Indian J Allergy Asthma Immunol 2005; 19(2) : 85-92

Prevalence of Asthma in highly Polluted Dhaka City and low Polluted Coastal area of Bangladesh

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Abstract

Bangladesh National Asthma Prevalence Study (1999) states that 7 million people including 4 million children are suffering from asthma and prevalence is more in rural area than metropolitan area of Bangladesh. The present study compares the prevalence of asthma and its trigger factors in 2 contrasting settings viz. highly polluted Dhaka city and least polluted coastal area of Bangladesh. It was a cross sectional study; conducted from January to April 2001, using multistage stratified random sampling design. Face to face interviews were taken at the household level through a pre-tested questionnaire in a total Population of 6161 (M: F = 109.7:100; Dhaka 3087 and coastal area 3029). The prevalence of asthma (recent wheeze) was 6.8% (95% Cl 6.2-7.5) Frequency of all categories of asthma was significantly higher in coastal area than Dhaka city. The common cold, extreme weather, ingestion of cold food/drink, allergenic food, dust, gas/kerosene stove and motor vehicle fumes, were possible trigger factors of asthma for residents of both Dhaka city and coastal area. The history of bronchiolitis and exposure to wood stove fumes in infancy was noticed associated with asthma in both the settings but more in coastal area. The first and full moon seem to be important trigger factor (history) for asthma in coastal area. In conclusion, asthma is more prevalent in coastal area with low outdoor pollution.

Key words: Asthma, Prevalence, Indoor Pollution, Trigger factors, Bangladesh

INTRODUCTION

Globally 150 million people are suffering from asthma[1]. In 1997, a study on childhood asthma in Bangladesh showed 11.8% prevalence of asthma in the coastal region[2]. According to the National Asthma Prevalence Study (NAPS-1999), 7 million people including 4 million children are suffering from asthma in Bangladesh[3]. NAPS demonstrated that prevalence of asthma was more among children, in households with 3 or less people, in low-income group and in illiterate sub-urban and rural population than in inhabitants of metropolitan cities like Dhaka. These two studies demonstrated that asthma prevalence was more in apparently less outdoor polluted area than high polluted area.

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IJAAI, 2005, XIX (2) p 85-92.

The present study was aimed to determine the prevalence of asthma in two contrasting environment viz. highly polluted Dhaka city and low polluted coastal area of Bangladesh. Attempts were also made to identify trigger factors of asthma at the above survey sites.

MATERIAL AND METHODS

This was a cross sectional study, which quantified the distribution of asthma in coastal inhabitants and residents of Dhaka city, Bangladesh. The survey was conducted from January 2001 to April 2001, funded by Bangladesh Medical Research Council, Dhaka.

Sampling

A multi-stage stratified random sampling design was followed. The study sites were divided into two - highly polluted stratum and low polluted stratum. Dhaka city is known as the most polluted area of Bangladesh[4]. Coastal area adjacent to the Bay of Bengal is recognized as the low polluted area of Bangladesh[4]. Dhaka city was stratified into 4 major geographic zones: (1) Old Dhaka, (2) New Dhaka, (3) Mixed Zone, (i.e. in between old and new Dhaka) and (4) Slum zone. One thana (large administrative unit) from each zone, then one municipality block from each thana and finally 3 mohallas (small administrative units) from each block were randomly selected for the study. Sixty families covering two hundred and fifty people were interviewed from each mohalla, thus 750 people were interviewed from each zone to cover 3000 population of Dhaka city. Coastal areas of Bangladesh were divided into 3 zones: (1) Western zone (Bagerhat-Khulna), (2) Southern zone (Bhola-Patuakhali) and (3) Eastern zone (Cox's Bazar-Teknaf). One thana from each zone and then four villages from each thana were selected. Randomly selected 60 families covering two hundred and fifty people were interviewed from each village for 1000 people from each thana, to cove 3000 coastal population.

Identification of households

Sixty households from Dhaka city and 60 households from coastal region were selected randomly from each primary sampling center (mohallah/village). On an average, each household was considered to consists of five members. All members from 5 years to 44 years of the selected households wee included in the study. When 250 eligible subjects were not available from 60 households, the adjacent household of the last one was included to obtain the required number of samples.

Data collection procedure

Four teams were formed for data collection. All members of the teams were physicians led by a Pulmonologist. In each household, face to face interviews were performed with the members using a pre-tested structured questionnaire prepared on the basis of studies of NAPS[3], ECRHS[5], ISAAC[6] and Usherwood et al[7]. Information regarding the household was recorded on the first page of the questionnaire. Separate questionnaires were used for each individual member of the household.

Operational definitions[3,6]

Children: 5 to 14 years of age. Children aged below five years were excluded from the study because of diagnostic inconsistencies.

Adult: 15 to 44 years of age. Persons above 44 years of age were excluded from the study to avoid the geriatric co-morbidities.

Wheeze: Whistling sound arising from chest not from nose or throat.

Asthma prevalence: Prevalence of recent wheeze (RW), wheeze in last 12 months, was defined as asthma prevalence.

Current Asthma: At least 3 attacks of wheeze in last 12 months.

Ever Wheeze (EW) : Wheeze at any time in the past.

Doctor diagnosed asthma (DDA): Doctor of any category (either qualified or quack) having diagnosed the named individual as suffering from asthma.

Perceived asthma (PA) : Perception of having asthma in adults by themselves or in children by the parents.

Statistical analysis

The prevalence of asthma and its different categories were estimated with exact binomial 95% confidence interval (CI) to convey stability of the estimates. The χ^2 test or χ^2 test for trend were used for the difference between proportions. All analysis was performed using SPSS version 10.0 for Windows.

RESULTS

A total of 6116 subject were interviewed. There were 3200 men and 2916 women (M : F = 109.7 : 100). Of the total population, 3087 (50.5%) subjects were recruited from Dhaka city and 3029 (49.5%) from coastal area. Table 1 shows the socio-demographic characteristics of the study population.

Table 1. Socio-demographic characteristics of the study population

Characteristics	Dhaka City (n=3087)		Coastal area (n=3029)	
	Number	Percent	Number	Percent
Age groups in years				
5-9	299	9.7	488	16.1
10-14	375	12.1	568	18.8
5-14 (Children)	674	21.8	1056	34.9
15-24	908	29.4	795	26.2
25-34	836	27.1	533	17.6
35+	669	21.5	645	21.3
15-44 (Adults)	2413	78.2	1973	65.1
Sex				
Male	1602	51.9	1598	52.8
Female	1485	48.1	1431	47.2
Education Level				
Illiterate	699	22.6	824	27.2
Primary	704	22.8	1172	38.7
Secondary	908	29.4	850	28.1
Higher Secondary & above	776	25.1	183	6.0
Main Occupation				
Business	388	12.6	244	8.1
Agricultue	5	0.2	137	4.5
Service	432	14.0	160	5.3
Housewife	606	19.6	646	21.3
Students	1010	32.7	1203	39.7
Others	446	14.8	510	18.6
Monthly Family Income in BD* Taka (1US$=56 BD Taka)				
3000 or less	513	16.6	1281	42.3
3001-6000	366	11.9	1006	33.2
6001-9000	62	2.0	293	9.7
9001-12000	230	7.5	296	9.8
More than 12000	1916	62.1	153	5.1

*BD = Bangladesh

The prevalence of asthma (recent wheeze) with 95% confidence interval by age, sex, geographical regions and economic groups of studied population was 6.8% (Table 2). The prevalence of various categories of asthma has been shown in table 3. The prevalence of different form of asthma in coastal area was significantly higher than that of Dhaka city.

The prevalence of asthma was significantly higher in children than adults, both in coastal area and in Dhaka city for all categories of asthma (Table 4).

Regarding trigger factors only those persons (Dhaka city n = 106, coastal area n = 166) who responded clearly in affirmative/negative were included (Table 5).

It has been observed that common cold, extreme hot / cold weather, cold food/drink, allergenic food / drink, dust, gas / kerosene stove fume, motor vehicle fume, were probable trigger factors at both the sites, Dhaka and coastal area. Their role seems significantly higher in the asthmatics of Dhaka city. Wood stove fume and history of probable bronchiolitis in infancy were possible triggers in both the settings but significantly higher in coastal area. Bathing was a less important trigger factor in both the settings. Use

Table 2. Prevalence of asthma with age, sex, monthly income and geographical region

Variables	Dhaka City (n=3087)		Coastal Area (n=3029)	
	Prevalence	95% CI	Prevalence	95% CI
Age group				
5-14 years				
Male	7.0%	4.0-11.7	10.1%	7.2-14.0
Female	4.8%	2.5-8.9	9.6%	6.7-13.5
15-44 years				
Male	4.0%	2.9-5.5	6.5%	4.9-8.6
Female	3.8%	2.7-5.4	7.0%	5.2-9.4
Monthly income				
Taka 4000 or less	4.3%	0.2-23.9	9.2%	7.7-11.0
Taka 4001-10000	5.3%	3.2-8.5	5.4%	3.9-7.5
Taka 10001+	4.4%	3.5-5.6	5.3%	2.0-12.5

Table 3. Prevalence of various categories of asthma at two different geographical regions

Asthma Category	Dhaka City (n=3087)			Coastal Area (n=3029)			Significance (p value)
	No.	Prevalence (%)	95% CI*	No.	Prevalence (%)	95% CI*	
Ever Wheeze	129	4.2	3.5-5.0	284	9.4	8.4-10.5	<.001
Recent Wheeze	126	4.1	3.4-4.9	288	9.5	8.5-10.6	<.001
Current Asthma	78	2.5	2.0-3.1	151	5.0	4.3-9.5	<.001
Perceived Asthma	133	4.3	3.6-5.1	310	10.2	9.2-11.4	<.001
Doctor Diagnosed Asthma	118	3.8	3.2-4.6	242	8.0	7.1-9.0	<.001

*CI = Confidence Interval

Table 4. Prevalence of asthma feature with age and geographical region

Asthma Category	Children				Adults			
	Dhaka City (n=674)		Coastal Area (n=1056)		Dhaka City (n=2413)		Coastal Area (n=1973)	
	No	Prevalence (%)	No	Prevalence (%)	No	Prevalence (%)	No	Prevalence (%)
Ever Wheeze	36	5.3	128	12.1	93	3.9	156	7.9
Recent Wheeze	33	4.9	121	11.5	93	3.9	167	8.5
Current Asthma	22	3.3	57	5.4	56	2.3	94	4.8
Perceived Asthma	39	5.8	133	12.6	94	3.9	177	9.0
Doctor Diagnosed Asthma	34	5.0	114	10.8	84	3.5	128	6.5

Table 5. Trigger factors of asthma in Dhaka city and coastal area

Trigger factors of asthma	Dhaka City (n=106)		Coastal area (n=166)		Significance (p value)	Total (n=272)	
	No	%	No	%		No	%
Common cold	89	84.0	103	62.0	<0.001	192	71.6
Extreme hot/cold	80	76.2	88	53.3	<0.001	168	61.8
Cold food/drink	89	84.0	84	48.6	<0.001	173	64.3
Allergenic food	36	34.0	35	21.2	<0.05	71	26.1
Dust	87	82.1	73	44.0	<0.001	160	58.8
Gas/kerosene stove fume	79	74.5	29	17.5	<0.001	108	39.7
Wood stove fume	27	24.5	137	82.5	<0.001	164	60.3
Motor vehicle fume	83	78.3	15	9.1	<0.001	98	36.0
H/O early childhood bronchiolitis	23	21.7	102	61.4	<0.001	125	46.0
Bathing	11	10.4	25	15.2	0.27	36	13.2
Carpet/blanket/dress	37	34.9	7	4.3	<0.001	44	16.2
Full and first moon	6	5.7	85	48.9	<0.001	91	34.5
Pollen	4	3.8	3	1.8	0.28	7	2.6
Pet animal	4	3.8	1	0.6	0.08	5	1.8
Cockroach	2	1.9	2	1.2	0.64	4	1.5

of carpet could be an important trigger factor in Dhaka city. The first and full moon was associated as important trigger factor in coastal area. Pollen, pet animal and cockroach did not seem related as triggers in Dhaka city or coastal area. (Table 5).

DISCUSSION

This study was conducted to collect data on the prevalence of asthma in two groups of people with different background and level of pollution. Dhaka is

considered to be the city of higher outdoor pollution[4], whereas the coastal area is with low pollution. The prevalence of all definitions of asthma was higher in coastal area than the metropolitan Dhaka city. These finding are not compatible with the common belief that outdoor pollution is associated with increased prevalence of asthma in children in Bangladesh. The prevalence of asthma among children was higher than that of adults. The risk factors for the asthmatic population of Dhaka city were common cold, foods, dust fumes from stoves and motor vehicles, carpet, allergenic food and drinks and climatic exacerbation i.e. extreme hot and cold. On the contrary, the risk factors for the people residing in coastal area were physical exercise, wood stove fumes and first and full moon.

A multi-stage stratified random sampling design was followed for selection of the study population. The sample size was more than 3000 for each group of population and was adequate to estimate the prevalence[8]. The instrument used for data collection was developed from the NAPS[3], ECRSH[5] and ISAAC[6] questionnaires. Nevertheless, this study has a number of limitations. Firstly, it is a questionnaire-based study. To overcome this limitation all teams were led by a pulmonologist. They inquired carefully in all asthma cases to confirm their diagnosis of asthma. All confusing cases e.g. COPD were considered as non-asthma subject. Secondly, ever wheeze number of cases could be under diagnosed due to long recall period.

Previous studies have shown different results regarding prevalence of asthma in coastal area. The prevalence of asthma was observed lower in humid-coastal area than in dry-inland of Australia[9] and Saudi Arabia[10]. This study demonstrated the prevalence of all definitions of asthma higher in coastal area than in the Dhaka city. The reported prevalence of asthma is highest in Australia (30%) and New Zealand (30%)[11]. where the population is concentrated in the coastal belt of Pacific Ocean and Indian Ocean and the environment is apparently clean. In the sample surveyed, children population was more in the coastal area, 34.9% as against 21.8% in the Dhaka city (Table 1). The prevalence of asthma was observed more in children than adults[3,12]. In present study, it was observed that the coastal area, population was less educated (illiterate and or having only primary education 65.9%) than residents of Dhaka city (45.4%) (Table 1). Also, in coastal area, there were more people in the lower income group - 75.5% (earning up to $100 per month) compared to 28.8% in Dhaka city (Table 1). Prevalence of asthma was significantly higher in less privileged social classes within the population as reported earlier from Bangladesh[3] and other countries[13].

The houses in coastal area were relatively damper than in Dhaka city. Dampness in the homes has been regarded a new public health issue for asthma and other chest diseases in the subtropical countries[14]. The indoor environment of coastal residences was fraught with the fumes from the domestic wood stove (82.5%) as against 27% users in Dhaka city (Table 5). In Bangladesh, use of wood stove in poorly ventilated homes, often in conjugation with other biogas fuels has been frequently encountered. Exposure to wood smoke has been found associated with chronic respiratory symptoms[15]. The wood smoke contains potent respiratory irritants such as formaldehyde, acrolene, nitrogen oxide, sulphur dioxide and particulates[16]. Eposure to extremely high levels of wood smoke has been linked with respiratory problems. After a work shift, forest firefighters experienced an acute decrease in pulmonary function[17]. Similarly, Florida wildfires were associated with increased visits to the emergency department for asthma and acute bronchitis[18].

Bronchiolitis in early infancy is believed to contribute to increased prevalence of asthma in coastal area. Long-term sequelae are common after bronchiolitis, with up to 70% of infants experiencing recurrent cough and wheezing[19]. In the present study, there was history of probable bronchiolitis in infancy in 61.4% children in coastal area and on the contrary, 23% children in Dhaka city. The first attack of wheeze in infants with low-grade fever and preceding rhinitis are mostly due to bronchiolitis[20]. In Bangladesh also, epidemics of bronchiolitis are experienced in the first year of life of children[21]. Infections in children with respiratory viruses like Respiratory Syncitial Virus (RSV), which induce a Th_2 response with increasing IgE production lead to unmasking of asthma manifestations[22].

Apart from wood stove fume and history of probable bronchiolitis in infancy, some factors were common in both the settings but significantly higher in Dhaka city. The factors were common cold, extreme hot or cold climate, cold food/drink. allergenic food, dust, gas/kerosene stove and fumes of motor vehicles which cotributes towards asthma exacerbations. In relation to the fumes of motor vehicle, similar findings were reported from Germany[23,24]. It is interesting to record that people residing in coastal area considered that first and full moon were risk factors for triggering asthma. No other published study showed this peculiar relationship. The relationship of the status of moon with asthma is difficult to explain. It may be due to some effect of gravitational force and change of concentration of ozone, or other micro particle in environment during first and full moon. Further study may be undertaken to confirm this observation. However, it was our common observation; that rural people of Bangladesh complain about exacerbation of other chronic illnesses (e.g. arthropathy) during the time of full and first moon.

In conclusion, this study demonstrates that asthma is more prevalent in low polluted coastal area of Bangladesh than Dhaka city. This suggests that the prevalence of asthma is not directly proportional to high levels of environmental pollution. In depth investigation on factors underlying asthma preponderance in coastal area is required.

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