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Self-reported asthma symptoms in children and adults of Bangladesh: findings of the National Asthma Prevalence Study

M Rashidul Hassan,[a] ARM Luthful Kabir,[b] Asif M Mahmud,[a] Fazlur Rahman,[b] M Ali Hossain,[a] K Saifuddin Bennoor,[c] Md Ruhul Amin[d] and M Mostafizur Rahman[a]

Background No population-based studies to determine the magnitude of the asthma problem have been carried out in Bangladesh. This study aimed to define the prevalence of asthma as well as to identify the risk factors of asthma in the general population of Bangladesh.

Methods A cross-sectional study was conducted from January 1999 to August 1999 on 5642 Bangladeshi people. Data were collected from randomly selected primary sampling units of 8 municipality blocks of 4 large metropolitan cities, 12 municipality blocks of 6 district towns and 12 villages of 6 districts chosen randomly from all 64 districts of the country. Face-to-face interviews were performed with the housewives or other guardians at the household level using a structured questionnaire.

Results The prevalence of asthma (wheeze in the last 12 months) was 6.9% (95% CI : 6.2–7.6). The prevalence of other asthma definitions were: ever wheeze (lifetime wheeze) 8.0% (95% CI : 7.3–8.7); perceived asthma (perception of having asthma) 7.6% (95% CI : 6.9–8.3); doctor diagnosed asthma (diagnosis of asthma by any category of doctor either qualified or unqualified) 4.4% (95% CI : 3.9–4.9). The prevalence of asthma in children (5–14 years) was higher than in adults (15–44 years) (7.3% versus 5.3%; odds ratio [OR] = 1.41, 95% CI : 1.09–1.82). Asthma in children was found to be significantly higher in households with ⩽3 people than in larger households (OR = 2.20, 95% CI : 1.24–3.20). The low-income group (OR = 1.41, 95% CI : 1.04–1.92) and illiterate group (OR = 1.51, 95% CI : 1.01–2.24) were more vulnerable to asthma attacks than the high-income group and more educated people, respectively.

Conclusions Asthma in Bangladesh appears to be a substantial public health problem: an estimated 7 million people including 4 million children suffer from asthma-related symptoms.

Keywords Asthma, wheeze, prevalence, population-based study, Bangladesh

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Asthma is a substantial health problem among children and adults worldwide, with increasing prevalence rates in many countries.[1] If 10% of children and 5% of adults have asthma, figures that are conservative for western countries[1] but may be overestimates in some developing countries, the global burden of asthma is in the order of 130 million people. Mortality rates from asthma in western countries vary between one and five per 100 000, and result in some 60 000 deaths annually, many of which occur in young people and are preventable.[2] International comparisons of prevalence and characteristics of asthma have been greatly facilitated by the completion of two major initiatives in asthma epidemiology—the European Commission Respiratory Health Study (ECRHS)[3] and the International Study of Asthma and Allergies in Childhood (ISAAC).[4] The first

[a] Institute of Diseases of the Chest and Hospital, Mohakhali, Dhaka-1212, Bangladesh.

[b] Institute of Child & Mother Health, Matuail, Dhaka-1362, Bangladesh.

[c] National Institute of Cancer Research & Hospital, Mohakhali, Dhaka-1212, Bangladesh.

[d] Bangladesh Institute of Child Health (Shishu Hospital), Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh.

Correspondence: M Rashidul Hassan, Institute of Diseases of the Chest and Hospital, Mohakhali, Dhaka-1212, Bangladesh. E-mail: asmaasso@bttb.net.bd, mrhassan@bangla.net

phase of ISAAC has been completed in 156 collaborating centres of 56 countries covering a population of 721 601 children.[5] So far, only one study[6] has been conducted to determine the prevalence of asthma in Bangladesh. It was conducted on children in a coastal region and showed the prevalence of asthma to be 11.8%. Since the nationwide prevalence of asthma was not known, this study was undertaken to determine the prevalence and associated factors of asthma and wheeze in Bangladesh in all age groups. It was conducted under the joint auspices of Asthma Association and The Chest and Heart Association of Bangladesh with collaboration from government health authorities, local medical practitioners and field workers.

Methods

This was a cross-sectional prevalence study, which quantified the distribution of asthma in the Bangladeshi population. This survey was conducted from January 1999 to August 1999.

Sampling and identification of the households

A multi-stage stratified random sampling design was followed. The whole country was stratified into three major strata: metropolitan, other urban and rural areas. The primary sampling unit (PSU) for the rural areas was village and that for urban areas was municipality block (mohalla). Data were collected from 14 metropolitan centres, 12 other urban centres and 12 rural centres. These centres were selected randomly. Twenty-five households for the metropolitan strata and 34 households for other urban and rural strata were selected randomly from each centre. On average, each household was considered to consist of five members. All members of the selected households were included in the survey.

Data collection procedure

Eight teams were formed for data collection. All members of the teams were physicians led by pulmonologists. In each household, face-to-face interviews were performed with the housewives or other available people using a pre-tested structured questionnaire (prepared on the basis of studies of ECRHS,[3] ISAAC[4] and Usherwood *et al.*[7]) to collect data about all members of the household. Information regarding the household was recorded on the first page of the questionnaire; separate questionnaires were used for each individual member of the household.

Definitions

Children were defined as those aged 5–14 years, adults as people aged ⩾15 years. Children aged <5 years were excluded from the study. Assessment of the economic status of the families was based on questions on family income and expenditure in the month preceding the interview.

'Surplus' meant that income exceeded the expenditure. This is the affluent group having an approximate monthly income >Tk15 000 (>US$300) per month. 'Balance' meant almost equal income and expenditure. This group comprises people with middle income having an approximate monthly income between ⩽Tk15 000 and ⩾Tk3000 (⩽US$300 and ⩾US$60) per month. 'Deficit' indicated when expenditure exceeded the income. This is the poor group having an approximate monthly income <Tk3000 (<US$60) per month.

Wheeze was defined as the whistling sound arising from the chest and not from the nose or throat. Asthma prevalence was defined as the prevalence of recent wheeze (in last 12 months). Ever wheeze was wheeze any time in the past. Doctor diagnosed asthma was the asthma diagnosed by any category of doctor (either qualified or quack). Perceived asthma was the perception of having asthma in adults by themselves or in children by the parents. Night cough was defined as cough at night in the absence of any chest infection or heart disease in last 12 months. 'Night cough, waking' was cough at night, which woke up the person, in the absence of any chest infection or heart disease in the last 12 months.

Statistical analysis

The prevalence of asthma and its different categories were estimated with exact binomial 95% CI. The χ^2 test or χ^2 test for trend were used for the difference between proportions. Age-standardized prevalence rates were calculated for the populations of metropolitan, other urban and rural areas using direct method of standardization. Adjustment was made using the Bangladeshi population of 1991 as reference.[8] Unadjusted odds ratio (OR) with 95% CI based on observed prevalence were calculated to compare the patients with asthma to subjects without asthma. Multiple logistic regression analysis was applied to adjust for confounding among risk factors and to determine the most influential factors on asthma prevalence. The adjusted OR was calculated with a model that included age, sex, household size, economic status, schooling and smoking behaviour. All analyses were performed using SPSS version 7.5 for Windows.

Results

A total of 963 families were studied covering 5642 people. Table 1 shows the population characteristics of the studied population.

The prevalence of recent wheeze (asthma) was 6.9% (95% CI : 6.2–7.6). The distribution of different categories of asthma definitions among children (5–14 years), adults (15–44 years) and all ages (5+ years) is shown in Table 2. Table 2 demonstrates that the prevalence of asthma in childhood (5–14 years) was higher than that in adults (15–44 years) for all categories of asthma except night cough and 'night cough, waking' which were more prevalent in adults.

The prevalence of asthma was similar in metropolitan areas 6.6% (95% CI : 5.5–7.8), other urban areas 7.8% (95% CI : 6.5–9.05) and rural areas 7.0% (95% CI : 5.7–8.0), when age was adjusted for.

Younger children of 5–9 years and adults of 35–44 years were more likely to suffer from asthma than children aged 10–14 years or younger adults, respectively (Tables 3 and 4). Small households (⩽3 members) were found to be more vulnerable (OR = 2.20, 95% CI : 1.24–3.20) to childhood asthma than larger households (⩾7 members). When considering all age groups, the 'deficit' group (OR = 1.41, 95% CI : 1.04–1.92) as well as the illiterate group (OR = 1.51, 95% CI : 1.01–2.24) were found to be more vulnerable to asthma attacks than the 'surplus' group and the more educated group, respectively.

The risk of asthma was greater among active smokers than non-smokers. The group most affected by asthma were the smokers with a history of smoking of more than 15 pack-years

Table 1 Population characteristics (n = 5642)

Characteristics	No.	Percentage (%)
Sex		
Male	2881	51.1
Female	2761	48.9
Age distribution (years)		
5–14	1571	27.8
15–44	3006	53.3
45+	1065	18.9
Economic status of households (n = 963)		
Surplus budget	252	26.2
Balanced budget	428	44.4
Deficit budget	278	28.9
No reply	5	0.5
Education level		
Illiterate	1327	23.5
Primary (5 years of schooling)	1818	32.2
Secondary (10 years of schooling)	1566	27.8
⩾Higher secondary	931	16.5
Occupations		
Students	1868	33.1
Housewives	1322	23.4
Service holders	580	10.3
Agricultural work	374	6.6
Day labour	164	2.9

(OR = 2.37, 95% CI : 1.04–5.41), as compared with the non-smokers.

When considering only the oldest age group (45+ years), asthma was found to be more prevalent in illiterate people (OR = 2.69, 95% CI : 1.17–6.15) and populations living in other urban areas (OR = 1.69, 95% CI : 1.05–2.70).

Discussion

This population-based study confirms that the prevalence of asthma in Bangladesh is high. The prevalence among children was found to be higher than among adults. Children under 5 years were excluded from the study. It seems likely that respiratory viral infections have an important part to play in the production of wheeze in young children.[9] Asthma is also more prevalent in people belonging to lower socioeconomic groups and adult populations of lower educational status.

This nationwide study provided the first opportunity to examine reported asthma symptoms in children and the adult population of Bangladesh. A standard methodology including stratified random sampling covering the whole country was followed. The instrument used in the study has been adapted from the ECRSH[3], ISAAC[4] and Usherwood[7] questionnaires. Respiratory physicians were directly involved in the data collection process in the field.

Nonetheless, the study has a number of limitations. The first limitation of the study is the mode of ascertainment of asthma cases. The diagnosis was on the basis of reported symptoms ever and recent. This method of diagnosis could inflate the number of asthma cases due to similar presentation resulting from other diseases. On the other hand, the number of cases could be under-reported due to the long recall period. For population-based epidemiological studies, there is no satisfactory definition or 'gold standard' diagnostic investigation for asthma. In common with most epidemiological studies on asthma, the symptoms suggestive of asthma and parental awareness were relied upon. In the stratification of economic status, there is no standard methodology for quick assessment in the community. We grouped the studied population on the basis of preceding month's income and expenditure into 'deficit', 'balanced' and 'surplus' groups. However, this method does not reflect the actual economic status of the family as perception of solvency varies among various strata of people.

The prevalence of childhood asthma (7.3%) is much lower than that of the developed countries like the UK (29%), Australia (30%), New Zealand (30%) and USA (21%) but similar to those of regional countries like Pakistan (8%) and India (7%).[10] In general terms, higher prevalence rates have been found among children from 'westernized' countries than in developing countries in Asia and Africa. These differences may be real or may reflect study methodology. The children of Bangladesh are very prone to infections like measles, tuberculosis, and helminthes. The prevalence of measles in children under 5 years and below 9 months was found to be 1.5% and 17.8%, respectively.[11] The prevalence of tuberculosis in the Bangladeshi population was 0.5% of the total population.[12] The prevalence of geohelminths in school children (age 5–14 years) by stool microscopy showed *Ascaris lumbricoides* in 69%, *Trichuris trichura* in 39% and *Ankylostoma duodenale* in 8%.[13] The infections of tuberculosis and measles are protective against the development of asthma.[14–16] Helminthic infections also appear to protect against asthma.[17]

Table 2 Prevalence of asthma features by age groups

	No. and prevalence			
Asthma features	Children (5–14 years) n = 1571	Adults (15–44 years) n = 3006	Adults (45+ years) n = 1065	All age groups (5+ years) n = 5642
Ever wheeze	141 (9%)	186 (6.2%)	125 (11.8%)	453 (8.0%)
Recent wheeze	114 (7.3%)	158 (5.3%)	117 (11.0%)	389 (6.9%)
Perceived asthma	134 (8.5%)	168 (5.6%)	125 (11.8%)	428 (7.6%)
Doctor diagnosed asthma	69 (4.4%)	105 (3.5%)	73 (6.9%)	248 (4.4%)
Night cough	104 (6.6%)	273 (9.1%)	193 (18.1%)	568 (10.1%)
Night cough, waking	108 (6.9%)	226 (7.5%)	170 (16.0%)	500 (8.9%)

Table 3 Crude and adjusted odds ratio (OR) and 95% CI for the association of selected risk factors and asthma among Bangladeshi population of 5–14 years

Variables	No.	Asthmatic	Non-asthmatic	OR	95% CI	Adjusted OR[a]	95% CI
Age (years)							
10–14	875	53	822	1			
5–9	696	61	635	1.49	1.01–2.22	1.25	0.83–1.90
Sex							
Female	799	56	743	1			
Male	772	58	714	1.08	0.72–1.61	1.05	0.72–1.55
Schooling							
Secondary	296	30	266	1			
Primary	972	70	902	0.69	0.43–1.11	0.55	0.27–1.16
Illiterate	303	13	290	0.40	0.19–0.81	0.74	0.74–1.17
Geographical location							
Metropolitan	452	22	430	1			
Other urban	525	40	485	1.61	0.92–2.85	1.58	0.92–2.72
Rural	594	52	542	1.88	1.09–3.24	1.76	1.04–2.98
Economic status							
Surplus	350	20	330	1			
Balanced	704	43	631	1.12	0.63–2.02	0.99	0.57–1.73
Deficit	517	48	469	1.69	0.96–3.01	1.39	0.80–2.43
Household size							
7+	769	54	715	1			
4–6	652	40	612	0.87	0.56–1.35	1.16	0.76–1.77
⩽3	150	20	130	2.04	1.14–3.62	2.20	1.24–3.20

[a] Variables mutually adjusted for each other.

Asthma was found to be more prevalent in children aged 5–14 years (7.3%) than in the adults of 15–44 years (5.3%) even after controlling for sex, household size, economic status and schooling. A similar finding was observed in Australia where asthma affects approximately one in five children and one in ten adults.[18]

Children in small households (⩽3) were more vulnerable to asthma. The explanation might be that respiratory infections are less likely to occur in these less crowded households as compared to larger households where respiratory infections are more prevalent. It is proposed that certain viral infections early in life may be protective against the development of allergic disease.[19] Declining family size, improvements in household amenities and higher standards of personal cleanliness have reduced the opportunity for cross infection in young families. This may have resulted in more widespread clinical expression of atopic disease.[20] The prevalence of asthma was significantly higher in the less privileged social classes like the 'deficit' and illiterate groups within the population. These findings are in concordance with the studies conducted in New York City where rates of hospitalization because of asthma were generally higher in poor, unemployed and less educated residents.[21,22]

Interestingly, our study shows that asthma is equally prevalent in metropolitan areas, in other urban areas and in rural areas. Though the city areas are highly polluted compared to rural and other areas, there is no definite basis that macro-environmental factors such as climate and pollution are important determinants of regional variations of asthma severity. It is fashionable to ascribe the recent increase in the prevalence of asthma to atmospheric pollutants, such as nitrogen oxides, which have been implicated in the high prevalence of respiratory symptoms and asthma in western society. Pollution can undoubtedly trigger asthmatic attacks and be detrimental to lung function but the evidence regarding the role of pollutants in the development of asthma is much less convincing.[23,24] These factors are possibly important in causing variations over a short period of time. A German study also supports this view, as no significant difference was shown in the lifetime prevalence of wheeze in two areas differing in pollution levels.[25]

The risk of asthma was greater among active smokers than non-smokers in this study. Cigarette smoking is a powerful risk factor for the development of chronic mucus hypersecretion and progressive airflow obstruction in middle and old age.[26] The 4-year incidence of doctor diagnosed asthma among people aged 10–39 years in Tucson, Arizona, was three times greater among smokers than among non-smokers at the start of the observation period.[27]

Further studies need to be done to look into the details of risk factors and protective elements for the development of asthma in Bangladesh.

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Table 4 Crude and adjusted odds ratio (OR) and 95% CI for the association of selected risk factors and asthma among Bangladeshi population of 15–44 years

Variables	No.	Asthmatic	Non-asthmatic	OR	95% CI	Adjusted OR[a]	95% CI
Age (years)							
15–24	1381	53	1328	1			
25–34	946	53	893	1.49	0.99–2.24	1.44	0.93–2.20
35–44	679	52	627	2.08	1.34–3.14	1.88	1.18–3.00
Sex							
Male	1514	74	1440	1			
Female	1492	84	1408	1.16	0.83–1.62	1.30	0.80–2.14
Occupation							
Housewife	938	56	882	1			
Labour	100	8	92	1.37	0.58–3.09	1.43	0.60–3.46
Agriculture work	205	10	195	0.81	0.38–1.67	1.03	0.44–2.44
Schooling							
Secondary+	748	35	713	1			
Primary	1055	53	1002	1.08	0.68–1.71	1.01	0.57–1.79
Illiterate	607	38	569	1.36	0.83–2.24	0.93	0.52–1.65
Geographical location							
Metropolitan	1050	52	998	1			
Other urban	1011	65	946	1.32	0.89–1.89	1.29	0.88–1.91
Rural	945	41	904	0.87	0.56–1.35	0.81	0.51–1.65
Economic status							
Surplus	830	42	788	1			
Balanced	1362	63	1299	0.89	0.58–1.35	0.93	0.61–1.40
Deficit	814	53	761	1.31	0.84–2.02	1.34	0.85–2.14
Household size							
7+	1705	95	1610	1			
4–6	1196	63	1299	0.82	0.59–1.15	0.75	0.53–1.06
≤3	105	11	94	1.98	0.97–3.96	1.69	0.86–3.32
Smoking history							
No smoking	2550	128	2422	1			
1–14 pack-years	386	21	365	1.09	0.66–1.79	1.10	0.63–1.92
15+ pack-years	70	9	61	2.79	1.26–5.97	2.37	1.04–5.41

[a] Variables mutually adjusted for each other.

KEY MESSAGES

- Prevalence of asthma in Bangladeshis substantial; it is higher among children (<15 years) than adults.
- The prevalence of asthma in Bangladesh is similar to neighbouring countries but lower than in developed countries.
- Asthma is more common in families with fewer children.
- Asthma is more prevalent in poor and illiterate groups of people.

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Commentary: Does the 'hygiene hypothesis' provide an explanation for the relatively low prevalence of asthma in Bangladesh?

Charlotte Braun-Fahrländer

The prevalence of childhood asthma in Bangladesh is much lower than in developed countries, but similar to those of other countries in this region like Pakistan and India.[1] These differences in asthma prevalence may be attributed to a 'western lifestyle', which among other factors is characterized by a higher level of hygiene, lower rates of infections, and small family size. Among the Bangladeshi children, those living in small families (three or less people) were more likely to suffer from asthma. The observation of an inverse relation between sibship size and atopy formed the basis of what is known today as the 'hygiene hypothesis'.[2] The immunological extension of this concept is the distinction of Th1 and Th2 lymphocyte populations in laboratory animals and the recognition that 'natural immunity'

Department of Environment and Health, Institute of Social and Preventive Medicine, University of Basel, Steinengraben 49, 4051 Basel, Switzerland.

to bacterial and viral infections induce a Th1 pattern of cytokine release, potentially suppressing the Th2 immune response involved in IgE mediated allergy. Thus, changes in the level of stimulation from the microbial environment associated with improvements in public health and hygiene may have indirectly influenced the postnatal development of immune functions, so as to increase predisposition to chronic allergic conditions during childhood.[3]

The high rates of respiratory infections, tuberculosis, measles and helminths infections in Bangladeshi children might thus contribute to lower rates of allergy. There is, however, conflicting evidence whether early (viral) infections may enhance or decrease the risk of developing asthma. A recent longitudinal birth cohort study from Germany showed that repeated lower respiratory tract infections early in life were positively associated with subsequent development of asthma, wheeze, and bronchial hyperreactivity. In contrast, early episodes of other infections (particularly viral infections) were inversely related to the development of asthma at age 7.[4] Reverse causation seems a plausible explanation for the positive association between lower respiratory tract infections and subsequent wheeze and asthma, with lower respiratory tract infections being predictors of, rather than risk factors for, asthma.

Epidemiological evidence supporting the 'hygiene hypothesis' can further be found in studies of Italian military cadets. Respiratory allergies were less frequent in cadets with antibodies against hepatitis A virus and were inversely related to other orofecal and foodborne infections.[5] These types of infections are likely to play an important role in countries like Bangladesh.

Studies in rural areas of Central Europe have shown that growing up on a farm and more specifically contact to farm animals was associated with a substantial decrease in risk for the development of hay fever and asthma, when children from farming families were compared to their peers living in the same villages.[6,7] Whether increased exposure to microbial compounds has to occur early in life to affect maturation of the immune system, thereby reducing the risk for development of allergic diseases has recently been investigated in a cross-sectional study in Switzerland, Austria and Germany.[8] Exposure of children younger than one year, compared with those aged 1–5 years, to stables and consumption of farm milk was associated with lower frequencies of asthma, hay fever and atopic sensitization. The results of these studies provide further evidence for the hygiene hypothesis and may in part explain the lower rates of asthma and allergy found in rural communities as compared to urban ones.

In Bangladesh, asthma was equally prevalent in metropolitan areas, in other urban areas and in rural areas. Thus, the effect of farming seen in European studies was not observed in Bangladesh. In a recent case-control study on indoor exposures and childhood asthma in Nepal, keeping cattle inside of the family home was associated with a risk reduction for asthma whereas keeping cattle outside of the home had no protective effect.[9] Thus, it is conceivable that there might be variations in asthma prevalence in Bangladesh associated with keeping cattle indoors. Alternatively, if exposure to infections and unhygienic drinking water is the main source of microbial stimulation of Bangladeshi children, and if these exposures are evenly distributed between metropolitan areas, urban areas and rural communities, no variation in asthma prevalence would be expected.

In conclusion, the hygiene hypothesis may at least in part explain the lower prevalence of asthma observed in Bangladesh as compared to developed countries. However, the prevalence of asthma in Bangladesh is substantial and represents an important public health problem which might increase in parallel with the economical development of the country.

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