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Risk factors associated with childhood asthma in 5 – 11 years old children

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Abstract

Background: Various factors are known to precipitate an attack of asthma. Though no obvious causes can be found in these instances however since our climate and environment differ as do our habits and diets from those in other countries it is pertinent to examine whether the trigger factors in Sri Lanka are also different. So, the mothers of the asthmatic children were questioned regarding the likely precipitating factors pertaining to the present attack.

Methods: In order to identify the risk factors for childhood asthma in children in the age group 5 – 11 years a community based cross sectional analytical study was conducted in the Colombo Municipal Council area in the Colombo district. The sample size included 683 children in the age group of 6 – 11 years residing in the Colombo Municipal Council area. An interviewer administered questionnaire was used for data collection.

Results: Childhood asthma was statistically significantly associated with the following factors: Child's history of eczema($p<0.05$), exclusive breast feeding beyond six months ($p<0.05$), location of house near dusty environment ($p<0.001$), main fuel as firewood ($p<0.05$), place of sleep($p<0.05$),the type of mattress cover($p<0.001$), burning of mosquito coils ($p<0.05$),birth weight less than 2.5kg($p<0.001$), Family history of asthma($p<0.001$), and smoking habits of the father when at home($p<0.001$). The other factors which were looked into were the age of starting the complementary feeding ($p>0.05$), age of starting the formula feeding ($p>0.05$), family history of allergy ($p>0.05$), these were not significant. After the logistic regression birth weight less than 2.5 Kg has shown the strongest association with childhood asthma (OR 5.35), Whereas starting of complimentary feeding before 6/12 has a protective effect (OR .24).

Conclusion: Birth weight less than 2.5 Kg has shown the strongest association with childhood asthma

Keywords: Childhood asthma; Risk factors; Urban setting

1. Introduction

Many factors have been postulated for the rising of prevalence of asthma. It may be due to changes in lifestyle or environmental pollution that has taken place over the past few decades. Rapid socioeconomic development associated with urbanization has given rise to a progressive increase in the occurrence of asthma. Urban populations in the process of industrialization appear to be affected more than the rural population. A study conducted in India concluded that the increase in the prevalence and the severity of asthma in the metropolitan cities correlates with environmental pollution, urbanization and change in the demography of the city [1].

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Several risk factors have been identified in relation to asthma. These factors could be broadly divided into exogenous and endogenous risk factors. The exogenous risk factors which cause asthma in children include exposure to viral infections, low socioeconomic status, passive smoke exposure, not being breastfed during infancy and allergen exposure. The endogenous risk factors which cause asthma in children include male gender, intermittent airway reactivity, history of atopy and allergy and family history of asthma [2].

The first attack of asthma is usually seen before the age of five years. In the natural course of the disease, about a quarter of all asthmatic children grow up to be adult asthmatics. Those who develop wheeze in the first two years of life are prone to grow out of it during adult life but those who develop symptoms after the third year are more likely to have persistence of asthma into adulthood. Girls are more prone to carry the disease over to the adult life [3, 4].

Asthma in childhood presents itself in many clinical forms with variable degree of severity. The symptoms of asthma consist of periodic attacks of shortness of breath, wheeze, occasional tightness of chest and cough. Sometimes, cough may be the only symptom, particularly in children and usually occurs at night. Most attacks are mild and last for a few minutes, but symptoms may sometimes persist for several hours or longer, especially if effective treatment is not given in time. Some of them have intermittent symptoms precipitated especially by bouts of coughing and cold.

These symptoms of asthma are mainly due to the narrowing of bronchi, contraction of the muscle layer in the walls of the bronchi, and the swelling of the mucous membrane lining the bronchi with increased secretion of mucus. The increasing morbidity of asthma has been associated with dramatic advances in the understanding of the immunopathology of the disease and development of a rational approach to its treatment.

Childhood asthma is poorly understood because of its unpredictable course and difficulty in treating. In the majority of cases, asthma is mild, is easily controlled with treatment and breathing may be normal between attacks. However, about 1-2 percent of wheezing children have a serious form of the disease characterized by daily wheezing, marked interference with daily activities, growth retardation and chest deformities.

There are many views regarding the nature and management of asthma. In contrast to most other diseases, childhood asthma so far has no 'perfect cure', but the disease can be very well controlled using the currently available medications. The ultimate aim of treatment is to allow the child to have a normal or near normal life and growth process. 'Reliever drugs' are used to treat the acute attacks while 'preventive drugs' are used to avert acute episodes and disturbances of the normal life style of the child. These drugs are safe when used properly in the recommended doses under medical supervision. Many drugs are inhaled through special devices and this mode of administration is considered to be safe and have less side effects. Once the child or the parents are properly trained on the use of inhalers, the devices may be used safely and easily. Inhalers are not addictive, contrary to the myth popular among many parents.

Onset of asthma can be seen at any age. It was observed that about 78 percent of asthma in children begins when the child is less than five years of age [5]. Similar findings can be seen in the study by Al-Shairi et al [6] in Saudi Arabia. Peter et al [7] on their study findings reported that most asthmatics had their first asthmatic episode before their third birthday.

Some studies have proven that boys get asthma more than girls and the difference was significant [8]. In contrast, a Malaysian study by Quah et al [9] showed that there was no significant difference between the groups. Karunasekara et al [10] from their study also reported that prevalence of asthma in males did not significantly differ from that of females ($p=0.5$). Various precipitating factors for childhood asthma have been reported. It includes exercise, cold weather, excitement, contact with animals, certain foods, plants, dust and smoke [11,12].

Hassan et al [13] had found that children with illiterate parents were more vulnerable to asthma attacks than children of more educated parents. Similar findings were reported by De Britto et al [14] in Brazil. One component of the ISAAC study, which considered the relationship between per capita gross national product and the prevalence of symptoms of asthma among 56 countries, found that there is a positive association between the per capita income and the prevalence of asthma [15]. Sin et al [8] on their population-based cohort study found that childhood asthma is more among the low-income group people.

There is an ethnic and racial difference in the prevalence of asthma. Lieu et al [16] in their study in America found that black children had worst asthma status than their white and Latino peers. Gergen et al [17] found in their American study that prevalence of asthma was higher in black than white children (9.4% vs 6.2%, $p< 0.01$). It has been suggested that the sibling effect may be the result of common childhood infections that has a protective effect towards the development of the disease. Children who have no siblings are usually exposed to common infections later in life than

are children with siblings. This hypothesis is supported by the recent studies showing that recurrent viral infections reduce the production of IgE and activate TH1 like helper cells as opposed to TH2 cells [18].

Obesity promotes inflammation and impedes mechanical constrains to the airways. Sin et al [8] found a high birth weight is a risk factor for asthma in childhood. Other studies have found that there is an association between impaired foetal growth and childhood asthma [19]. Breast feeding in early infancy may help to reduce the risk of wheezing. Most studies suggest that breast-feeding has a protective effect towards asthma [20]. But, Infante-Rivard [18] and Kaluarachchi and Perera [21] on their studies couldn't confirm of this observation. Exclusive breast-feeding in young infants tend to postpone the introduction of foreign proteins in the form of cow's milk which is known to be associated with increased predisposition to bronchial asthma in later life. Therefore, exclusive breast feeding has a protective effect against development of severe asthma. In this study, breast-feeding was defined as exclusive if the child is exclusively breastfed for the first four months of life.[22]. Karunasekara et al [10] in their study found that non continuation of breast-feeding beyond six months is a risk factor for the development of asthma. Oddy et al [21] in their study reported an increased risk of developing asthma (OR=1.25, CI=1.52) at 6 years of age when milk other than breast-milk was introduced before the age of 4 months.

Crook [23] states that, the non-IgE mediated sensitivity to common foods, especially milk, plays a significant role in causing asthma in many children. Also, he had mentioned that, to identify this type of sensitivity requires a carefully designed and appropriately executed trial elimination diet. Atopic disorders are a type of immediate hypersensitivity reactions with increased levels of serum IgE levels. It exhibits a strong familial predisposition and Kumar et al [24] on their clinic-based study among asthmatic patients had shown that 54 percent of children had a positive family history of atopy. Correlation between a history of atopy and childhood asthma is documented in several studies [11, 12, 24]. A study conducted by Shin and others in Korea to evaluate the frequency of atopy, asthma and sensitization to house dust mite in children (0 -12 years) with allergic symptoms found that asthma is related to atopy with increasing age and house dust mite sensitization seems to be an important determinant of asthma in older children.

An association between asthma and eczema has been reported. Karunasekara et al [10] in their study found 3 percent prevalence of eczema among asthma children of 5-11 year age group.The association between family history of asthma and the occurrence of asthma had been reported in various studies. Data on the inheritance of asthma are most compatible with polygenic or multifactorial determinants. A genetic predisposition combined with environmental factors may explain most cases of asthma. A child with one parent affected has about 25 percent of risk of having asthma and the risk is increased to about 50 percent when both parents are affected[5].Paramesh et al[25] on their observations on family history found that the incidence of asthma in child is 19 percent when one parent is having asthma and is 2.0 percent in case of one sibling having asthma. Karunasekara et al [10] in their study showed that the risk of asthma is increased when the father has a history of asthma (OR=6.4, 95% CI=3.2-13.2), mother has a history of asthma (OR=4.4, 95% CI=2.6-6.75) and a sibling has asthma (OR=4.3, 95% CI=2.0-9.7).

There are only a limited amount of studies found in the literature regarding the living environment which is relevant to Sri Lanka. Kaluarachchi and Perera [21] on their study found an association between the congestion of the bedroom and childhood asthma. Paramesh et al [1] in their study showed that the schools in heavy traffic areas had more asthmatic children than schools with less traffic. This difference was significant. Kaluarachchi and Perera [21] from their study showed that there is an association between childhood wheezing and the presence of a ceiling in the bedroom, but they couldn't prove the significance between the type of the house and childhood wheezing.

Hassan et al [13] in their study found that asthmatic children were significantly more in households with three or less number of people than in larger households (OR=1.41, 95% CI=1.04-1.92). Tobacco smoke is one of the sources of air pollution in the home. It is known to contain many air pollutants that have a deleterious effect on respiratory tract and has been associated with increased frequency of respiratory tract infections and bronchial asthma. Many studies had reported that children exposed to parental cigarette smoking may develop chronic cough, phlegm and persistent wheeze (asthma)[25, 26,27].Wafula et al[22] in their study to evaluate the effect of passive smoking on the severity and age of onset of bronchial asthma found that passive smoking is associated with early onset asthma, and possibly with development of severe asthma. In this study, passive smoking is defined as any exposure to cigarette smoke at home. Many studies found significant association between family history of smoking and asthma [1, 28.] A history of parental smoking was higher (37.8%) in those with diagnosed asthma compared to non-asthmatics (27%) [29].

Meanwhile, Ehrlich et al[29] had investigated whether the household Environmental Tobacco Smoke (ETS) exposure is associated with increased Bronchial Hyperresponsiveness (BHR) in children with asthma. He studied a sample of 240 children aged 7-11 years with reported asthma or multiple asthma symptoms identified at a community survey in Cape Town. The sample underwent a histamine challenge test and a urinary creatinine analysis. Parents were interviewed

for the information on smoking habits. But, Infant -Rivard [26] on his case control study found that the presence of other smokers (other than the parents) is not significantly associated with asthma. Burning of mosquito coils is found to be a triggering factor in 6 percent of children with asthma in India [25]. Similar findings were shown with the Sri Lankan children among 5-11 years (OR=1.8) [10].

In Sri Lankan studies, a significant association was noted between the method of cooking and childhood asthma[21, 30] Bener et al[31] observed increased prevalence rate of asthma in children belonging to families with pets. A Sri Lankan study among the children below 12 years showed showed no significant association of asthma with pets in household[21]. Paramesh et al[1] stated that they have observed where the pets are more the asthma is less prevalent.

2. Material and methods

The study was carried out in the Colombo Municipal Council area in the Colombo district. The study design was a community based cross sectional study.

Colombo Municipal Council has a good health infrastructure. Public Health Department and the Health Curative Department of the CMC provide health facilities to the city dwellers under two department heads, namely; The Chief Medical Officer of Health (CMOH) and the Chief Dispensary Medical Officer (CDMO). The CMOH is assisted by three deputies to cover Environmental Sanitation, Maternal and Child Health and Epidemiology and Administration. There are six Medical Officer of Health (MOH) divisions namely District 01, 2A, 2B, 03, 04 and 05 to cover the whole of the CMC area under six Medical Officers of Health. Under each MOH, there are Public Health Inspectors, one for each municipal ward, a Health Education Officer, Food Inspectors and several Health Instructors. In addition, there is an Epidemiology Unit in the Public Health Department under CMOH, and he acts as the Regional Epidemiologist for the CMC. Under the administration of the CDMO, there are twenty-five Municipal Dispensaries scattered all over the city, in charge of 25 Medical Officers assisted by Pharmacists, Attendants etc. These provide out-patient care facilities.

The study population consisted of children aged 5-11 years residing in the CMC area for a minimum period of six months at the time of the data collection. A sample of 683 children in the age groups 5 – 11 years were recruited to the study. The study sample was selected using the cluster sampling method to get a probability sample since there was no proper sampling frame available. The clusters were allocated on the basis of probability proportionate to size (PPS) of the population.

A pre tested interviewer administered questionnaire was used as the study instrument. The respondents of this questionnaire were defined as the mothers of children aged 5 to 11 years or the person who spent the maximum time with the index child when the mother is not there to look after the child (either dead, left the child or gone abroad).

Ten Public Health Midwives (PHMM) were selected as the data collectors of the study. The PHMM has no role in the clinical aspect of asthma management as part of their routine duty.

3. Results

A univariate analysis was carried out to determine the association between the asthma status and the selected risk factors.

In the preliminary univariate analysis relationship between childhood asthma and associated factors were studied. It identified many factors which are significant but independently associated with the asthma status of the child. After carrying out this analysis it is difficult to draw conclusions about the relative importance of each individual risk factor because of their confounding nature. Therefore, to eliminate the confounding effect of multiple risk factors the multivariate logistic regression analysis was performed.

Multivariate logistic regression model is a powerful statistical tool for estimating the magnitude of association between an exposure and binary outcome after adjusting simultaneously for a number of potential confounding factors.

Table 1 Risk factors associated with childhood asthma (Unadjusted Odds Ratios)

Factor (Exposure Variable)	**Asthma**		**OR**	**95% CI**
	Present	**Absent**		
History of Eczema				
Yes	15	53	2.01	1.06-3.71
No	162	1149		
History of food Allergy				
Yes	28	140	1.43	0.9-2.26
No	14	1063		
Duration of breast feeding				
Less than 6/12	84	479	1.38	0.99 - 1.92
More than 6/12	89	699		
Age of starting complementary feeding				
Before 6/12	123	856	0.91	.62 – 1.35
After 6/12	44	281		
Age of starting formula feeding				
Before 6/12	77	471	1.25	0.89-1.75
After 6/12	89	680		
Burning of mosquito coils				
Yes	63	316	1.55	1.10-2.19
No	26	280		
Presence of pets				
Yes	32	157	1.47	0.95-2.27
No	145			
Birth weight				
Less than 2.5Kg	57	214	2.27	1.57-3.27
More than2.5 Kg	113	962		
Family history of asthma				
Yes	85	259	3.36	2.4 - 4.71
No	92	942		
Family History of eczema				
Yes	21	89	1.72	1-2.91
No	153	1113		
Family History of allergy				
Yes	32	178	1.28	0.8 – 1.97
No	144	1022		

The steps which used for Logistic regression as follows.

- Presence of asthma was the dependent variable and encoded as
  - Presence of asthma – 0
  - Absence of asthma - 1
- Variables which were recognized as at univariate analysis was included in logistic regression model.
- All the recognized variables were entered as categorical variables.

The method which used to assess the relevance of each variable in the model is the forward selection procedure. Twelve variables were eligible to enter into the model and logistic regression was carried out using SPSS software. Table 2 shows risk factors identified in the model.

Table 2 Summary of logistic regression analysis

Independent variable	Unstandardized logistic regression coefficient(B)	Standard error of B	Statistical significance of B	Adjusted OR	95% CI
Complementary feeding	1.06	0.24	0.000	0.34	0.21-0.55
Birth weight	1.67	0.50	0.001	5.35	1.98– 14.42
Constant	2.12	0.44	0.000		

The final model had identified two factors as the most important correlates of the childhood asthma after controlling for the possible confounders. Risk levels of those factors are as follows; Starting of complementary feeding before 6/12 and Birth weight less than 2.5 Kg. Of those two factors identified by the final model birth weight less than 2.5 Kg has shown the strongest association with childhood asthma (OR 5.35), Whereas starting of complimentary feeding before 6/12 has a protective effect (OR .24)

Other than the above selected factors, the association for the factors in the table 3 were also assessed.

Table 3 Factors associated with childhood asthma

Factor	Level of significance
Sex of the child	χ^2 =0.89 , P>.05
Ethnicity	χ^2 = 20.8, P > .001
Age of starting formula feeding	χ^2=1.24, P > 0.05
Location of the house	χ^2= 33.58, P<.001
Material of walls of house	χ2= 3.6, P >0.05
House floor - finishing	χ2= 1.3, P >0.05
House roofing material	χ2= 14.4, P <0.05
Presence of ceiling	χ2= 5.1, P <0.05
Place of sleeping	χ2= 9.5, P < 0.05
Type of mattress cover	χ2= 24.5, P >0.001
Main fuel source of cooking	χ2= 56.3, P < 0.05
Smoking habits of mother when at home	χ2= 1.76, P > 0.05
Smoking habits of father when at home	χ2= 9.35, P < 0.001

4. Discussion

Drug therapy for bronchial asthma, although a practical and successful approach, can be considered as only one of the strategies for controlling this disease. Strategies targeting specific associated factors suspected to influence the onset and the severity of bronchial asthma offer an important avenue for controlling this condition [5, 22, 28]. The present study was an effort to identify some of these selected factors commonly associated among 5 – 11-year age group. An increased susceptibility of the males too many diseases attributed to their biological differences were well documented. Sin D.D. et al [8] have reported a higher incidence of bronchial asthma among male children compared to females In contrast Quah et al [9] reports no gender difference in boys and girls. The present study also does not show any significant difference in the prevalence of CA between boys and girls, 13.8 percent and 12.1 percent respectively

Though the several studies have shown decrease prevalence of childhood asthma with increasing age this study conducted on children aged 5- 11 years found no association between CA and age. But the Sri Lankan study of Karunasekara et al [10] had proved that there was a significant decrease trend in prevalence of asthma with increasing age in girls ($P<0.05$).

Ethnic origin may also play a role in the prevalence of asthma. Difference in asthma incidence was documented among different ethnic groups because of their difference in social and cultural back grounds [32]. Present study also shows a significant ethnic difference in the prevalence of asthma and it is more among Sinhalese and the difference among ethnic groups are statically significant.

Shaheen et al[19] found that there is an association between impaired fetal growth and CA. The present study also showed asthma was common among low birth weight babies. For those who did not breast feed exclusively for six completed months, the risk of CA is high in the present study. This indicates, protective effect of exclusive breast feeding towards asthma and it is similar to the findings of the others [10,21]. The effect of early introduction of formula milk and complementary food may be confounded by the effect of early abundant of exclusive breast feeding. It is thought early introduction of cow's milk and complementary food are capable of mediating an immunological reaction which can initiate the hypersensitivity state as dietary molecules are more likely to be absorbed by the more permeable intestines of neonates and early infancy. The 12.5% children who had introduced formula milk before 6 months had asthma compared to the 13.5% children who had introduced formula milk after 6 months($p>0.05$). These findings are compatible with the findings of the others[10,21].

Many childhood with asthma had a history of Allergy. Though the Crook [23] had stated that non IgE mediated sensitivity to common foods, played a significant role in the development of asthma. Also, the correlation between childhood asthma and allergic history of the child are also documented [11,12,25]. The present Study did not find a significant association between CA and family history of allergy. ($p>0.05$)

Many studies had shown that there is an association between family history and asthma. Although family history and asthma is well documented, the mode of inheritance is still not clear. The present study also found a significant association between family history and CA ($p<0.011$). Present study shows, that the mothers of 20.3% of asthmatic children and 10.3% of the non-asthmatic children had asthma, while father of 6.2% of the asthmatic children and 2.9% of the non-asthmatic children ($p>0.05$) had asthma. Significant association also found in the present study between CA and history of asthma among brothers ($p<0.05$) sisters ($p<0.001$) and others ($p<0.05$)

Though there are enough studies available regarding the CA and the housing conditions, most of them are relevant to the western countries. For the present study materials used for floor, wall and roof were considered. There is no association between CA and the material of the floor. Also there is no association found between the types of the material used for walls. But a significant association was found between the types of the material used for the roof. The asthmatic children were more in houses where the roof is with a ceiling, this difference is significant ($p<0.05$)

Source of combustion produce in the home include wood and gas stores and fire places, all of which may release carbon monoxide, nitrogen dioxide and respirable particles which contain potentially carcinogenic polycyclic, aromatic hydrocarbons. The respirable particles that are released when fuel are incompletely burn can lodge in the lungs and damage the tissues. In the present study there is a significance association between the main fuel source used for cooking and the CA. The 11.3% of the children with asthma and 7.5% children without asthma use firewood as a source of cooking. This difference was significant at $p<0.05$. The similar findings could be seen in Lankathilaka et al [30]and Karunasekara et al[10] on their studies.

Tobacco smoke is known to contain many air pollutions that have deleterious effects on the respiratory tract and can cause Bronchial Asthma. This form of tobacco smoke is responsible for 85% of indoor pollution in household. Most published studies demonstrate that smoking is a risk factor for childhood asthma [1,33]. The present study showed a statistically significant association with father's smoking habits when at home, but not with the mother or others smoking habits.

5. Conclusion

Birth weight less than 2.5 Kg has shown the strongest association with childhood asthma. The outcome of the study can be made use by policy makers in the Health Ministry for improvement of management of childhood asthma as well as the local government authorities in approving house plans to minimize the impact from the home environment.

Compliance with ethical standards

Acknowledgments

The present research work does not contain any studies performed on animals/humans subjects by any of the authors.

Disclosure of conflict of interest

Authors declared that there is no conflict of interest in connection to this study.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

[1] Paramesh H. Epidemiology of asthma in India. The Indian Journal of Pediatrics. 2002 Apr;69(4):309-1.

[2] Morgan G, Corbett S, Wlodarczyk J. Air pollution and hospital admissions in Sydney, Australia, 1990 to 1994. American journal of public health. 1998 Dec;88(12):1761-6.

[3] Mansfield J.Dr, Asthma Epidemic. 2nd ed. Oxford Medical Publications; 1999.

[4] Kuzemko J. Asthma in children. 3rd ed. Liverpool: University of Cambridge; 1998.

[5] Nelson WE. Textbook of pediatrics. Academic Medicine. 1996 Oct 1;34(10):1056.

[6] Shairi A, Al Dawood K. Schoolbodys in urban industrial environments: are they at increased risk of bronchial asthma? EMHJ-Eastern Mediterranean Health Journal, 5 (4), 657-663, 1999.

[7] Peter J. B, Rodger Ian, Neil C T. Asthma: Basic Mechanisms and Clinical Management. 3rd ed. Academic press: London; 1988.

[8] Sin DD, Spier S, Svenson LW, Schopflocher DP, Senthilselvan A, Cowie RL, Man SP. The relationship between birth weight and childhood asthma: a population-based cohort study. Archives of pediatrics & adolescent medicine. 2004 Jan 1;158(1):60-4.

[9] QUAH BS, RAZIF A, RAZAK A, HASHIM M, HASSAN M. Prevalence of asthma, rhinitis and eczema among schoolchildren in Kelantan, Malaysia. Pediatrics International. 1997 Jun;39(3):329-35.

[10] Karunasekera KA, Perera KP, Perera MR, Abeynarayana J. Genetic and environmental risk for asthma in children aged 5-11 years. Sri Lanka Journal of Child Health. 2005;34(3):79-83

[11] Anderson HR, Butland BK, Strachan DP. Trends in prevalence and severity of childhood asthma. Bmj. 1994 Jun 18;308(6944):1600-4.

[12] Lee DA, Winslow NR, Speight AN, Hey EN. Prevalence and spectrum of asthma in childhood. Br Med J (Clin Res Ed). 1983 Apr 16;286(6373):1256-8.

[13] Hassan MR, Kabir AL, Mahmud AM, Rahman F, Hossain MA, Bennoor KS, Amin MR, Rahman MM. Self-reported asthma symptoms in children and adults of Bangladesh: findings of the National Asthma Prevalence Study. International journal of epidemiology. 2002 Apr 1;31(2):483-8.

[14] De Britto MC, Bezerra PG, Ferreira OS, Maranhao IC, Trigueiro GA. Asthma prevalence in schoolchildren in a city in north-east Brazil. Annals of tropical Paediatrics. 2000 Jun 1;20(2):95-100.

[15] Stewart AW, Mitchell EA, Pearce N, Strachan DP, Weiland SK. The relationship of per capita gross national product to the prevalence of symptoms of asthma and other atopic diseases in children (ISAAC). International journal of epidemiology. 2001 Feb 1;30(1):173-9.

[16] Lieu TA, Lozano P, Finkelstein JA, Chi FW, Jensvold NG, Capra AM, Quesenberry CP, Selby JV, Farber HJ. Racial/ethnic variation in asthma status and management practices among children in managed Medicaid. Pediatrics. 2002 May 1;109(5):857-65

[17] Gergen PJ, Mullally DI, Evans III R. National survey of prevalence of asthma among children in the United States, 1976 to 1980. Pediatrics. 1988 Jan;81(1):1-7.

[18] Infante-Rivard C, Amre D, Gautrin D, Malo JL. Family size, day-care attendance, and breastfeeding in relation to the incidence of childhood asthma. American journal of epidemiology. 2001 Apr 1;153(7):653-8.

[19] Shaheen SO, Sterne JA, Montgomery SM, Azima H. Birth weight, body mass index and asthma in young adults. Thorax. 1999 May 1;54(5):396-402.

[20] Oddy WH, Holt PG, Sly PD, Read AW, Landau LI, Stanley FJ, Kendall GE, Burton PR. Association between breast feeding and asthma in 6 year old children: findings of a prospective birth cohort study. Bmj. 1999 Sep 25;319(7213):815-9.

[21] Kaluarachchi N, Perera B. Some facets of wheezy children in general practice: A prospective study on 3183 children. Proceedings of the Sri Lanka college of paediatricians annual scientific congress. 2000.

[22] Wafula EM, Limbe MS, Onyango FE, Nduati R. Effects of passive smoking and breastfeeding on childhood bronchial asthma. East African medical journal. 1999 Nov 1;76(11):606-9.

[23] CROOK W. Asthma and Food Sensitivity. Pediatrics. 1991;88(2):419 - 420.

[24] Kumar L, Singh M. Respiratory Allergy. Indian Journal of pediatrics. 2002;69(3):237-244.

[25] Duff AL, Pomeranz ES, Gelber LE, Price GW, Farris H, Hayden FG, Platts-Mills TA, Heymann PW. Risk factors for acute wheezing in infants and children: viruses, passive smoke, and IgE antibodies to inhalant allergens. Pediatrics. 1993 Oct;92(4):535-40.

[26] Infante-Rivard C. Childhood asthma and indoor environmental risk factors. American Journal of Epidemiology. 1993 Apr 15;137(8):834-44.

[27] Holberg CJ, Wright AL, Martinez FD, Morgan WJ, Taussig LM, Group Health Medical Associates. Child day care, smoking by caregivers, and lower respiratory tract illness in the first 3 years of life. Pediatrics. 1993 May;91(5):885-92.

[28] Raj A, Mishra A, Feinsilver SH, Fein AM. An estimate of the prevalence and impact of asthma and related symptoms in a New York City middle school. Chest. 2000 Oct 1;118(4):84S-.

[29] Ehrlich R, Ehrlich RI, Jordaan E, Du Toit D, Potter P, Volmink J, Zwarenstein M, Weinberg E. Household smoking and bronchial hyperresponsiveness in children with asthma. Journal of Asthma. 2001 Jan 1;38(3):239-51.

[30] Lankathilaka K, Senaviratne S, Fernando D. Indoor air quality and respiratory symptoms among children and women. Department of medicine: University of Colombo;1998(unpublished).

[31] Bener A, Al-Jawadi TQ, Ozkaragoz F, Al-Frayh A, Gomes J. Bronchial asthma and wheeze in a desert country. The Indian Journal of Pediatrics. 1993 Nov;60(6):791-5.

[32] International Study of Asthma and Allergies in Childhood (ISAAC) Steering Committee T. Worldwide variation in prevalence of symptoms of asthma allergic rhino conjunctivitis, and atopic eczema: ISAAC. Lancet (London, England). 1998;351(9111):1225-32.

[33] Kasim AD. Parental smoking and the risk of respiratory symptoms among school boys in Al-Khobar City, Saudi Arabia