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Airborne Pollen Survey of Karachi and Adjacent Areas in Relation to Allergy

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Abstract: The aerobiological studies of Karachi area were carried by Burkard Volumetric Spore Trapper. A total of 14332/cubic meter pollen grains were trapped. Pollen grains of grasses were more abundant which showed a maximum frequency (about 35.5%) followed by Mimosaceae (19.5%) and Chenopodiaceae (16.5%). During 15th October 2001 to 14th October 2004, pollen of 32 families viz., Poaceae, Amaryllidaceae, Acanthaceae, Amaranthaceae, Chenopodiaceae, Combretaceae, Mimosacae, Meliaceae, Myrtaceae, Palmae, Euphorbiaceae, Cyperaceae, Caesalpiniaceae, Papilionaceae, Bignoniacea, Boraginaceae, Bombacaceae, Typhaceae, Malvaceae, Convolvulaceae, Solanaceae, Gentianaceae, Geraniaceae, Compositae, Cucurbitaceae, Rubiaceae, Rhamnaceae, Capparidaceae, Pinaceae, Cupressaceae and Zygophyllaceae were recorded. Pollen of families like Poaceae, Chenopodiaceae, Mimosaceae, Myrtaceae and Combretaceae were dominant during the record period (15th Oct., 2001-14th Oct., 2004). The other significant pollen were of Combretaceae, Compositae (8.4%) and Meliaceae (3.7%). The pollen of herbaceous families were dominated followed by the pollen of tree and shrubs. As far as the frequency of airborne pollen is concerned two pollen seasons were observed within three years. The first season was in April and second was in August. however, in both the seasons different pollen types were dominant every year.

Key words: Airborne pollen · grasses · allergy · Karachi

INTRODUCTION

Aerobiology is a science dealing with airborne particles of biological origin, carried out and transported passively with the air current. Air borne pollen grains of various plants species are responsible for different type of allergies. The pollen grains and fragments transported by the air generally range between 10-50 µm in size.

The allergy caused by the pollen is due to the presence of certain allergens which are protein and glycoprotein that are capable of eliciting the formation in susceptible humans of specific skin-sensitizing antibodies through the body immune system [1, 2]. The characteristic feature of pollen sensitivity is its seasonal pattern of occurrence usually at the time when pollen and other allergenic plant debris show a heavier atmospheric concentration. The kinds of particles present in the atmosphere that are allergenic vary according to climate, geography and vegetation but little information is available on their relative importance

Aerobiological investigations in relation to allergy have been carried out; amongest other such as Davidson [3] in South Africa, Newmark [4], Mittre and Khandiwal [5], Frinking and Rijsdijk [6], Nautival and Midha [7], Solomon [8], Nilsson [9], Reddi *et al*. [10], Banik and Chanda [11], Takahashi *et al.* [12], Jager *et al.* [13], Molina *et al*. [14], Wan *et al*. [15].

Airborne surveyed in various parts of India have been examined by Nair [16], Singh *et al*. [17]. Diurnal variation of airborne brich pollen in some parts of Sweden have been examined by Berggren *et al*. [18] and atmospheric pollen grains in Iran have been studied by Amin and Bokhari [19].

Through understanding of the processes involved in development and dispersal of pollen grains, one may predict when a species is about to shed its pollen and how the total amount will be. Studying the processes that determine the transport and spread of pollen and spores in the atmosphere will provide data to calculate where pollen and spores will be deposited. Finally, by studying the allergenic symptoms in allergic people, one could learn to alleviate the reaction of the human body to these essentially harmless allergens.

A daily task of the aerobiologist is to provide report on air borne pollen and spores every day, a practice which is being followed in almost all the developed countries.

There is no record of airborne pollen and spore data from Karachi although the rate of asthma is quite high in Karachi and its vicinity. However, preliminary study of atmospheric pollen have been carried out from Karachi by

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Kazmi *et al*. [20]. No data is available on airborne pollen grains in Karachi, in relation to allergic patients. The aim of the present work is to determine diurnal and seasonal frequency of airborne pollen and spores and to correlate various types of allergies with them.

Geographically Karachi division is entirely a sea-borne land, lies in the southern part of Pakistan, between latitude 24°.50'-25°.15' north and longitude 65°.51'-67°.40' east. It is bordered in west by Lasbella district and in the northeast by Thatta district (Map-1) Arabian Sea is towards its south while swampy area of Indus delta lies in the southeast corner. The area of Karachi is 1357 square miles and comprises of the city of Karachi (566 square miles) 91 villages and 5 islands [21].

The climate of Karachi has been referred to by Chaudhri [22] as subtropical maritime desert. Qadir *et al.* [23] determined the bioclimate of Karachi by Holdridge's system [24] and classified under the category of Desert bush formation.

The climate remains moderate and pleasant throughout the year due to the presence of sea but sometimes the cold or hot waves do effect Karachi during winter and summer seasons. The average annual rainfall is 7.71 inches, out of which 6.65 inches are received during the monsoon period lasting from June to September. In the rest of the months rainfall is the meager. Due to the scanty rainfall in autumn, winter and spring for a continuous period of eight months the perennial vegetation remains dormant in places where ground water is deep, because root system of some perennial plant do not reach to ground water.

The coastal regions (e.g. Cape Monze) and inland region (e.g. Gadap, Manghopir, Khadeji fall area, etc.) show a considerable variation in temperature. The areas which are closer to sea have maritime trend but inland regions show continental trend. Summers are quite hot. The hottest month is June with a mean monthly temperature of about 97°F. The winter season is very short lasting from November to January. The coldest month is January.

The strong coastal winds are characteristic for this region. The wind blows mostly from northwest or west wardly direction and constantly carries sand and salt particles from beach to the interior.

MATERIALS AND METHODS

Pollen collection: In the present study Brukard volumetric spore trapper were used. The apparatus was placed at the height of 9 meters. Slides placed on the Burkard Sampler were changed daily. For comparison stick slides were also placed along with Burkard Volumetric Spore Sampler. The slides were exposed for 24 hours. The exposed slides were stained with Safranin and mounted in glycerine jelly. Pollen grains were counted under light microscope. Permanent slides of pollen grains were of selected plants for comparison purpose also prepared by the standard methods described by Erdtman [25], for comparison purpose. For light microscopy, the pollen grains were mounted in unstained glycerine jelly and observation were made with a Nikon type-2 microscope under (E40, 0.65) and oil immersion (E100, 1.25) using 10 x eye piece. For SEM studies, pollen grains suspended in a drop of water and directly transferred with a fine pipette to a metallic stub using double sided cellotape and coated with gold in a sputtering chamber (Ionsputter JFC-1100). Coating was restricted to 150A. The SEM. examination was carried out on a Jeol microscope JSM-T200. The measurements were based on 15-20 readings from each specimen. Polar length, equatorial diameter and exine thickness were measured.

The terminology used in accordance with Erdtman [25], Faegri and Iversen [26]; Kremp [27] and Walker and Doyle [28].

Meteorological data: Meteorological data (Table 1) of one year (15 Oct. 2001-14 Oct. 2004) has been collected from Meteorological department Karachi.

Clinical investigations: The clinical investigations were carried out in collaboration with the Allergy Unit of Aga Khan Medical Centre. The investigations include:

- Preparation of pollen extract by using standard technique [28].
- Skin testing with the antigenic extract 1:10 of (w/v) concentration.

Statistical analysis: Pearson correlation test was used to find a possible correlation between pollen concentrations and the main meteorological factors: humidity (%), maximum, minimum and mean temperatures (°C) and number of weeks. The statistical analysis was carried out taking into account the meteorological parameters and pollen concentrations throughout the year under study using statistical software Minitab version 15.

RESULTS AND DISCUSSION

During the period of 2001 (October 15) to 2004 (October 14) 14334 per cubic meter pollen grains were trapped by Burkard Volumetric Spore Trapper. These pollens belong to 32 families Among these the highest

pollen concentration was recorded in the month of August (in 2002-2003)1378/cubic meter (6.4%) and the lowest value June (2001-2002) 794/cubic meter (0.4%).

Seasonal periodicity: During 2001-2004 two pollen seasons were observed. In the first season highest pollen concentration was recorded in the month of August 1378. Second peak value was observed in the month of April 794/cubic meter in 2003. The highest pollen concentration in the month of August was because of grass pollen (816) and in the month of April (442) Meliaceae pollen were dominent followed, by Mimosaceae, Euphorbiaceae and Gramineae (Fig. 1).

In 2001-2002 also two pollen season were observed but one peak value was recorded in the month of September because of Combretaceae pollen but in second year August was the dominant season because of grass pollen. Similarly, although the April was also the one season in 2001-2002 but dominant because of grass pollen. In third year (2003-2004) two seasons were observed one in April because of Meliaceae pollen and second season due to the Mimosaceae pollen in March.

The concentration of pollen in the atmosphere also influence by climatic factors, temperature and humidity are the important climatic factor which effect pollen frequency [30]. The day with high humidity, low precipitation and low temperature show less pollen concentration in the air [30, 31].

It is obvious that the pollen season depends upon season and climatic factor. In the air presence of allergenic pollen various according to climatic, geography and vegetation.

In 2002-2003 (Second year) the large number of families were trapped as compared to first year (2001-2002) and third year (2003-2004). Pollen season of Poaceae was started in the second week of October.The lowest Grass pollen frequency was recorded in the second week of January 2003. However, the highest pollen count of Poaceae was recorded in the third week of August 2003 (Fig. 2). Pollen season of Amaranthaceae/Chenopodiaceae was started in October and lowest pollen count was in third week of March. The highest value was recorded in fourth week August.

The highest count of Mimosaceae pollen (*Prosopis*) was recorded in the first week of April. Lowest count of Mimosaceae pollen reported in the second week of September 2003.

During this study herbaceous plants were more than trees. Among all the pollen counts the of the Gramineae pollen (3268) was highest than other pollen types. Second dominant was *Prosopis* (Mimosaceae) 1794 and third was Chenopodiaceae/Amaranthaceae (1537)

In the second year and third year Meliaceae pollen were also dominant. Started fourth week of March and end last week of August the peak value of Meliaceae pollen observed in second week of April 2004. In second year (2002-2003) the number of Combretaceae pollen were more as compared to first year (2001-2002). Highest pollen count of Combretaceae pollen were found in the first week of November (2002). In the last year also in October c November the pollen count of *Conocarpus* was high. In second year (2002-2003) and third year (2003-2004) year pollen of Cyperaceae and Typhaceae were also trapped but less amount. Some new families

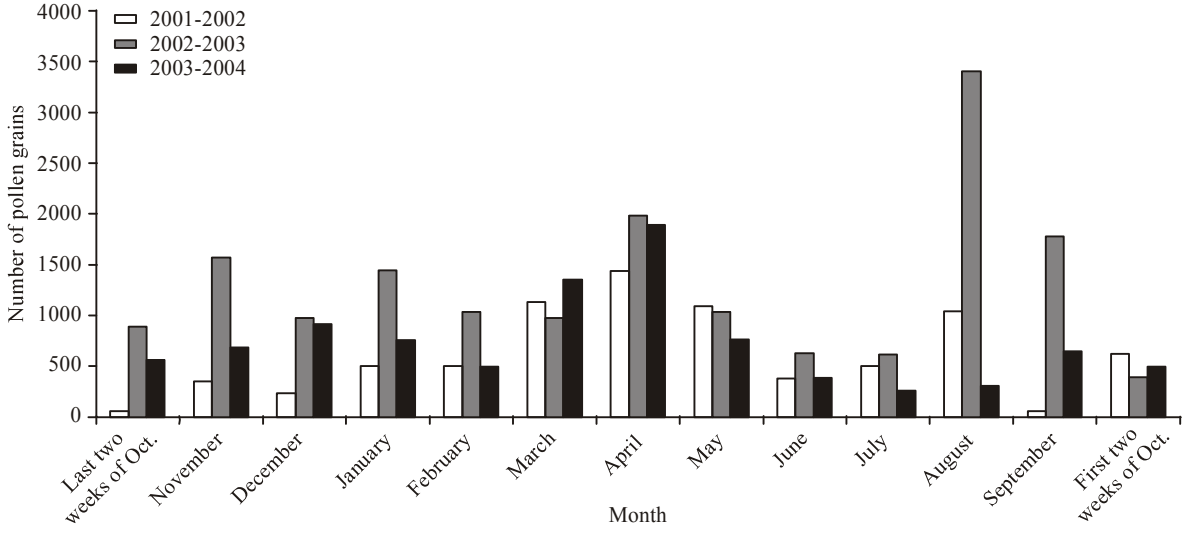

Fig. 1: Correlation of captured pollen during Oct 15 2001 to Oct 14 2004 on monthly basis

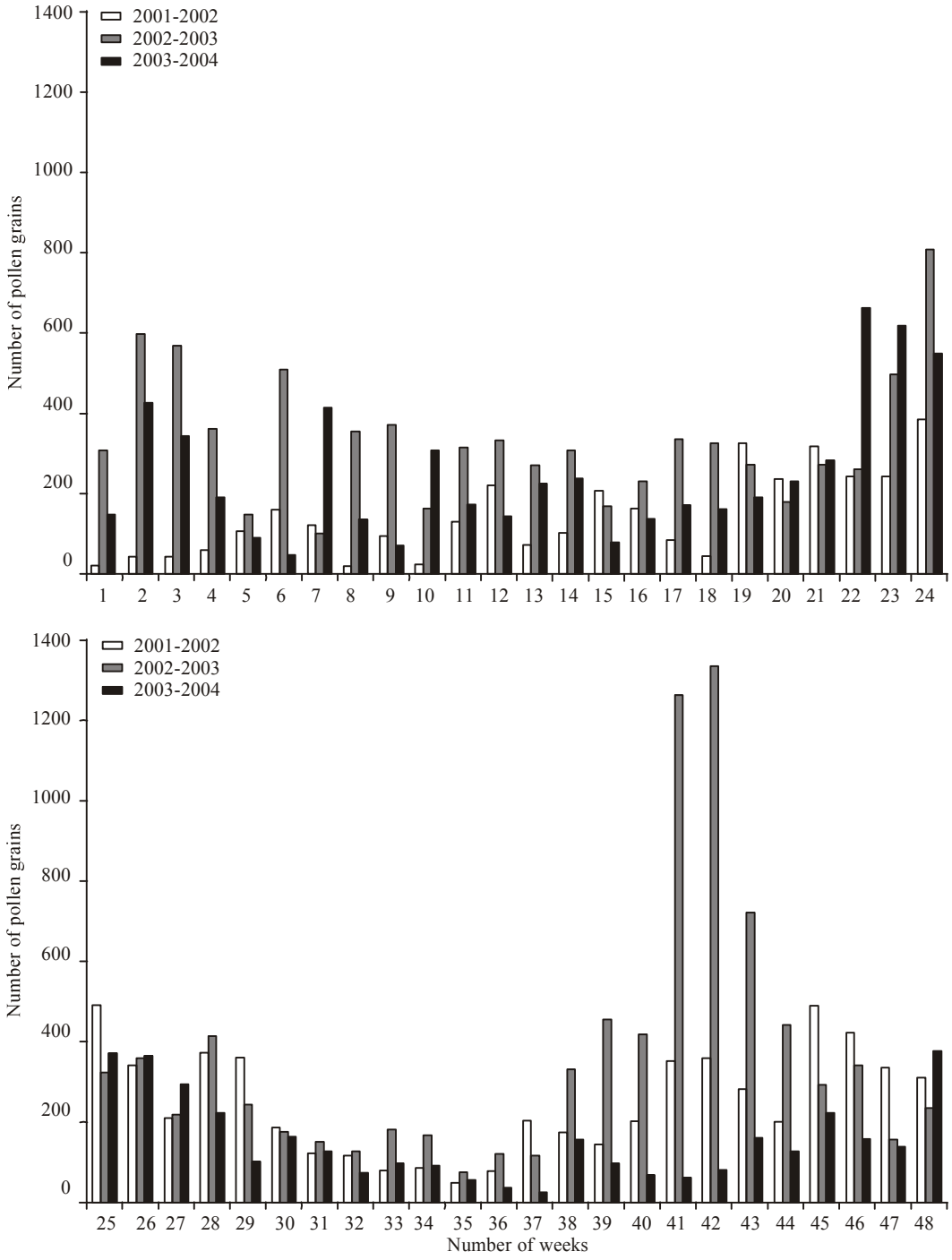

Fig. 2: Correlation data of pollen captured during Oct 15 2001 to Oct 14 2004 on weekly basis

from entomophilous plants were also trapped in this year like Rubiacea, Acanthacea, Amaryllidaceae, Pinaceae and Cupressaceae (Fig. 3).

The pollen of herbaceous plant were dominated, followed by the pollen of tree and shrub.

Airborne pollen are responsible for causing allergy particularly grasses. Obtulowiz *et al*., [32] reported that the grass pollen are the most important allergenic pollen in Poland. Increase in pollen frequency is also related to sunshine [30]. In the present study direct correlation was

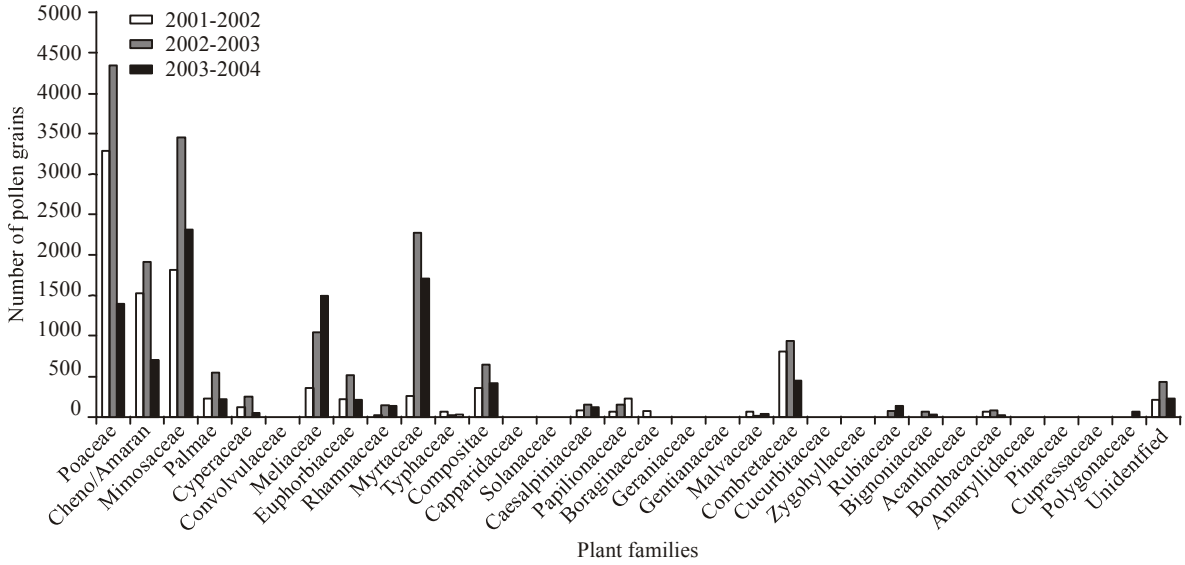

Fig. 3: Correlation of pollen grains captured during Oct 15 2001 to Oct 14 2004 on plant families basis

observed in the sunshine and the atmospheric pollen frequency, in the clear days more pollen concentration was observed. Similar in cloudy days or rainy days less pollen count was observed [33].

In the present study, although the pollen frequency was highest in the month of April and September but the percentage of asthma patient were more in the month of October-November (Oct, 2001-Oct, 2002). The percentage of *Conocarpus* species were most frequent from months of September-November and likely to be one of the causative agent of asthma.

Statistical survey: Pearson correlation test was performed to determine the influence of meteorological parameters on airborne pollens. Correlation was generally significant, as shown in the results, where a statistically-significant positive correlation (p=0.01) was found between airborne pollen and daily maximum, minimum and average temperature. The significant correlations and their p-values are calculated.

During 2001-2002: Strong correlation between Gramineae and minimum temperature ($r^2 = 0.541$, $p<0.001$), Chenopodiaceae/Amaranthaceae and maximum temperature ($r^2 = 0.400$, $p<0.005$) and humidity percentage ($r^2 = 0.421$, $p<0.003$), Euphorbiaceae and maximum ($r^2 = 0.433$, $p<0.002$), Mimosaceae and minimum temperature ($r^2 = 0.640$, $p<0.00$), Mimosaceae and maximum temperature ($r^2 = 0.692$, $p<0.00$), Palmae and minimum temperature ($r^2 = 0.469$, $p<0.001$), Palmae and maximum temperature ($r^2 = 0.562$, $p<0.00$), Palmae and humidity percentage($r^2 = 0.474$, $p<0.001$), Meliaceae and maximum temperature($r^2 = 0.464$, $p<0.002$), Combretaceae and minimum temperature ($r^2 = 0.469$, $p<0.001$)., Compositae and minimum temperature ($r^2 = 0.522$, $p<0.00$).

During 2002-2003: Strong correlation between Gramineae and average temperature ($r^2 = 0.654$, $p<0.001$), Chenopodiaceae/Amaranthaceae and minimum temperature ($r^2 = 0.356$, $p<0.01$) and humidity percentage ($r^2 = 0.421$, $p<0.003$), family Euphorbiaceae and humidity percentage ($r^2 = 0.426$, $p<0.003$), Mimosaceae and average temperature ($r^2 = 0.823$, $p<0.000$), Palmae and average temperature ($r^2 = 0.77$ 1, $p<0.003$), Palmae nd humidity percentage($r^2 = 0.901$, $p<0.000$), Cyperaceae and average temperature($r^2 = 0.407$, $p<0.004$), Comberataceae and average temperature ($r^2 = 0.417$, $p<0.0030$).

During 2003-2004: Strong correlation between Gramineae and humidity percentage ($r^2 = 0.341$, $p<0.015$), Palmae and humidity percentage ($r^2 = 0.417$, $p<0.003$), Compositae and average temperature ($r^2 = 0.410$, $p<0.014$), Comberataceae and average temperature ($r^2 = 0.77$ 1, $p<0.003$), Palmae and humidity percentage ($r^2 = 0.362$, $p<0.011$).

Clinical investigation: To determine the allergic response to the pollens identified in the study in patients with allergic respiratory disease, allergy skin tests were performed by the prick and intradermal methods. This methodology is widely used to determine specific hypersensitivity in patients with allergic diseases. The wheal and flare response was measured and graded for severity according to accepted standards. The allergy

skin tests were performed only to pollen extracts, which were commercially available.

44 patients with allergic respiratory disease underwent allergy skin tests at the Aga Khan University Hospital Allergy Clinic. A positive skin test associated with clinical disease is considered a fairly reliable evidence of that specific allergen causing the clinical disease. Immunoglobulin E hypersensitivity to a specific pollen in patients with decreasing frequency as follows:

	Pollen	Prick skin test	Intradermal skin test	Total
1	*Amaranthus viridus* (Amaranthaceae)	5	6	11
2	*Atriplex stocksii* (Chenopodiaceae)	8	3	11
3	*Salsola barysoma* (Chenopodiaceae)	5	3	8
4	*Cynodon dactylon* (Gramineae)	3	5	8
5	*Sorghum helepense* (Gramineae)	5	2	7
6	*Secale cereal* (Gramineae)	3	4	7
7	*Prosopsis juliflora* (Mimosaceae)	3	1	4
8	*Plantago ovata* (Plantaginaceae)	2	2	4
9	*Chenopodium album* (Chenopodiaceae)	2	2	4
10	Eucalyptus sp. (Myrtaceae)	2	0	2
11	*Acacia nilotica* (Mimosaceae)	1	1	2

Out of 32 pollen families identified in our study, 11 were confirmed to cause skin reactivity and probable clinical disease. The remaining air-borne pollens identified in the Karachi area could not be related to causing clinical disease because the specific antigens for skin testing were not commercially available. To determine the potential allergen city of the pollens not tested in this study, it is recommended that local production of these antigens be undertaken for diagnostic and therapeutic applications in the future. This way a comprehensive and evidence based diagnostic and therapeutic measures can be available to patients.

Mostly Gramineae, Chenopodiaceae, Amaranthaceae and Plantaginaceae are allergenic pollen. Green *et al*. [34] reported highest percentage of grass pollen during airborne survey of Australia. Similarly, Njokuocha [35] also trapped Poaceae, Amaranthaceae/Chenopoidaceae, Combretaceae pollen during air borne pollen survey of Nsukka, Nigeria.

Metrological Data 2001-2002

Date	Temp (°C) Min	Max	Outlook	Humidity (%)	No. of weeks
Oct-2001, 15-21	22.4	36.0	Sunny	64.6	1
Oct-2001, 22-31	21.7	34.2	Sunny	62.1	2
Nov-2001, 01-07	20.8	34.3	Sunny	38.0	3
Nov-2001, 08-14	17.6	33.4	Fair/Hazy	20.4	4
Nov-2001, 15-21	17.8	34.3	Fair/Hazy	23.8	5
Nov-2001, 22-30	17.0	31.4	Fair	37.5	6
Dec-2001, 01-07	17.8	30.8	Sunny	48.0	7
Dec-2001, 08-14	14.6	29.8	Sunny	64.3	8
Dec-2001, 15-21	14.0	28.6	Sunny	43.2	9
Dec-2001, 22-31	14.0	27.8	Sunny	38.0	10
Jan-2002, 01-07	13.8	27.4	Sunny	50.1	11
Jan-2002, 08-14	14.8	27.8	Sunny, Fair cold night	31.2	12
Jan-2002, 15-21	13.7	25.0	Fair/cold night	23.3	13
Jan-2002, 22-31	10.9	25.5	-do-	29.3	14
Feb-2002, 01-07	15.0	25.7	Sunny	30.4	15
Feb-2002, 08-14	12.4	25.4	Sunny	16.8	16
Feb-2002, 15-21	15.7	27.4	Sunny	35.1	17
Feb-2002, 22-30	16.8	28.6	Sunny	47.2	18
Mar-2002, 01-07	16.8	29.7	partly cloudy	44.0	19
Mar-2002, 08-14	19.3	31.7	-do-	37.6	20
Mar-2002, 15-21	18.4	33.4	Fair/Hazy morning	28.6	21
Mar-2002, 22-31	21.5	32.1	Sunny	35.6	22
Apr-2002, 01-07	23.1	33.4	Sunny	48.1	23
Apr-2002, 08-14	24.3	32.7	-do-	55.3	24
Apr-2002, 15-21	23.3	32.8	-do-	56.0	25
Apr-2002, 22-30	24.1	35.3	-do-	44.4	26
May-2002, 01-07	24.1	35.6	-do-	52.5	27
May-2002, 08-14	26.0	34.8	-do-	54.4	28
May-2002, 15-21	27.0	36.4	Partly cloudy	56.1	29
May-2002, 22-31	27.7	32.2	-do-	67.0	30
Jun-2002, 01-07	27.5	33.2	-do-	64.6	31
Jun-2002, 08-14	27.5	33.5	-do-	64.5	32
Jun-2002, 15-21	28.0	34.0	-do-	61.3	33
Jun-2002, 22-30	28.2	34.9	-do-	66.0	34
Jul-2002 01-07	27.0	32.2	-do-	50.2	35

Metrological Data 2001-2002 (Continued)

Jul-2002 08-14	27.5	31.8	Mostly cloudy	65.8	36
Jul-2002 15-21	27.0	31.2	-do-	68.8	37
Jul-2002 22-31	26.0	30.9	-do-	71.6	38
Aug-2002, 01-07	25.5	30.7	-do-	65.4	39
Aug-2002, 08-14	26.0	30.0	Cloudy	71.8	40
Aug-2002, 15-21	26.0	27.7	Mostly cloudy	68.8	41
Aug-2002, 22-31	25.0	30.0	Partly cloudy	72.7	42
Sep-2002, 01-07	25.0	17.5	Partly cloudy	72.8	43
Sep-2002, 08-14	25.0	31.0	-do-	54.2	44
Sep-2002, 15-21	24.8	30.4	-do-	70.7	45
Sep-2002, 22-30	24.1	31.4	-do-	73.6	46
Oct-2002, 01-07	23.2	33.0	Sunny	60.0	47
Oct-2002, 08-14	22.5	35.6	Sunny	48.3	48

Metrological Data 2002-2003

	Temp (°C)				
Date	Min	Max	Outlook	Humidity (%)	No. of weeks
Oct-2002, 15-21	22.0	36.0	Dry	47.0	1
Oct-2002, 22-31	22.0	35.0	Hot/dry	38.0	2
Nov-2002, 01-07	19.0	35.0	Fair	23.0	3
Nov-2002, 08-14	19.0	31.0	Partly cloudy	37.0	4
Nov-2002, 15-21	17.0	33.0	Fair	33.0	5
Nov-2002, 22-30	15.0	31.0	Fair/cloudy	41.0	6
Dec-2002, 01-07	14.0	30.0	Fair/cloudy	23.0	7
Dec-2002, 08-14	13.0	28.0	Fair/cool night	19.0	8
Dec-2002, 15-21	17.0	30.0	Fair/cool night	50.0	9
Dec-2002, 22-31	14.0	25.0	Fair/cool night	51.0	10
Jan-2003, 01-07	11.0	25.0	Fair/cool night	30.0	11
Jan-2003, 08-14	11.0	28.0	Fair/cool night	24.0	12
Jan-2003, 15-21	13.0	28.0	Fair/cool night	18.0	13
Jan-2003, 22-31	16.0	27.0	Fair/partly cloudy	45.0	14
Feb-2003, 01-07	14.0	27.0	Fair/cool night	30.0	15
Feb-2003, 08-14	15.0	30.0	Fair/cool night	18.0	16
Feb-2003, 15-21	18.0	27.0	Partly cloudy/light rain	41.0	17
Feb-2003, 22-30	20.0	30.0	Partly cloudy	52.0	18
Mar-2003, 01-07	16.0	29.0	Partly cloudy	17.0	19
Mar-2003, 08-14	18.0	34.0	Partly cloudy	24.0	20
Mar-2003, 15-21	20.0	31.0	Partly cloudy	51.0	21
Mar-2003, 22-31	23.0	34.0	Partly cloudy	48.0	22
Apr-2003, 01-07	23.0	39.0	Hot and dry	14.0	23
Apr-2003, 08-14	23.0	35.0	Fair/Partly cloudy	48.0	24
Apr-2003, 15-21	25.0	35.0	Hot and dry	42.0	25
Apr-2003, 22-30	25.0	37.0	Hot and dry	40.0	26
May-2003, 01-07	26.0	36.0	Hot and dry	27.0	27
May-2003, 08-14	26.0	36.0	Hot and dry	55.0	28
May-2003, 15-21	27.0	34.0	Worm and humid	66.0	29
May-2003, 22-31	27.0	34.0	Partly cloudy/warm and humid	63.0	30
Jun-2003, 01-07	28.0	34.0	Hot and Humid	66.0	31
Jun-2003, 08-14	28.0	34.0	Hot and Humid	64.0	32
Jun-2003, 15-21	28.0	36.0	Hot and Humid/light rain	60.0	33
Jun-2003, 22-30	29.0	34.0	Partly cloudy/Light rain	66.0	34
Jul-2003 01-07	29.0	36.0	Cloudy/Rain	60.0	35
Jul-2003 08-14	29.0	34.0	Cloudy/Rain	65.0	36
Jul-2003 15-21	27.0	34.0	Cloudy/Rain	65.0	37
Jul-2003 22-31	26.0	31.0	Cloudy/Rain	79.0	38
Aug-2003, 01-07	26.0	32.0	Light rain	72.0	39
Aug-2003, 08-14	27.0	33.0	Cloudy	66.0	40
Aug-2003, 15-21	27.0	32.0	Cloudy/Light rain	58.0	41
Aug-2003, 22-31	26.0	32.0	Cloudy/Light rain	69.0	42
Sep-2003, 01-07	26.0	32.0	Partly cloudy	60.0	43
Sep-2003, 08-14	25.0	31.0	Partly cloudy	62.0	44
Sep-2003, 15-21	25.0	33.0	Partly cloudy	57.0	45
Sep-2003, 22-30	24.0	35.0	Hot/Partly cloudy	43.0	46
Oct-2003, 01-07	22.0	39.0	Hot and Dry	25.0	47
Oct-2003, 08-14	22.0	36.0	Hot and Dry	40.0	48

Metrological Data 2003-2004

	Temp (°C)				
Date	Min	Max	Outlook	Humidity (%)	No. of weeks
Oct-2003, 15-21	21.4	36.6	Hot and Dry	32.6	1
Oct-2003, 22-31	19.6	35.4	Hot and Dry	36.6	2
Nov-2003, 01-07	18.4	35.1	Fair/Partialy Cloudy	39.3	3
Nov-2003, 08-14	15.4	33.1	Fair/Partialy Cloudy	32.0	4
Nov-2003, 15-21	14.6	29.1	Fair/Cool Night	29.7	5
Nov-2003, 22-30	13.0	30.6	Fair/Cool Night	22.6	6
Dec-2003, 01-07	13.7	31.1	Fair/Partialy Cloudy	42.3	7
Dec-2003, 08-14	14.4	29.0	Cold Hazy/Grain	36.1	8
Dec-2003, 15-21	9.4	26.3	Fair/Cool Night	30.3	9
Dec-2003, 22-31	9.7	25.8	Fair/Cool Night	42.3	10
Jan-2004, 01-07	11.4	25.7	Cold Hazy/C. Rain	24.1	11
Jan-2004, 08-14	13.0	28.4	Fair/Cool Night	35.1	12
Jan-2004, 15-21	14.4	26.7	Fair/Cloudy	43.1	13
Jan-2004, 22-31	11.6	24.9	Partialy Cloudy/Grain	28.2	14
Feb-2004, 01-07	11.3	29.1	Fair/Hazy Night	25.9	15
Feb-2004, 08-14	13.7	29.0	Fair/Cool Night	23.7	16
Feb-2004, 15-21	14.7	30.9	Fair/Sunny	42.6	17
Feb-2004, 22-28	17.1	31.0	Sunny	37.4	18
Mar-2004, 01-07	15.7	35.1	Hot and Dry	19.0	19
Mar-2004, 08-14	18.6	34.7	Hot and Dry	41.9	20
Mar-2004, 15-21	19.9	38.0	Hot and Dry	21.7	21
Mar-2004, 22-31	20.3	35.8	Hot and Dry	19.9	22
Apr-2004, 01-07	23.7	34.2	Hot and Dry	48.7	23
Apr-2004, 08-14	23.7	36.4	Hot and Dry	43.4	24
Apr-2004, 15-21	25.9	35.3	Hot and Dry/P. Cloudy	39.6	25
Apr-2004, 22-30	24.8	35.4	Hot and Dry/P. Cloudy	50.6	26
May-2004, 01-07	25.7	40.0	Hot and Dry/Wind	37.6	27
May-2004, 08-14	26.3	36.7	Partialy Cloudy	54.7	28
May-2004, 15-21	27.8	34.8	Partialy Cloudy	61.0	29
May-2004, 22-31	28.0	35.7	Hot and Dry	57.8	30
Jun-2004, 01-07	27.3	34.3	Hot and Humid	65.0	31
Jun-2004, 08-14	28.9	38.6	Hot and Dry	53.4	32
Jun-2004, 15-21	29.6	35.1	P. Cloudy/Wind Rain	59.6	33
Jun-2004, 22-30	28.4	34.3	P. Cloudy/Wind	63.5	34
Jul-2004, 01-07	28.3	33.9	P. Cloudy/L. Rain	66.0	35
Jul-2004, 08-14	27.7	33.0	P. Cloudy/L. Rain	62.1	36
Jul-2004, 15-21	27.4	33.0	P. Cloudy/Dizzle	64.4	37
Jul-2004, 22-31	27.0	33.2	P. Cloudy/Dizzle	59.2	38
Aug-2004, 01-07	26.5	32.2	P. Cloudy/Rain	68.8	39
Aug-2004, 08-14	26.4	32.0	P. Cloudy/Rain	65.4	40
Aug-2004, 15-21	25.3	32.0	P. Cloudy	65.0	41
Aug-2004, 22-31	25.7	31.7	P. Cloudy	66.7	42
Sep-2004, 01-07	25.0	31.0	Fair/P. Cloudy	57.0	43
Sep-2004, 08-14	25.0	31.0	P. Cloudy	60.7	44
Sep-2004, 15-21	25.5	31.0	P. Cloudy	58.8	45
Sep-2004, 22-30	26.5	35.5	P. Cloudy/L. Rain	52.5	46
Oct-2004, 01-07	24.8	34.8	P. Cloudy/L. Rain	46.6	47
Oct-2004, 08-14	22.3	33.3	Fair/Hazy Morning	38.0	48

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