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The Impact of Asthma and Allergic Diseases on Schoolchildren: Are They at Increased Risk of Absenteeism and Poor School Performance?

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1. Introduction

1.1 Asthma and allergic diseases in children

Asthma is the most common chronic illness of childhood in both developed and developing countries and there is a wide concensus that asthma and allergies have become more prevalent among children (Robertson et al., 2004). Among children, higher prevalence rates of asthma have been found in industrialized western countries than in developing countries in Asia and Africa (Beasley et al., 2000). In some western countries, the prevalence of asthma and allergies has reached alarming proportions, affecting more than one-third of the children within the general population (Khaldi et al., 2005). It appears that differences in asthma prevalence between population groups are due to differential exposure to environmental factors: genetic variations alone could not account for the risk in the prevalence of disease over a few decades. Allergen exposure in early life appears to correlate with sensitization and expression of asthma and atopy. Lifestyle factors including diet and ambient air pollution may be disease modifiers (Shapiro & Stout, 2002).

Air pollution has a positive and significant effect on asthma exacerbation. A cohort study on asthma and exposure to ozone reported that pollution has been associated with new onset asthma as well as other respiratory diseases (McConnell et al., 2002). Urban atmospheric pollution has a well known impact on acute and chronic respiratory disease. The United Nations estimated that over 600 million people in urban areas worldwide were exposed to dangerous levels of traffic generated air pollutants (Cacciola et al., 2002). There is substantial epidemiological evidence indicating a link between respiratory and cardiovascular morbidity and outdoor air pollution levels (Bener et al., 2009).

1.2 Magnitude of asthma and allergic diseases

A recent study on asthma reported a high prevalence of asthma among Qatari children(Janahi et al., 2006). The rapid growth and changing environmental and social conditions in the State of Qatar affected the prevalence of allergic diseases in Qatar. Exposure to air pollution has been considered to be one of the leading factors in public health problems in oil-rich developing countries. In Qatar, air pollution originates mostly

from motor vehicle exhaust fumes and industry fumes. As a result, concentrations of CO, NO_2, O_3 and airborne particles are generally high. Air pollution in Qatar has been a contributing factor for the high prevalence of asthma and related allergic diseases. Air pollution is a worldwide problem related to densely populated urban areas and to heavily industrialized regions.

1.3 School failures a problem

Asthma is the most common chronic illness among school children and an important cause of school absenteeism and reduced participation in sports and other activities (Maziak et al., 2003). Asthma is the principal cause of school absences due to chronic disease in childhood accounting for 20% of school days lost among elementary and high school students. Education is one of the main foundations for the child's development and also for national human resource development. Chronic illness may lead to school failure by increasing school absence during exacerbations. The characteristics of school failure in Qatar has been studied and found that asthma is one of the leading causes of school absence. Recent studies investigated the relationship between school absenteeism, presence of asthma and air pollution.

2. Methods

2.1 Sampling design

The study included schoolchildren and adolescents in the age group 6 – 18 years, studying in the primary, preparatory and secondary levels in government and private schools in the State of Qatar. This study consists of an amalgamation of three cross-sectional studies conducted among school students on the prevalence of asthma and allergic diseases and their impact on school attendance in children. The first cross sectional study covered 3283 school children aged 6-14 years to determine the prevalence of asthma and allergic diseases among this age group. The second cross sectional study included 31,400 Qatari school children aged 6-12 years to investigate the school absenteeism as a result of asthma and wheezing. The third was a prospective cross sectional study that assessed the factors contributing to school failure among school children studying in grade 1 to 12. Students were recruited from the schools situated in both urban and semi-urban areas of Qatar.

All three studies used a multi-stage stratified random sampling technique which ensured that the school children were selected randomly. The list of names of schools in urban and semi-urban areas was obtained from the Supreme Council for Education and Higher Education. A total of 151,050 students are studying in primary, preparatory and secondary schools. There are 299 schools, of which 152 are boys and 147 for girls located in 21 different districts. During the first stage, one school from each of these 5 districts was selected randomly, thus overcoming the so called 'cluster effect'. Similarly, the classrooms and schoolchildren were selected in the second and third stages using the same simple random sampling procedure. Approval for the study was obtained from the Medical Ethics Committee of the Hamad General Hospital, Hamad Medical Corporation.

2.2 Data collection

Data collection of the three studies was during the years 2003 to 2008. The screening survey for asthma was carried out in the selected schools to represent the entire State of Qatar. The

survey instrument was tested on 125 students and thus validated the questionnaire. All schools have a policy of recording illnesses including asthma and their personal details which were captured by school health nurses. We have used the School Health Registry for obtaining the students information and school absenteeism due to asthma and wheezing. An approval was obtained from the Regional Directors of Education and from individual school principals at all selected schools. Again we had a double confirmation on the data obtained on asthmatic children by using the modified version of the International Study of Asthma and Allergies in Childhood [ISAAC] questionnaire (Vichyanond et al., 1998) and another questionnaire (Bener et al., 1994a). A written consent form was obtained from the parents of each child, after giving an explanation of the aims and nature of the studies. The questionnaires with a letter of explanation in Arabic were distributed to the parents of these children and lived in either urban or semi-urban areas of Qatar.

2.3 Data collection instrument

The International Study of Asthma and Allergies in Childhood (ISAAC) questionnaires included the questions related to asthma and allergic rhinitis. The questions concerning the diagnosis of asthma were "Has the child ever been diagnosed as having asthma by a doctor?", and "has the child ever needed treatment or hospital admission due to asthma?" The diagnosis of Allergic rhinitis was based on questions such as: Has your child ever had a problem with frequent sneezing or prolonged blocked nose during the last six months when he/she did not have a cold or flu? The questions concerning the diagnosis of persistent eczema were as follows: Has your child ever had a dry and itchy red rash for at least 6 months?

2.4 Statistical analysis

Student's t-test (two tailed) was used to determine the significance of any difference between two continuous variables. Chi-square and Fisher exact test were performed to ascertain the association between two or more categorical variables. The level $p<0.05$ was considered as the cut-off value for significance.

3. Discussion

3.1 Prevalence of asthma and allergic diseases

Asthma is the single most prevalent cause of childhood disability. The children with asthma are poorer in health, limited in daily activities and experience more visits to health care professionals and hospitalizations. Despite advances in the understanding of asthma's pathophysiology, there have been increases in the prevalence, morbidity and mortality of children with asthma during the last 2 decades (Mannino et al, 2002). There have been relatively few studies on the relationship between asthma and school absenteeism and performance. Asthma and allergic diseases are the most common childhood chronic disease and continues to be a major cause of morbidity and health service use in Qatar. The most internationally accepted and validated methodology for measuring asthma prevalence in children is through school sampling using the International Study of Asthma and Allergies in Childhood (ISAAC) survey. The screening survey for asthma and allergic diseases is important because asthma prevalence seems to be increasing in rapidly developing urban communities.

In a population based sample of 3283 school children in the age group 6 – 14 years in Qatar, a high prevalence rate of diagnosed asthma (19.8%), allergic rhinitis (30.5%) and pulmonary infection (11.9%) was observed (Janahi et al., 2006). On the whole, the prevalence of asthma decreased with age, while the prevalence of pulmonary infection and throat infection increased with age. There were significant differences in the male-female prevalence rates of asthma and allergic rhinitis in all of the 3 age groups; 6-8 years, 9-11 years and 12-14 years. Prevalence rate of asthma was significantly higher in males (25.6%) than that of the females (13.4%) ($p<0.001$). Allergic rhinitis was significantly higher in boys of 6 – 8 years compared to girls in the same age group (41.3% vs. 29.3%; $p<0.001$). The overall prevalence of throat infection (46.8% vs. 38.3%), pulmonary infection (15.9% vs. 7.5%) and allergic rhinitis (33.2% vs. 27.6%) were found to be significantly higher among males than females ($p<0.001$). (Table 1)

Variables	Number of children											
	6-8 n=1390			9-11 n=1497			12-14 n=396			Overall n=3283		
	n(%)			n(%)			n(%)			n(%)		
	Male N=690	Female N=700	Total N=1390	Male N=808	Female N=689	Total N=1497	Male N=165	Female N=152	Total N=317	Male N=1663	Female N=1541	Total N=3204
Asthma	212 (30.7)***	93 (13.3)	305 (21.9)	177 (21.9)***	94 (13.6)	271 (18.1)	50 (22.9)*	23 (12.9)	73 (18.4)	439 (25.6)***	210 (13.4)	649 (19.8)
Eczema	155 (22.5)	160 (22.9)	315 (22.7)	159 (19.7)	153 (22.2)	312 (20.8)	72 (33.0)*	39 (21.9)	111 (28.0)	386 (22.5)	352 (22.5)	738 (22.5)
Allergic rhinitis	285 (41.3)***	205 (29.3)	490 (35.3)	216 (26.7)	179 (26.0)	395 (26.4)	68 (31.2)	48 (27.0)	116 (29.3)	569 (33.2)***	432 (27.6)	1001 (30.5)
Throat infection	314 (45.5)**	267 (38.1)	581 (41.8)	380 (47.0)**	273 (39.6)	653 (43.6)	109 (50.0)**	60 (33.7)	169 (42.7)	803 (46.8)***	600 (38.3)	1403 (42.7)
Pulmonary infection	85 (12.3)**	48 (6.9)	133 (9.6)	152 (18.8)***	58 (8.4)	210 (14.0)	36 (16.5)**	11 (6.2)	47 (11.9)	273 (15.9)***	117 (7.5)	390 (11.9)

* $p<0.05$; ** $p<0.01$; ***$p<0.001$ (Difference between males and females in the group)
**** Bener et al.,2005

Table 1. Prevalence rate of bronchial asthma, eczema and allergic rhinitis and other respiratory disorders in Qatari school children 6-14 years compared by gender****

The Venn diagram shows the asthma overlapping with allergic rhinitis and eczema. 71.9% of the children who had asthma also had either allergic rhinitis or eczema. 5.1% had all three diseases. Asthma with allergic rhinitis was 11.8% and asthma with eczema was 7.5%. (Figure 1)

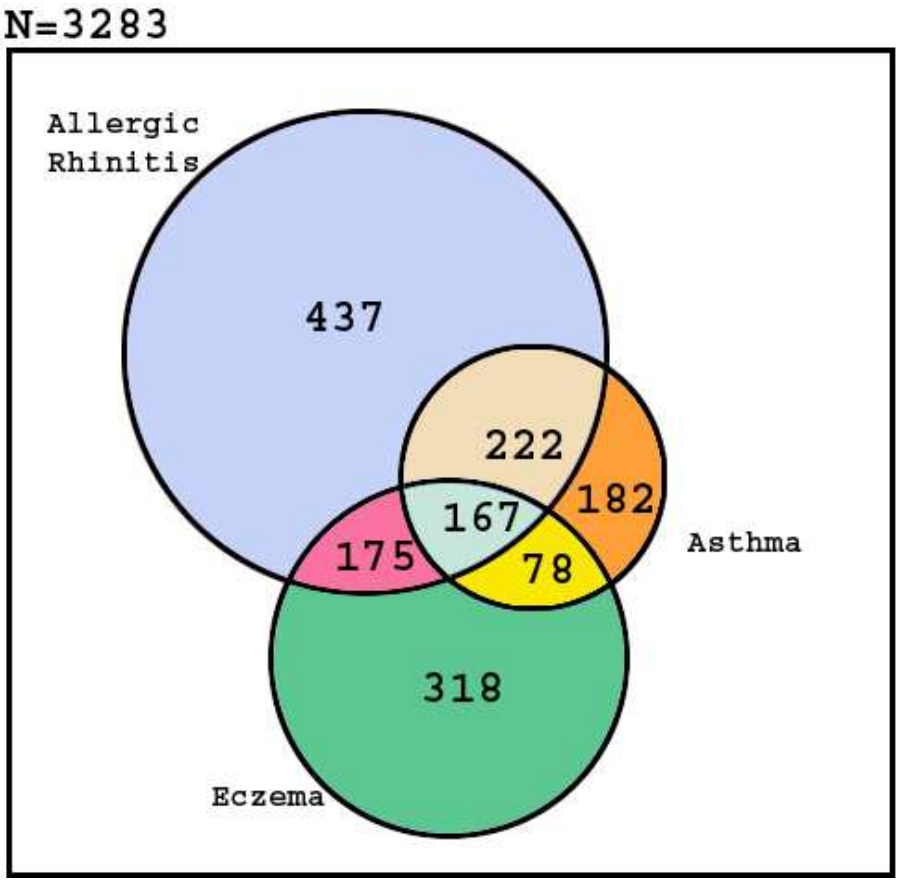

Fig. 1. Venn diagram showing the overlapping of asthma with allergic rhinitis and eczema

Another cross-sectional population based study of 31,400 primary children aged 6 -12 years revealed that 10.4% of them were reported with asthma and wheezing, with a higher frequency among boys (12.2%) than girls (8.6%) (Bener et al., 2007). (Table 2)

Variables	Boys	Girls	Total
Primary school students	n(%)	n(%)	N (%)
Number of primary school Students	16,130 (51.4%)	15,270 (48.6)	31,400 (100%)
School Registry Asthma and Wheezing	1,962 (12.2%)	1,308 (8.6%)	3,270 (10.4%)

*Bener et al., 2007

Table 2. Frequency of asthma, allergic rhinitis and wheezing in school children in the State of Qatar*

The comparison in prevalence of bronchial asthma and allergic rhinitis between Qatar with the neighbouring countries revealed that the prevalence of asthma (19.8%) and allergic rhinitis (30.5%) was significantly higher in school children in Qatar compared to U.A.E (13.6% & 22.9%; p<0.001) and Saudi Arabia (6.8% & 17.9%; p<0.001). These results show that allergic rhinitis is more frequent among school children than asthma in Arabian Gulf countries. The prevalence rate of asthma (11.8% vs. 9%) and allergic rhinitis (18.5% vs. 17.5%) was higher among mothers than fathers. The morbidity pattern of the asthma and allergic diseases was similar in these three Gulf countries. (Table 3)

Variable		Qatar* N=3283 n(%)	UAE** N=729	P value	Saudi Arabia*** N=3041 n(%)	P value
Child						
	Asthma	649(19.8)	99(13.6)	<0.001	207(6.8)	<0.001
	Allergic Rhinitis	1001(30.5)	167(22.9)	<0.001	544(17.9)	<0.001
	Eczema	738(22.5)	100(13.7)	<0.001	329(10.8)	<0.001
Paternal history						
	Asthma	297(9.0)	43(5.9)	0.007	137(4.5)	<0.001
	Allergic Rhinitis	575(17.5)	79(10.8)	<0.001	319(10.5)	<0.001
	Eczema	444(13.5)	76(10.4)	0.021	109(3.6)	<0.001
Maternal						
	Asthma	388(11.8)	39(5.3)	<0.001	135(4.4)	<0.001
	Allergic Rhinitis	608(18.5)	117(16.0)	NS	317(10.4)	<0.001
	Eczema	486(14.8)	64(8.8)	<0.001	114(3.7)	<0.001

*Bener et al., 2005 **Behbehani et al.,2000 *** Al-Frayh et al., 1993

Table 3. Prevalence of bronchial asthma and allergic rhinitis of school children in Qatar, UAE and Saudi Arabia

The rise in prevalence found in Gulf countries is consistent with a variety of independent studies of asthma prevalence trends conducted in the United States and other industrialized countries (Urick et al., 1996; Anderson et al., 1994). The prevalence rates of asthma in the UK (15.2%) (Doull et al., 1996) and France (14.9%) (Fontaine et al., 1999) was comparable to the rates found in the Gulf countries

The logistic regression analysis of factors involved in the etiology of asthma in our study of genetic and environmental risk factors associated with asthma showed parental asthmatic to be the significant factor after adjusting for confounding factors (Bener et al, 2005) (Table 4). In addition, our results showed that father smoking was a significant risk factor for asthma among children, which is consistent with previous reported studies (Bener et al., 1996; Jenkins et al., 1993).

Independent Variables	Relative Risk	95% Confidence Interval	p – value significance
Allergic to food	2.161	(1.641-2.846)	0.0001
Allergic to medicine	2.905	(1.736-4.861)	0.0001
Father asthmatic	2.332	(1.763-3.085)	0.0001
Mother asthmatic	1.786	(1.383-2.305)	0.0001
Sibling asthmatic	2.921	(2.368-3.603)	0.0001
Asthma in second degree relative	1.623	(1.318-1.999)	0.0001
Father smoking	1.402	(1.145-1.717)	0.001

Table 4. Genetic and environmental risk factors associated with asthma as estimated by stepwise logistic regression analysis (Bener et al., 2005).

3.2 Absenteeism among children with asthma

Numerous studies have documented that asthma is the principal cause of school absences due to chronic disease in childhood, accounting for 20% of school days lost for elementary and high school students. Few studies report difficulties for these children at school, mainly absence due to asthma and difficulties in physical education.

The studies conducted in Qatar showed a correlation between asthma and high rates of student absenteeism. Asthmatic children (34.7%) were more absent from school than the healthy peers (22.8%). Absenteeism was observed more in asthmatic children studying in primary (14.8% vs. 10%) and intermediate levels (50.3% vs. 45.8%) than the children without asthma. Among the children with asthma, Boys (55.6%) were absent more frequently than girls (44.4%). 77.5% of the children with asthma were Qatari children (Table 5).

Variable		Asthmatic Children		Non-Asthmatic Children	
		Number of Students Without Absence n=487 n(%)	Number of Absentees n=169 n (%)	Number of Students Without Absence n=2099 n(%)	Number of Absentees n=478 n(%)
Grade					
Primary (Grade 1-6)		66(13.6)	25(14.8)	529(25.2)	48(10.0)
Intermediate (Grade 7-9)		253(52.0)	85(50.3)	804(38.3)	219(45.8)
Secondary (Grade 10-12)		168(34.5)	59(34.9)	766(36.5)	211(44.1)
Gender	Boys	281(57.7)	94(55.6)	1182(56.3)	264(55.2)
	Girls	206(42.3)	75(44.4)	917(43.7)	214(44.8)
Nationality	Qatari	384(78.9)	131(77.5)	1446(68.9)	327(68.4)
	Non-Qatari	103(21.1)	38(22.5)	653(31.1)	151(31.6)

Table 5. Distribution of students absent from the school according to asthma status (Bener et al., 2007).

Our study on the impact of asthma and air pollution on school attendance of primary school children revealed that a good proportion of the primary children were absent from school because of asthma and wheezing in the studied academic year (Bener et al., 2007). A majority of the asthmatic children were absent for 1-5 days (29%), followed by 6 – 10 days (23%). Similarly, 26.7% of the total children with allergic rhinitis were absent for 1-5 days and 6 – 10 days (26.1%). There was a statistically significant difference between asthmatic and wheezing students in number of days absent from the school ($p<0.0001$). (Table 6)

Allergic disease	Number of days absent from school						
	None	1-5	6-10	11-15	16-20	>20	Total
Asthma	583	605	479	177	160	79	2083
Wheezing Children	280	262	234	79	60	21	936
Allergic Rhinitis	704	668	651	230	182	63	2498
Total	1567	1535	1364	486	402	163	5517

P<0.001 (very highly statistically significant)

Table 6. Number of days absent from school due to asthma, wheezing and allergic rhinitis among the primary school children during the academic year, 2003-2004 (Bener et al., 2007).

Most absenteeism occurred during the spring/summer season for both boys (45%) and girls (47%), followed by autumn for boys (33%) and girls (36%). Girls were more absent from asthma and allergic diseases during autumn (36% vs. 33%), and spring/summer (47% vs. 45%) when compared with boys. (Table 7)

Seasons	Boys Frequency of absent (%)	Girls Frequency of absent (%)	Total
Autumn	532(33%)	327(36%)	859
Winter	355(22%)	163(17%)	508
Spring/Summer	724(45%)	425(47%)	1149
Total	1611(100%)	905(100%)	1255

P = 0.036 (Statistically significant)

Table 7. Number of Days absent from school due to asthma and wheezing by season (Bener et al. 2007).

Absenteeism was reported more frequently among asthmatic children (34.7%) in Qatar compared to non-asthmatic children (22.8%). Most studies confirmed our findings and demonstrated that students with asthma miss more school days than students without asthma (Milton et al., 2004). The majority of the asthmatic children in Qatar were absent for 1 – 5 days which is similar to a study done in Rochester, Minnesota which found that public school children with asthma had 2 excess days of absenteeism per year compared to their healthy peers (Silverstein et al., 2001). In the UAE, the number of days absent from school ranged from none to more than twenty days in the academic year and the median absence was 6 days in the diagnosed asthmatic group and 5 days among wheezing children (Bener et al., 1994b). Similarly in Saudi Arabia school absenteeism was higher among asthmatic children (13.6 days/year), while it was lower among their non-asthmatic counterparts (3.7 days) (Al-Dawood et al., 2002). A cross sectional study conducted in the USA, demonstrated that children with asthma averaged 7.6 school days absent compared with 2.5 days in the non-asthmatic group (Fowler et al., 1992). The Centers for Disease Control and Prevention documented that in the USA, asthma accounted for almost 13 million missed school days and 2.5% of all outpatient visits for children younger than 18 years in 2004. (Akinbami et al, 2006).

In Qatar, 50.3% of the absenteeism was observed in asthmatic children studying in intermediate level (aged 12 – 14 years). In the United Arab Emirates, 57% of asthmatic children aged 6-9 years missed at least 1 day of school compared with 42% in 10-14 year old similar children (Bener et al., 1994b). It is possible that increased absenteeism in younger asthmatic children due to the fact that asthma exacerbations are more severe in younger children. But in Qatar, more absenteeism was reported among older children. In contrast, a study of Los Angeles Inner City schools found that younger known asthmatic students missed school more than older ones (Bonilla et al; 2005). Five-year-old children with asthma missed about twice as much school as 10 to 11 year old children with asthma. All these studies show that asthmatic children have more absenteeism days than non-asthmatic ones.

3.3 Asthma and school performance

Children with asthma may be at risk for decreased school performance for a number of reasons including increased absenteeism, iatrogenic effects of asthma medication, teachers' or parents' perception that the child is too vulnerable to participate in school activities. An assessment of school performance of asthmatic children compared with non-asthmatic children was done in table 8. The data showed that school performance of asthmatic children was poor and they were scholastically backward. Nearly half of the asthmatic children had learning disabilities (42.3%) and poor in doing homework (50.1%). Asthmatic children had poor school performance; they were disturbance to other students (44.4%), trouble maker at school (25.1%) and had a tendency to runaway from school (15.4%).

Children with asthma are conceivably at risk for decreased school functioning and it could be due to acute exacerbation of the disease, asthma medication, poor medical management of the disease and increased absenteeism. The studied children with asthma were more likely to have activity limitations than non asthmatic children.(Table 8)

School absences due to asthma has been found more harmful academically because prolonged absences from school may contribute significantly to negative school performance. It was found from the results that children with asthma were often confronted

with educational difficulties and disruption resulting from frequent absences. The National Maternal and Infant Health Survey documented that children with asthma were at 1.7 times greater risk for a learning disability (Fowler et al., 1992).

School performance	Asthmatic	Non-Asthmatic	*P-Value*
	n(%) n=487	n(%) n=2099	
Student hates school	131(26.9)	703(33.5)	0.344
Students hates certain subjects	309(63.4)	1352(64.4)	0.899
Students hates certain teachers	188(38.6)	728(34.7)	0.600
Students hates school system	113(23.2)	479(22.8)	0.959
Doesn't do homework	244(50.1)	886(42.2)	0.292
Runaway from school	75(15.4)	246(11.7)	0.447
Trouble maker at school	122(25.1)	359(17.1)	0.167
Learning disabilities	206(42.3)	684(32.6)	0.171
Side talks in the class room/disturb other students	216(44.4)	791(37.7)	0.370

Table 8. Assessment of school performance among school children in Qatar according to asthma status (Bener et al., 2007).

3.4 Asthma and academic performance

Education is one of the most important aspects of human resources development. Every child should have the opportunity to achieve his or her academic potential. But, it was noticed that the studied asthmatic children were more likely to have poor academic results than those without asthma. More than half of the asthmatic children had poor examination scores; poor (34.5%) and average (31.4%) with a significant difference compared with healthy peers ($p<0.001$). Similar patterns were observed among children with allergic rhinitis, wheezing and allergic diseases. Children with allergic rhinitis (35.4%), wheezing (31.9%), and allergic diseases (30.6%) scored poor grade in their examinations. More than half of the asthmatic children were significantly below average in their academic performance compared to those without asthma ($p<0.001$). These results showed that school performance and examination scores were both influenced by the asthma incidence and the effectiveness of the management of the asthma. (Table 9).

Similar to the results on academic performance of asthmatic children in Qatar, Fowler et al (1992) noted a greater likelihood of grade failure among children with asthma compared with healthy children in a population based sample of American children in grades 1 to 12. The study observed negative correlations between absenteeism from asthma and academic performance.

Variables	Academic performance					P-Value
	Total n(%)	Poor n(%)	Average n(%)	Good n (%)	Very Good n (%)	
Asthmatic						
Yes	487 (100)	168 (34.5)	153 (31.4)	112 (23.0)	54 (11.0)	<0.001
No	2099 (99.9)	171 (8.1)	529 (25.2)	807 (38.4)	592 (28.2)	
Allergic rhinitis						
Yes	659 (100)	233 (35.4)	189 (28.7)	161 (24.4)	76 (11.5)	<0.001
No	1927 (100)	149 (8.0)	493 (25.6)	742 (38.5)	543 (28.2)	
Wheezing						
Yes	216 (99.9)	69 (31.9)	67 (31.0)	51 (23.6)	29 (13.4)	<0.001
No	2370 (100)	196 (8.3)	615 (25.9)	906 (38.2)	653 (27.6)	
Allergic Diseases						
Yes	294 (100)	90 (30.6)	89 (30.3)	73 (24.8)	42 (14.3)	<0.001
No	2292 (100)	183 (8.0)	593 (25.9)	885 (38.6)	631 (27.5)	

Table 9. Assessment of academic performance in school children in Qatar according to asthma status (Bener et al., 2007).

3.5 Asthma and behavioral problems

Behavioral problems were more persistent among asthmatic children compared to those without asthma. This is evident from the data of the school children that most of the parents of children with asthma reported behavioral problems more than the parents of those without asthma. A good proportion of the parents of asthmatic children compared to parents of non-asthmatic children, indicated that their children had behavioral problems like anxiety (65.3% vs. 42.8%), exam fear (77% vs. 70.1%), shyness (44.1% vs. 29.3%), anger (50.1% vs. 34.7%), violent behaviour (19.3% vs. 9.6%) and fights among peers (32.6% vs. 21.3%). (Table 10)

Similar to our study findings on the behavioural problems of school children with asthma, Halterman et al (2006) indicated that those children with persistent asthma scored worse on peer interactions and task orientation and were more likely to exhibit shy and anxious behaviors compared with non-asthmatic children. Mcquaid et al (2001) reported that associations between asthma and reading problems, grade repetition, learning disabilities and behavioral problems were observed in asthmatic children.

Behavioural Problems	Studied school children		*P-Value*
	Asthmatic n=487 n(%)	Non-Asthmatic n=2099 n(%)	
Anxiety	318(65.3)	898(42.8)	0.002
Fear	197(40.5)	798(38.0)	0.745
Exam fear	375(77.0)	1471(70.1)	0.310
Shy	215(44.1)	615(29.3)	0.031
Day dream	131(26.9)	434(20.7)	0.306
Jealousy	131(26.9)	277(13.2)	0.010
Anger	244(50.1)	728(34.7)	0.034
Stealing	75(15.4)	183(8.7)	0.127
Selfish	37(7.6)	145(6.9)	0.832
Cheating	84(17.2)	277(13.2)	0.420
Violent behaviour	94(19.3)	202(9.6)	0.038
Low self esteem	215(44.1)	665(31.7)	0.076
Bad peers	103(21.1)	497(23.7)	0.692
Fights among peers	159(32.6)	447(21.3)	0.068

Table 10. Assessment of behavioral problems among the studied school children in Qatar according to asthma status (Bener et al, 2007).

3.6 Asthma and air pollution

Academic performance can be affected by pollution through four mechanisms: absenteeism due to asthma caused by pollution, attention problems in school due to asthma caused by pollution, fatigue in doing school work due to asthma caused by pollution and negative effect of pollution on brain development (Bener et al., 2007).

The cross sectional study among 31,400 primary school students aged 6-12 years in Qatar confirmed that there was a seasonal influence of asthma and wheezing on school attendance among students in spring/summer and autumn seasons and air pollution was very high during that period. It was noted from the figure that the measured pollutants peaked the highest in spring and summer season and asthma adversely affected school attendance rates during that time. (Figure 2)

These results support the fact that air pollution has an impact on asthma. This is in agreement with other studies of two populations of Australian (Peat et al., 1987) and United Arab Emirates (Bener et al., 1994b) that high prevalence of asthma was found in primary school children during spring/summer seasons which led to more absenteeism from school.

Air pollution has been associated with a number of detrimental health effects for children especially respiratory diseases. A study evaluating the impact of air pollution on respiratory diseases showed that there was an association between increasing air pollutant levels and patients admitted for respiratory diseases (Bener et al., 2009). The data showed that as the

concentrations of NO_2 and O_3, increased, there was an increase in the number of admissions from respiratory diseases. Ozone had a statistically significant effect on both upper respiratory and lower respiratory illness rates. This shows a positive association between air pollution and respiratory diseases (Table 11).

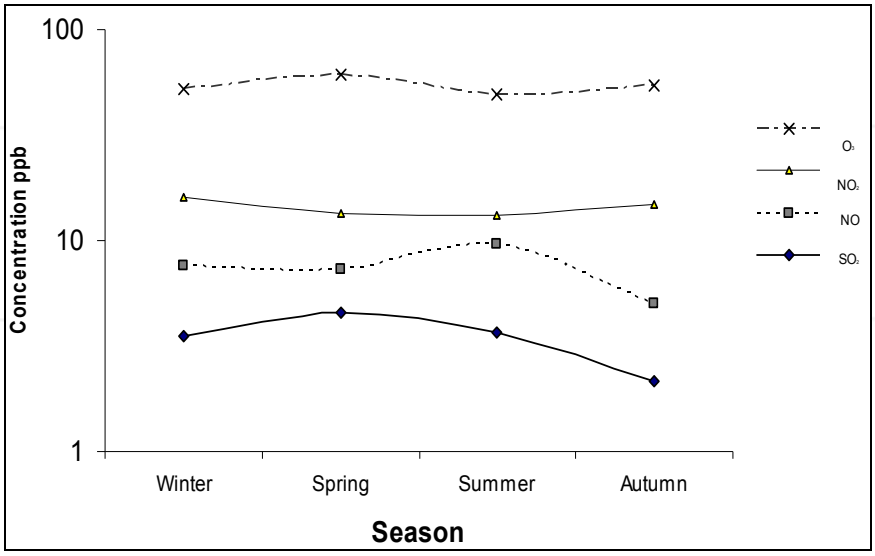

Fig. 2. Seasonal average of SO_2, NO, NO_2, and O_3 in the polluted areas, State of Qatar during the years 2003 to 2004 (Bener et al., 2007).

Variables	Yearly average			
	2002	2003	2004	2005
Air pollutants				
CO	1.070	1.050	1.13	1.19
NO_2	0.027	0.030	0.032	0.033
NO	0.013	0.015	0.028	0.029
O_3	0.028	0.025	0.027	0.029
$S0_2$	0.004	0.004	0.005	0.006
PM_{10}	91.00	99.00	105.00	111.00
Hospital Admissions				
Respiratory diseases	4.428	5.121	5.064	5.300
Cardiovascular diseases	3.419	3.368	3.400	3.914
Ischemic Heart diseases	5.218	5.359	5.247	5.599

Table 11. The trend in concentration of air pollutants and the number of daily admissions from respiratory and cardiovascular diseases, 2002 – 2005 (Bener et al., 2009).

Ozone is found in outdoor air when sunlight provides sufficient photochemical energy to drive reactions of oxygen with a number of gaseous pollutants. McConnell et al. (2002) stated in his study that children who lived in high ozone areas and play sports outdoors were more likely to be diagnosed with asthma than those who did not play sports. In the low ozone areas, there was no difference in asthma rates between children who played sports and those who did not. This shows that the extra exposure to ozone in the ozone areas causes either the onset of asthma or the earlier onset of asthma among children.

Source and Nation	Sample Size and age group	Prevalence	Days of Absence/year.
MIDDLE EAST REGION STUDIES			
Bener et al. 1994b (United Arab Emirates)	1910 school students Aged 6-14.	6.7% School Health Records. 2% Survey	6 days/yr median (diagnosed asthma) 5 days/yr median (wheezing – undiagnosed asthma).
Al-Ghamdy et al. 2000 (Saudi Arabia)	• 606 children Aged 0-13 years. • Recruited from pediatric clinics and hospitals.	Not Reported	Missing between 1-3 weeks of school/year: • 6% for mild asthma • 23% for moderate asthma • 39% for severe asthma.
Al-Dawood 2002 (Saudi Arabia)	• 1482 male school students • Aged 6-15years.	9.5%	13.6 days – students without previous physician diagnosis. 3.7 days – students with physician diagnosed asthma.
Bener et al. 2007 (Qatar)	• 31,400 school students. (national sample) • Aged 6-12years	10.4%	8.02 days / year.
Shohat et al. 2005 (Israel)	• 10,057 school students. (national sample) • Aged 13-14 years	7%	7.3 – 9.8 days / year.
ASIA-PACIFIC REGION STUDIES			
Lai et al. 2003 (Asia-Pacific Region)	• 108,000 households (Parents) in • 8 major cities of China, Hong Kong, Korea, Malaysia, Philippines, Singapore, Taiwan,and Vietnam.	Not reported.	Absence from school because of asthma was reported by 36.5% of parents.

Source and Nation	Sample Size and age group	Prevalence	Days of Absence/year.
Lim et al. 2003 (Singapore)	1,744 School Teachers	8.9%	• 5.1days/month • Range: 4-14days/ month.
EUROPEAN STUDIES			
Doull et al. 1996 (United Kingdom)	• 4830 parents of children gistered with 95 general practitioners • Aged 7-9years.	15.2%	• 7.2% had missed >5 days / year for asthma. • 0.9% had missed >20 days / year.
Fontaine et al. 1999 (France)	• 1707 students 6th grade • 1 French region.	14.9%	• 4.5% had 3 wheezing episodes/week • 18.5% of students with asthma missed days within past year.
NORTH AMERICAN STUDIES			
Newacheck and Halfon 2000 (USA)	• 62,171 children • Aged under 18 years	14.2%	9.7 days/year.
Silverstein et al. 2001 (USA)	• 184; Case-control (92 cases, 92 controls). • 5-12years	14.3%	8.95 days/year
Moonie et al. 2006 (USA)	• 9014 students • Aged 5-17.	9.7%	Mean 9.2 days/year
Mellinger-Birdsong et al. 2003 (USA)	• 2700 children • Aged 0-17 years	10.5%	• Mean 6.1days/year. • 54% missed school because of asthma.

Table 12. Key Published Articles that address Asthma and Absence from School

Most of the published articles revealed a high prevalence of asthma in their countries and there was an association between school absenteeism and asthma episodes.Children with asthma were at particular risk for academic difficulties. It is essential that asthmatic symptoms should be analyzed scientifically to discover its underlying cause and find a remedy. For school aged children, untreated asthma can lead to excessive school absences and inability to maximize their learning experiences when they are at school. Although teachers generally have accepting attitudes toward students with asthma, their knowledge about asthma is low and they do not feel adequately prepared to assist children with the management of asthma in the classroom. It is important to assist schools to manage students with asthma and minimize symptoms of asthma by optimizing the school environment. The American College of Allergists reported that school performance among a significant proportion of children with asthma is affected adversely by the schools approach to their

medical condition (Richards et al., 1986). It was reported that a considerable reduction in school absenteeism can be achieved with appropriate prophylaxis and treatment (Bener et al., 1994).

In conclusion, the study findings revealed the following:

1. Asthma is a chronic childhood disease and it is a common cause of absenteeism from school among students.
2. Children with asthma experienced recurring episodes of absenteeism and this pattern may be contributing to decreased school performance.
3. Air pollution has an impact on asthma which results in significant school absenteeism among students.
4. These studies indicate that children with persistent asthma symptoms may be the necessary target of intervention to reduce absenteeism and improve school performance.

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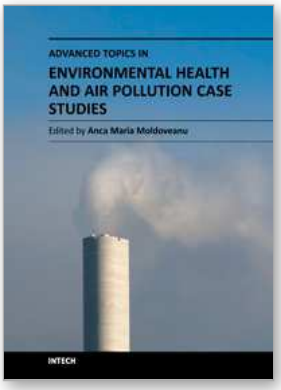

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