	100.00
SAC	1	3	6	1	2	13
	7.69	23.08	46.15	7.69	15.38	100.00
VKC	7	18	15	10	5	55
	12.73	32.73	27.27	18.18	9.09	100.00
Total	8	24	21	12	11	76
	10.53	31.58	27.63	15.79	14.47	10.00

Pearson chi2 (8) = 14.3095 $p = 0.074$ Mean age 30.63 Std Dev 13.22 Min age 10 Max age 76

Table 3: Diagnosis versus sex

Diagnosis	Sex		Total
	Female	Male	
AKC	4	4	8(10.53%)
	50.00	50.00	100.00
SAC	9	4	13(17.11%)
	69.23	30.77	100.00
VKC	33	22	55(72.37%)
	60.00	40.00	100.00
Total	46	30	76
	60.53	39.47	100.00

Pearson chi2 (2) = 0.7897 p =0.674

Table 4: Ethnicity

Ethnicity	Frequency	Percentage	Cumulative
Dalit	2	2.63	2.63
Disadvantaged janjatis	9	11.84	14.47
Disadvantaged non-dalit terai caste group	1	1.32	15.79
Don't know	3	3.95	19.74
Relative advantaged janjatis	16	21.05	40.79
Upper caste group	45	59.21	100.00
Total	76	100.00	

Table 5: Season versus frequency

Season	Frequency	Percentage	Cumulative
Autumn	17	22.37	22.37
Monsoon	18	23.68	46.05
Spring	12	15.79	61.84
Summer	13	17.11	78.95
Winter	16	21.05	100.00
Total	76	100.00	

Table 6: Skin prick test results for pollens-A

Pollen	Total tests	2+	3+	4+	Marked positive 2+ to 4+	% Marked positive
1. Suaeda fruticosa	76	9	10	3	22	28.95
2. Chenopodium murale	76	11	10	0	21	27.63
3. Sorghum vulgare	76	12	8	0	20	26.32
4. Salvadora persica	76	7	11	1	19	25.00
5. Ailanthus excelsa	76	9	7	2	18	23.68
6. Cassia occidentalis	76	10	8	0	18	23.68
7. Cyperus tereticornis	76	10	8	0	18	23.68
8. Gynandropsis gynandra	76	10	8	0	18	23.68
9. Ricinus communis	76	11	7	0	18	23.68
10. Zee mays	76	6	11	0	17	22.37
11. Albizia lebbeck	76	5	8	2	15	19.74
12. Argemone mexicana	76	8	4	3	15	19.74
13. Broussonetia papyrifera	76	5	10	0	15	19.74
14. Crataeva nurvala	76	9	6	0	15	19.74
15. Cynodon dactylon	76	3	11	1	15	19.74
16. Asphodelus tenuifolius	76	9	5	0	14	18.42
17. Cannabis sativa	76	8	6	0	14	18.42
18. Maerua arenaria	76	11	3	0	14	18.42
19. Ranunculus scleratus	76	6	8	0	14	18.42
20. Cassia siamea	76	10	3	0	13	17.11
21. Dodonea viscosa	76	5	8	0	13	17.11
22. Holoptelea integrifolia	76	6	6	1	13	17.11
23. Ipomoea fistulosa	76	10	3	0	13	17.11
24.Parthenium hysterophorus	76	5	8	0	13	17.11

Table 7: Skin prick test results for pollens-B

Pollen	Total tests	2+	3+	4+	Marked positive 2+ to 4+	% Marked positive
25. Prosopis juliflora	76	7	6	0	13	17.11
26. Putranjiva roxburghii	76	9	3	1	13	17.11
27. Xanthium strumarium	76	5	8	0	13	17.11
28. Artemisia scoparia	76	5	6	1	12	15.79
29. Chenopodium album	76	8	4	0	12	15.79
30. Brassica campestris	76	8	3	0	11	14.47
31. Cenchrus ciliaris	76	5	6	0	11	14.47
32. Lawsonia inermis	76	7	4	0	11	14.47
33. Rumex dentatus	76	3	7	1	11	14.47
34. Typha angustata	76	5	5	1	11	14.47
35. Amaranthus spinosus	76	4	4	2	10	13.16
36. Cocos nucifera	76	5	4	1	10	13.16
37. Eucalyptus tereticornis	76	5	5	0	10	13.16
38. Kigelia pinnata	76	6	4	0	10	13.16
39. Azadirachta indica	76	5	4	0	9	11.84
40. Cassia fistula	76	4	5	0	9	11.84
41. Imperata cylindrica	76	3	6	0	9	11.84
42. Melia azedarach	76	4	5	0	9	11.84
43. Morus alba	76	6	3	0	9	11.84
44. Pennisetum typhoides	76	5	4	0	9	11.84
45. Carica papaya	76	4	4	0	8	10.53
46. Adhatoda vasica	76	5	2	1	8	10.53
47. Ageratum conyzoides	76	4	4	0	8	10.53
48. Clerodendrum p	76	1	0	0	1	1.32
Pollen total	3648	318	283	21	622	17.05

Table 8: Skin prick test results for fungi

Fungi	Total tests	2+	3+	4+	Marked positive 2+ to 4+	% Marked positive
1. Alternaria tenuis	76	9	8	0	17	22.37
2. Aspergillus fumigatus	76	5	7	1	13	17.11
3. Rhizopus nigricans	76	5	7	1	13	17.11
4. Curvularia lunata	76	4	5	2	11	14.47
5. Aspergillus niger	76	7	2	1	10	13.16
6. Cladosporium herbarum	76	2	8	0	10	13.16
7. Helminthosporium sp.	76	8	1	0	9	11.84
8. Neurospora sitophilla	76	3	6	0	9	11.84
9. Aspergillus versicolor	76	7	0	0	7	9.21
10. Aspergillus flavus	76	0	6	0	6	7.89
11. Aspergillus tamarii	76	2	3	0	5	6.58
12. Mucor mucedo	76	1	4	0	5	6.58
13. Nigrospora oryzae	76	3	2	0	5	6.58
14. Fusarium solanii	76	3	1	0	4	5.26
15. Phoma betae	76	0	3	1	4	5.26
16. Trichoderma sp	76	4	0	0	4	5.26
17. Candida albicans	76	3	0	0	3	3.95
18. Penicillin sp	76	0	0	0	0	0.00
Total	1368	66	63	6	135	9.87

Table 9: Skin prick test results for insects

Insects	Total tests	2+	3+	4+	Marked positive 2+ to 4+	% Marked positive
1. Honey Bee	76	10	17	2	29	38.16
2. Mosquitoes	76	4	1	0	5	6.58
3. Ant	76	2	1	0	3	3.95
4. House fly	76	2	0	0	2	2.63
5. Dragonfly	76	0	1	0	1	1.32
6. Grass hopper	76	0	1	0	1	1.32
7. Butterfly	76	0	0	0	0	0.00
8. Cockroach (f)	76	0	0	0	0	0.00
9. Cochroach (m)	76	0	0	0	0	0.00
10. Cricket	76	0	0	0	0	0.00
11. Hornet	76	0	0	0	0	0.00
12. Jassids	76	0	0	0	0	0.00
13. Locust female	76	0	0	0	0	0.00
14. Locust male	76	0	0	0	0	0.00
15. Moth	76	0	0	0	0	0.00
16. Rice weevil	76	0	0	0	0	0.00
17. Yellow wasp	76	0	0	0	0	0.00
	1292	18	21	2	41	3.17

Table 10: Skin prick test results for dust

Dust	Total tests	2+	3+	4+	Marked positive 2+ to 4+	% Marked positive
1. House dust	76	14	20	1	35	46.05
2. Hay dust	76	14	10	0	24	31.58
3. Grain dust Rice	76	10	8	1	19	25.00
4. Cotton mill dust	76	10	8	0	18	23.68
5. Paper dust	76	8	8	1	17	22.37
6. Straw dust	76	5	6	0	11	14.47
7. Thrashing dust wheat	76	5	3	1	9	11.84
8. Grain dust(Bajra)	76	3	5	0	8	10.53
9. Grain dust jowar	76	3	4	1	8	10.53
10. Grain dust wheat	76	0	3	0	3	3.95
11. Grain dust soyabean	76	0	0	0	0	0.00
Total	836	72	75	5	152	18.18

Table 11: Skin prick test results for danders

Danders	Total tests	2+	3+	4+	Marked positive 2+ to 4+	% Marked positive
1. Dog dander	76	7	7	1	15	19.74
2. Horse dander	76	8	5	0	13	17.11
3. Human dander	76	4	7	1	12	15.79
4. Cow dander	76	7	2	0	9	11.84
5. Cat dander	76	3	4	0	7	9.21
6. Buffalo dander	76	4	2	0	6	7.89
Total	456	33	27	2	62	13.60

Table 12: Skin prick test results for fabrics and feathers

Fabrics and feathers	Total tests	2+	3+	4+	Marked positive 2+ to 4+	% Marked positive
1. Kapok cotton	76	10	9	2	21	27.63
2.. Pigeon feathers	76	10	8	1	19	25.00
3. Wool (mixed)	76	9	8	0	17	22.37
4. Sheep wool	76	7	8	1	16	21.05
5. Silk (raw)	76	4	7	1	12	15.79
6. Chicken feathers	76	4	4	0	8	10.53
Total	456	44	44	5	93	20.39

Table 13. Skin prick test results for non-juicy food - A

Non-juicy food - A	Total tests	2+	3+	4+	Marked positive 2+ to 4+	% Marked positive
1. Baker's yeast	76	9	10	1	20	26.32
2. Groundnut	76	8	11	1	20	26.32
3. Bengal gram	76	9	9	0	18	23.68
4. Dal urad	76	9	7	1	17	22.37
5. Mustard	76	9	7	1	17	22.37
6. Almonds	76	8	8	0	16	21.05
7. Chocolate	76	8	5	3	16	21.05
8. Coriander	76	9	7	0	16	21.05
9. Dal mansoor	76	10	5	1	16	21.05
10. Areca Nut	76	7	8	0	15	19.74
11. Coconut dry	76	6	8	1	15	19.74
12. Kabuli chana	76	7	8	0	15	19.74
13. Bajra	76	7	5	2	14	18.42
14. Black pepper	76	11	3	0	14	18.42
15. Dal rajma	76	5	6	2	13	17.11
16. Cardamom large	76	7	5	0	12	15.79
17. Cardemom small	76	7	5	0	12	15.79
18. Cashew nut	76	6	5	1	12	15.79
19. Jowar	76	9	3	0	12	15.79
20. Coffee beans	76	8	2	1	11	14.47
21. Dal moong	76	5	5	1	11	14.47
22. Dal raungi	76	4	6	1	11	14.47
23. Licorice	76	7	3	1	11	14.47
24. Rice	76	5	6	0	11	14.47

Table 14: Skin prick test results for non-juicy food - B

Non-juicy food B	Total tests	2+	3+	4+	Marked positive 2+ to 4+	% Marked positive
25. Dal arhar	76	5	3	2	10	13.16
26. Gumacacia	76	7	3	0	10	13.16
27. Cinnamon	76	5	3	1	9	11.84
28. Clove	76	2	6	1	9	11.84
29. Kattha	76	4	5	0	9	11.84
30. Soyabean flour	76	4	5	0	9	11.84
31. Walnut	76	5	4	0	9	11.84
32. Wheat	76	4	5	0	9	11.84
33. Dal moth	76	5	2	0	7	9.21

34. Tamarind	76	3	4	0	7	9.21
35. Tea	76	3	4	0	7	9.21
36. Lobia	76	4	2	0	6	7.89
37. Saufn	76	5	1	0	6	7.89
38. Cumin	76	4	1	0	5	6.58
39. Turmeric	76	4	1	0	5	6.58
40. Pista	76	2	2	0	4	5.26
41. Sonth	76	1	1	0	2	2.63
Total	3116	247	199	22	468	15.02

Table 15: Skin prick test results for juicy food

Juicy food	Total tests	2+	3+	4+	Marked positive 2+ to 4+	% Marked positive
1. Apple	76	12	4	0	16	21.05
2. Citrus(lemon)	76	4	7	2	13	17.11
3. Mushroom	76	9	3	0	12	15.79
4. Prawn	76	6	6	0	12	15.79
5. Radish	76	6	5	0	11	14.47
6. Banana(ripe)	76	3	7	0	10	13.16
7. Dhania leaves	76	4	6	0	10	13.16
8. Mustard leaves	76	3	6	1	10	13.16
9. Onion	76	9	1	0	10	13.16
10. Potato	76	6	4	0	10	13.16
11. Egg white	76	4	5	1	10	13.16
12. Chicken	76	4	5	1	10	13.16
13. Ginger	76	6	2	1	9	11.84
14. Fish	76	4	4	1	9	11.84
15. Beans fresh	76	4	4	0	8	10.53
16. Cabbage	76	6	2	0	8	10.53
17. Orange	76	3	5	0	8	10.53
18. Papaya(ripe)	76	6	1	0	7	9.21
19. Tomato	76	3	4	0	7	9.21
20. Milk	76	2	5	0	7	9.21
21. Mutton	76	4	3	0	7	9.21
22. Garlic	76	4	2	0	6	7.89
23. Lady finger	76	5	1	0	6	7.89
24. Cheeku	76	2	3	0	5	6.58
25. Mango (ripe)	76	3	2	0	5	6.58
26. Drum stick	76	3	1	0	4	5.26
Total	1976	125	98	7	230	11.64

Table 16: Skin prick test results for mites and miscellaneous allergens

Mites	Total tests	2+	3+	4+	Marked positive 2+ to 4+	% Marked positive
1. House dust mite(D. farinae)	76	7	21	4	32	42.11
Miscellaneous						
1. Parthenium leaves	76	3	1	0	4	5.26
2. Tobacco	76	18	21	2	41	3.17

Table 17: Comparative percentage study of allergens

Pollen	Total tests	2+	3+	4+	Marked positive 2+ to 4+	% Marked positive
1. Mite(D. farinae)	076	7	21	4	32	42.11
2. Fabrics and feathers	456	44	44	5	93	20.39
3. Dusts	836	72	75	5	152	18.18
4. Pollen	3648	318	283	21	622	17.05
5. Non Juicy food	3116	247	199	22	468	15.02
6. Danders	456	33	27	2	62	13.60
7. Juicy food	1976	125	98	7	230	11.64
8. Fungi	1368	66	63	6	135	9.87
9. Tobacco	76	2	3	0	5	6.58
10. Parthenium leaves	76	3	1	0	4	5.26
Insects	1292	18	21	2	41	3.17
Total	13376	935	835	74	1844	13.78

Table 18: Most common allergens

Allergens	Total tests	Marked positive	% Marked positive
1. House dust	76	35	46.05
2. Mite (D. farinae)	76	32	42.11
3. Honey Bee	76	29	38.16
4. Hay dust	76	24	31.58
5. Suaeda fruticosa	76	22	28.95
6. Chenopodium murale	76	21	27.63
7. Kapok cotton	76	21	27.63
8. Sorghum vulgare	76	20	26.32
9. Baker's yeast	76	20	26.32
10. Groundnut	76	20	26.32
11. Salvadora persica	76	19	25.00
12. Grain dust Rice	76	19	25.00
13. Pigeon feathers	76	19	25.00
14. Ailanthus excelsa	76	18	23.68
15. Cassia occidentalis	76	18	23.68
16. Cyperus tereticornis	76	18	23.68
17. Gynandropsis gynandra	76	18	23.68
18. Ricinus communis	76	18	23.68
19. Cotton mill dust	76	18	23.68
20. Bengal gram	76	18	23.68
21. Zee mays	76	17	22.37
22. Alternaria tenuis	76	17	22.37

23. Paper dust	76	17	22.37
24. Wool (mixed)	76	17	22.37
25. Dal urad	76	17	22.37
26. Mustard	76	17	22.37
27. Sheep wool	76	16	21.05
28. Almonds	76	16	21.05
29. Chocolate	76	16	21.05
30. Coriander	76	16	21.05
31. Dal mansoor	76	16	21.05
32. Apple	76	16	21.05

Table 19: Correlation between allergy with pollens and seasons

Pollen	Seasons					Total
	Autumn	Monsoon	Spring	Summer	Winter	
2+	69	85	49	62	53	318
	21.70	26.73	15.41	19.50	16.67	100.00
3+	74	81	33	51	44	283
	26.15	28.62	11.66	18.02	15.55	100.00
4+	0	16	1	4	0	21
	0.00	76.19	4.76	19.05	0.00	100.00
Total	143	183	83	117	97	622
	22.99	29.26	13.34	18.81	15.59	100.00

Pearson chi2(8) = 29.2884 $p = 0.000$

Table 20: Correlation between allergy with pollens and sex

Pollen	Sex		Total
	Female	Male	
2+	164	154	318
	51.57	48.43	100.00
3+	199	84	283
	70.32	29.68	100.00
4+	14	7	21
	66.67	33.33	100.00
Total	377	245	622
	60.58	39.42	100.00

Pearson chi2(2) = 22.3740 $p = 0.000$

Table. 21. Correlation between allergy with pollens and age groups

Pollen	Age					Total
	10-15	>15-25	>25-35	>35-45	>45	
2+	28	107	102	54	27	318
	8.81	33.65	32.08	16.98	8.49	100.00
3+	27	83	95	29	49	283
	9.54	29.33	33.57	10.25	17.31	100.00
4+	0	8	11	2	0	21
	0.00	38.10	52.38	9.52	0.00	100.00
Total	55	199	209	85	76	622
	8.84	31.83	33.44	13.67	12.22	100.00

Pearson chi2(8) = 23.0291 $p = 0.003$

Table 22: Correlation between allergy with pollens and ethnic groups

Pollen	Ethnicity						Total
	Dalit	Disadvantaged janjatis	Disadvantaged non-dalit terai caste group	Don't know	Relative advantaged janjatis	Upper caste group	
2+	4	46	0	6	57	205	318
	1.26	14.47	0.00	1.89	17.92	64.47	100.00
3+	4	36	9	8	65	161	283
	1.41	12.72	3.18	2.83	22.97	56.89	100.00
4+	0	7	0	0	10	4	21
	0.00	33.33	0.00	0.00	47.62	19.05	100.00
Total	8	89	9	14	132	370	622
	1.29	14.31	1.45	2.25	21.22	59.49	100.00

Pearson chi 2(10) = 34.3318 p = 0.000

Table 23: Summary of correlations (Pearson Chi2 = *p* values) between various allergens, season, sex, age and ethnicity.

Allergens	Season	Sex	Age	Ethnicity
Pollen	**0.000**	**0.000**	**0.003**	**0.000**
Fungus	0.188	**0.001**	0.171	0.176
Insects	0.772	0.482	0.359	0.238
Dusts	0.275	**0.019**	**0.001**	**0.011**
Dander	**0.034**	0.171	0.554	0.716
Feathers, fabrics	**0.004**	0.248	0.189	0.323
Non-juicy food	0.**010**	0.091	**0.002**	**0.000**
Juicy food	0.066	0.309	0.103	0.160

Discussion

There are very few published results for offending allergens for ocular allergy to be compared from these parts of the world (Kosrirukvongs, Visitsunthorn, Vichyanond, & Bunnag, 2001). In the study of Kosrirukvongs, P, et al (2001), allergy skin tests to common aero-allergens were positive in 95 % of their patients tested. Common allergens causing sensitization were house dust mites, house dust, cockroaches and grass pollen. There are, however, two Indian studies (Lal et al,, 2011; Prasad et al2009) on patients of nasobronchial allergy which are similar to the present study. As many of the patients in those studies also have ocular allergy as co-morbidity, comparison of their results with the present study should be interesting. Prasad et al (2009) studied sensitivity to various allergens in 48 patients with nasobroncial allergy in Lucknow. In their study, the common offending allergens were insects (21.8 %), followed by dusts (11.9 %), pollens(7.8 %), dander (3.19 %) and fungi (1.3 %). Lal et al (2011) tested skin prick tests for allergens in 331 patients with nasal allergy, allergic conjunctivitis and allergic asthma in Andhra Pradesh. A very high percentage of skin sensitivity was found against allergens in their study. Dust (89.72 %) was most common allergen followed by pollen (75.83 %), mites (73.71 %), food (64.65 %), moulds (42.29 %), animal epithelium (34.74 %) and insects (22.35 %). There is some similarity between the results of the study of Lal et al and of the present study where the most common allergens were found to be house dust (46.05 %) followed by house dust mite (42.11 %). As a group in the present study, mite was the most common allergen (42.11 %) followed by fabrics and feathers (20.39 %) and dusts (18.18 %), pollen (17.05 %) and non-juicy food (15.02 %). The groups such as danders (13.60 %), juicy food (11.64 %), fungus (9.87 %) and insects (3.17 %) were the least common. Allergy

with parthenium (rag weed) was very common in the study of Lal et al (30.21 %) but less common in this present study (5.26 %). Allergy with insects was very common in the study of Prasad et al (2009) but less common in the present study and in that of Lal et al (2011).

In the present study, allergy was more common in the upper caste group (59.21 %) and the relatively advantaged janjati group (21.05 %) as compared to the other lower caste groups. This finding is similar to other studies in which it was found that patients with a lower socioeconomic status who had helminthic infestations, poor sanitation and upbringing in the farms with many siblings had protection against allergic diseases (Araujo & de Carvalho, 2006; Flohr et al, 2006; Karadag et al, 2006) .

In the present study, the associations between season, age, sex and ethnicity and various allergens were studied. Allergy with pollen was more common in the autumn and monsoon seasons, in females, in the 15 to 35 age group - maybe because this age group engages in more outdoor travels and gets more exposure - and in the upper cast ethnic group. Surprisingly, allergy with pollen was not common in the spring season. This maybe because all these patients were perennial patients and had had several attacks in the year and that they had undergone the skin prick tests after many recurrences,. Probably their first attacks were in the spring but eventually they got tested in the autumn or rainy season.

There was no association between fungal allergens with age, ethnicity and season but only with the female sex. It was same with dust allergy. These were more common with females in this study. Allergy with dust was most common in the age group of over 15 to 25, probably, again, because this group is has the most outdoor exposure. House dust (46 %) was the most common allergen followed by hay dust, rice grain dust, cotton mill dust and paper dust. These results are similar to the study of Prasad et al (2009) in which house dust was the most common followed by grain dusts, cotton dust and paper dust. Allergy with danders, feathers/ fabric and non-juicy food allergens was more common in the monsoon and autumn seasons, like pollen allergy in this study. Non-juicy food was more common in the age groups of over 15 to 25 and over 25 to 35. This is contrary to other studies according to which, food allergy is more common in pediatric age groups (Baral & Hourihane, 2005; Ibanez & Garde, 2009). According to Ibanez and Garde (2005), egg (39 %) and milk (32 %) are the most common food allergen under the age of 14 in Spain. Similarly, Baral and Hourihane (2005) after analyzing available data have also reported that food allergy in young children is usually caused by milk (2.5 %), egg (1.3 %), peanut (0.8 %), tree nuts (0.2 %), fish (0.1 %) and shell fish (0.1 %).

Of the non-juicy foods, baker's yeast and ground nut were the most common allergens (26.32 %) in this study, followed by Bengal gram (23.68 %), dal urad (22.37 %), mustard (22.37 %), almonds, chocolate and coriander (all 21.05 %). Of the juicy foods, the common allergens were apple (21.05 %), lemon (17.11 %), mushroom (15.79 %), prawn (15.79 %), radish (14.47 %), ripe banana (13.16 %), coriander leaves (13.16 %), mustard leaves (13.16 %), onion(13.16 %), potato(13.16 %), egg white (13.16 %), chicken (13.16 %), ginger (11.84 %) and fish (11.84 %). Prasad et al (2009) did not test for food allergens. Lal et al(2011) have reported 64.65 % allergy with food but they have not specified the different foods responsible for the allergy.

Not much data is available about ocular allergy in Nepal. This pilot study, however, provides the first insight into the types of allergens in ocular allergy patients in Nepal. A larger cross-sectional, population-based study should be conducted to further the findings of this study.

The current drug treatment for ocular allergy targets the key mechanisms involved in the development of clinical disease: mast cells with

mast cell stabilizers, histamine with histamine receptor antagonists, inflammation with corticosteroids and severe inflammation with immuno-modulators. None of these agents are free of side effects and none abolish signs and symptoms completely (Leonardi, Motterle, & Bortolotti, 2008).

Ideally, skin prick tests should be performed in all patients presenting with ocular allergy and then patients can avoid the food allergens and allergens such as fabrics, feathers and danders. But for airborne allergens, if significant, immunotherapy in the form of subcutaneous vaccines should be used. The advantage of these vaccines has been proved to be significant in various studies (Huggins & Looney, 2004; Moote & Kim, 2011; Prakash & Murthy, 1992). Allergen-specific immunotherapy (SIT) is highly effective in the treatment of patients with severe allergic conjunctivitis/rhinoconjuctivitis or asthma and is recommended by the World Health Organization as an essential part of allergy management strategy. Subcutaneous immunotherapy (SCIT) involves the administration (usually subcutaneous) of increasing doses of allergen in order to achieve a hypo-sensitization. The duration of this effect is about 10 years in subcutaneous immunotherapy (SCIT) (Kari & Saari, 2010). Recently, sublingual immunotherapy (SLIT) has found to be effective in the form of drops or tablets in a manner similar to SCIT (Kari & Saari, 2010; Mosges, Bruning, Hessler, Gotz, & Knaussmann, 2007) and may replace SCIT.

Conclusion

Ocular allergy in Nepal is associated with various allergens (pollen, fungi, dusts, dander, insects, feathers/fabrics, non-juicy food, and juicy food). The allergens are specific for each individual. The various available treatments for ocular allergy do not relieve symptoms completely and these treatments are associated with various local and systemic side effects. All patients of ocular allergy, along with receiving the currently available treatment, should undergo analysis of their allergens in the form of skin sensitivity tests and then receive specific immune therapy (SIT).

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