Risk factors for asthma among primary school children in Baghdad, Iraq

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ABSTRACT

Objective: Asthma is one of the most common chronic diseases of children. To fill the gap in data concerning this disease in Iraq, we investigated the socio-demographic and other risk factors related to asthma occurrence among primary school children.

Methods: A case control study was conducted in Baghdad, Iraq among primary school children aged 6-12 years, for the period between October 2000 and June 2002. Six hundred and forty-four children with asthma were investigated with a control group of 1618 children without asthma. Well-constructed standardized modified questionnaires of International Study of Asthma and Allergies in Childhood were completed by the parents of the chosen children.

Results: From the studied risk factors, the following were found as significant risk factors for asthma development: crowding rate of ≥5 (odds ratio [OR]=1.65, 95% confidence interval [CI]=1.1–2.4), lower educational level of parents, prematurity (OR=1.61, 95% CI=1.003-2.59), low birth weight (OR=2.41, 95% CI=1.87-3.09), family history of asthma whether father (OR=3.86, 95% CI=2.54 –5.87), or mother (OR=8.27, 95% CI=5.21-13.15) or sibling (OR=4.33, 95% CI=3.24-5.8) and environmental exposure to tobacco smoking during pregnancy or currently from both parents. On the contrary, our study failed to detect significant association for the following factors: gender, residency, type of birth, breast feeding and duration.

Conclusion: Crowding, low parental education, prematurity, low birth weight, family history of asthma and smoking are significant risk factors for asthma development among our primary school children. Efforts must be concentrated for hygienic environment, good antenatal care and quitting smoking habits in order to overcome this health problem.

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Asthma is one of the most common chronic diseases of children.[1] For some children, asthma is a disease whose symptoms seem to remit with time; numerous children however, develop disease that is persistent throughout their lifetime and is associated with more sever symptoms, increased airway reactivity and loss of lung function.[2]

The prevalence of pediatric asthma has risen sharply over the past 30 years in many parts of the world with large geographical variations.[3-5] Between 1980 and 1995, the number of children with asthma in the United States (US) risen from 2.3-5.5 million.[3] The reasons for this dramatic increase are not yet clear and likely include multiple contributing factors.[3,4]

Atopy, the tendency to become allergic, is the most important predictor for the development of asthma.[3] While atopy is mainly determined genetically, genetic changes in population occur slowly and therefore, to explain the increase in asthma and atopy is difficult.[3-6] Recent research has therefore shifted attention from allergens that may cause sensitization or provoke asthma attacks, to factors that may program the initial susceptibility to asthma through allergic or nonallergic mechanisms.[5] Several studies have indicated that certain exposure

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to infectious agents early in life, may stimulate the immune system in opposite direction, thereby protecting individuals against asthma and atopy and which had led to the 'hygiene hypothesis'.[3,5] There are evidence that exposure to both allergens and irritants early in life, including air pollution and environmental tobacco smoke, may play a pivotal role in the development of asthma rather than genetic factors.[3-6] It seems that, as a result of changes in intrauterine and infant environment as well as changes in maternal diet, increased fetal growth, smaller family size, reduced infant infections and increased use of antibiotics and immunizations, have been inconsistently associated with an increased risk of childhood asthma.[3,5,6]

In Iraq, asthma is a common disease, particularly among primary school children. Unfortunately, no national database could be obtained, in spite of the increasing burden of this health problem that was observed during our clinical work. In order to fill the gap concerning asthma among primary school children, we conducted this study to investigate the relationship between asthma occurrence and socio-demographic characteristics and also to detect other risk factors for this disease.

Methods. A case control study was conducted in Baghdad, Iraq for the period between October 2000 and June 2002. The study was carried out on primary school children. A list of primary schools all over Baghdad was obtained from the Ministry of Education. A total of 1494 primary schools are distributed in Baghdad, in both urban and rural areas. Those schools are of 3 types: 1) for girls only, 2) for boys only, 3) for both. Official approval was obtained from all the authorized and responsible personnel prior to the study. Twenty schools were chosen randomly. The study included 644 asthmatic cases and 1618 of non-asthmatic children as a control group. Initially, the purpose of the current study was explained to the parents during the school's parents' day activity. A well-constructed standardized questionnaire was distributed to all the chosen children to be completed by their parents. In addition to the socio-demographic characteristics such as gender, residency and crowding rate of the index child; our questionnaire concentrated on the possible risk factors for the development of asthma, including type of delivery, birth weight, feeding pattern and duration of breast feeding, family history of asthma, educational level of parents and cigarette smoking exposure. There was a key question directed to the parents to confirm the child as asthmatic; whether their child has ever been diagnosed by a physician as having asthma? The response will be either yes or no. In addition, we follow-up the parents of the child when there was a positive response to confirm the diagnosis by determining the type of medications used by their child. A modification of the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire,[7] was carried out and was translated to Arabic language. The children in the control group was recruited from the same schools. Any student without asthma and those who did not experience wheezing since birth in the last 12 months were included. The data were analyzed using Statistical Package for Social Sciences version 10. Data were presented in simple measures of frequency (%), the significance of difference between proportions was tested using chi–square test (χ^2), with p value <0.05 as the level of significance; moreover, the strength of association was evaluated through comparing odds ratio (OR) and 95% confidence interval (CI).

Results. In our study, total males were 933; of them 274 were asthmatics, while total females were 1329 and 370 of them were asthmatics. Although there is no significant association (χ^2=0.63, p=0.49) between gender and occurrence of asthma, we observed that males were more exposed to risk of developing asthma (OR=1.08, 95% CI=0.9 – 1.3) compared to females, which shows marginal significance (**Table 1**). Regarding crowding status, our study found that 1391 children of the study group were living with crowding rates (CR) of <3, 724 with 3-5 CR and 147 with ≥5. We also found that the prevalence of asthma is increasing steadily in 381 students with increased CR of <3, 205 students with CR of 3-5 and 58 students with CR of ≥5 (**Table 1**). Statistical significant has been found between CR and asthma (χ^2=9.52, p=0.009). Moreover, in an attempt to identify whether CR acts as a risk factor for asthma occurrence by calculating OR for CR (3-5 versus <3) and (≥5 versus <3), interestingly, we detect that only CR of ≥5 acts as a significant risk factor for asthma occurrence (OR=1.65, 95% CI=1.1–2.4).

Our study detected that only 437 were living in rural areas, while the remaining 1824 lived in urban areas. We also found that those who reside in urban areas were having higher rate of asthma (29.2%) compared to those in rural areas (25.2%), but this difference was not significant (χ^2=2.84, p=0.09), however, our study also detected that those residing in urban areas were at marginal significant risk of exposure to asthma (OR=1.23, 95% CI=0.96–1.57) (**Table 1**). Out of the total 2262 questionnaires, 197 (8.7%) were discarded due to insufficient information regarding educational level of both parents. Parental education was classified into 4 categories; illiterate was classified as class 1, having primary school education was classified as class 2, having secondary or intermediate school education was class 3 and having college or higher education was considered as class 4. **Table 1** shows the educational level of parents and their association to

Table 1 - Sociodemographic risk factors related to asthma.

Risk factor	Asthmatic		Non - asthmatic		χ^2	*p* value	Odds ratio	95% Confidence interval
	n	(%)	n	(%)				
Gender								
Male (n=933)	274	**(29.4)**	659	(70.6)	0.63	0.49	1.08	0.9 - 1.3
Female (n=1329)	370	**(27.8)**	959	(72.2)				
Crowding rate								
<3	381	**(27.4)**	1010	(72.6)	9.52	0.009	0.96	0.78 - 1.17
3 - 5	205	**(28.3)**	519	(71.7)			1.65	
≥5	58	**(39.5)**	89	(60.5)				
Residency								
Urban	533	**(29.2)**	1291	(70.8)	2.84	0.09	1.23	0.96 - 1.57
Rural	110	**(25.2)**	32.7	(74.8)				
Maternal educational level								
Class 1	240	**(39.1)**	534	(36.8)	4.23	0.04	1.45	1.02 - 2.07
Class 2	138	**(22.5)**	269	(18.5)	6.79	0.009	1.65	1.13 - 2.42
Class 3	186	**(30.3)**	491	(33.8)	1.17	0.278	1.22	0.85 - 1.75
Class 4	49	**(7.9)**	158	(10.9)				
Paternal educational level								
Class 1	137	**(22.7)**	327	(22.6)	5.36	0.02	1.41	1.05 - 1.9
Class 2	110	**(18.2)**	229	(15.8)	9.19	0.002	1.62	1.18 - 2.22
Class 3	250	**(41.4)**	532	(36.8)	11.88	0.0006	1.59	1.22 - 2.07
Class 4	106	**(17.6)**	358	(24.7)				

Class 1 -illiterate or read and write only, Class 2 - primary school
Class 3 - secondary school of intermediate school, Class 4 - college and higher

Table 2 - Perinatal risk factors related to asthma.

Risk factor	Asthmatic N = 644		Non - asthmatic N = 1618		χ^2	*p* value	Odds ratio	95% Confidence interval
	n	(%)	n	(%)				
Type of birth								
Normal	603	(28.6)	1507	(71.4)	0.179	0.672	0.923	0.64 - 1.34
Cesarian section	41	(27)	111	(73)				
Gestational age								
Full term	615	(28.1)	1572	(71.9)	3.960	0.047	1.611	1.003 - 2.59
Premature	29	(38.7)	46	(61.3)				
Birth weight								
≤2500 Gm	144	(45.4)	173	(54.6)	52.004	0.000	2.41	1.87 - 3.09
≥2500 Gm	500	(25.7)	1445	(74.3)				

Table 3 - History of breast feeding during early life and its relation to asthma.

Risk factor	Asthmatic		Non - asthmatic		χ^2	*p* value	Odds ratio	95% Confidence interval
	n	(%)	n	(%)				
Breast feeding								
Present	481	(29.2)	1164	(70.8)	1.755	0.185	0.87	0.70 - 1.07
Absent	163	(26.4)	454	(73.6)				
Duration of breast feeding								
<6 months	83	(31)	185	(69)	0.55	0.468	1.11	0.82 - 1.49
≥6 months	398	(28.9)	979	(71.1)				

asthma. Our study found a significant difference in asthma prevalence among children with variations of parental education. The lowest percentage of asthma was among children with mothers having college certificate or higher (7.9%) and fathers having the same educational background (17.6%).

Taking college degree and above, was used as a reference group and for calculating OR for each level of education. Our study found that children whom mothers or fathers were illiterate (OR= 1.45, 95% CI= 1.02 – 2.07 and OR= 1.41, 95% CI= 1.05 – 1.9) respectively, were at significant risk of developing asthma. Similarly, when mother or father with primary school educational attainment (OR= 1.65, 95% CI= 1.13 – 2.42) and (OR= 1.62, 95% CI= 1.18 – 2.22); their children will be at risk of having asthma, on the other hand, when only the father having high school education (OR= 1.59, 95% CI= 1.22 – 2.07) but not mother (OR=1.22, 95% CI= 0.85 – 1.75) their child be at a significant risk of asthma occurrence **(Table 1)**. Therefore, the study gave an evidence that the low level of education acts as a significant risk factor for development of asthma.

Out of the 2262 studied children; 2110 were delivered via vagina normally, 2187 gave history of full term while only 75 children having history of prematurity. By using 2500 Gm as a cut off point to categorize the birth weight to normal (>2500 Gm) or low birth weight (LBW) (<2500 Gm), we had 317 children gave history of LBW. In studying the relationship between intrauterine life and contracting asthma by the child, our study detected that children who born prematurely were significantly (χ^2=3.96, p=0.047) contracting asthma in a higher rate (29/75) compared to those who born at a full term of gestation (615/2187). Moreover, history of prematurity was found as a risk factor for having asthma by index child (**Table 2**) .

Statistically, insignificant association was found between type of delivery whether normal (28.6%) or cesarean section (27%) and asthma occurrence (χ^2=0.18, p=0.672) .

The children with a history of LBW showed a significant higher rate (144/317) of asthma than those with no such a history (500/1945). Interestingly, our study detected that LBW acts as a significant risk factor for developing asthma (**Table 2**). Interestingly, our results found that the majority (1645) of the study group had history of exclusive breast feeding (BF); moreover 1377 of children had their BF period extended beyond 6 months. Our results showed that participant with such a history demonstrated slightly higher prevalence of asthma (29.2%) when compared to those with no such history (26.4%); however this difference statistically was insignificant (**Table 3**). Also, this study detected that duration of BF (<6 m, or ≥6 m) has no significant relation with development of asthma (χ^2=0.55, p=0.468), in spite that children with history of BF ≥6 m were showing lower prevalence rate of asthma (398/1377) compared to those with duration of BF <6 m (83/ 268) (**Table 3**).

Among the studied children, 95 demonstrated that asthma was present either in father, 99 in mother and 6 in both parents and 212 children had either a sister or brother with asthma. Considering family history of asthma, from **Table 4,** we can notice that a child of asthmatic father or mother were showing significantly higher rate (56/95) and (74/99) of asthma compared to those children with no parental history of asthma (588/2167) and (570/2163) (χ^2=45.23, p=0.000 and χ^2=108.87, p=0.000). Similarly, significantly higher rate of asthma was detected among children when one or more of their sibling was asthmatic (126/212) compared to those with non-asthmatic sibling (518/2050) (χ^2=110.13, p=0.000) Moreover, presence of family history of asthma whether father (OR= 3.86, 95% CI= 2.54 – 5.87), mother (OR= 8.27, 95% CI= 5.21 – 13.15) or sibling (OR= 4.33, 95% CI= 3.24 – 5.80) was detected as a significant risk factor for having asthma by their index child.

To highlight the issue of exposure to cigarette smoking, our study revealed that 88 children were exposed via their mothers and 509 via their fathers during their intrauterine life to smoking. While current exposure to smoking was detected among 42 children through their mothers and 494 children through their fathers. Interestingly, our study found that the prevalence of asthma was significantly higher among children with history of intrauterine exposure to cigarette smoking by their mothers (53/88) (χ^2=45.34, p=0.000) or their father (199/509) (χ^2=36.42, p=0.000) compared to their counter group. Also, significant higher rate of asthma was detected among children whom were currently exposed to cigarette smoking by either mother (19/42) (χ^2=5.91, p=0.015) or father (199/494) (χ^2=43.31, p=0.000). Moreover, this study gave evidence that exposure to cigarette smoking from both parents whether intrauterine or currently was acting as a risk factor for asthma occurrence (**Table 5**).

Discussion. The limitations of our study were the following: 1) Clinical examination of the children was not performed by the authors themselves in order to confirm the diagnosis of asthma. 2) Completing the questionnaire was carried out by the parents of the students without direct supervision of the authors therefore bias could be possible. 3) Recall bios of parents could be existing particularly regarding perinatal events, feeding pattern, and cigarette exposure during pregnancy and early life. There is a controversy on the gender and asthma. Some authors suggested the positive

Table 4 - Family history of asthma.

Risk factor	Asthmatic N = 644		Non - asthmatic N = 1618		χ^2	*p* value	Odds ratio	95% Confidence interval
	n	(%)	n	(%)				
Father								
Yes	56	(58.9)	39	(41.1)	45.23	0.000	3.856	2.54 - 5.87
No	588	(27.1)	1579	(72.9)				
Mother								
Yes	74	(74.7)	25	(25.3)	108.874	0.000	8.272	5.21 - 13.15
No	570	(26.4)	1593	(73.6)				
Both parents								
Yes	3	(50)	3	(50)	1.369	0.242	2.520	0.51 - 12.52
No	641	(28.4)	1615	(71.6)				
Sister or brother								
Yes	126	(59.4)	86	(40.6)	110.13	0.000	4.333	3.24 - 5.8
No	518	(25.3)	1532	(74.7)				

Table 5 - Cigarette smoking exposure related to asthma.

Risk factor	Asthmatic N = 644		Non - asthmatic N = 1618		χ^2	*p* value	Odds ratio	95% Confidence interval
	n	(%)	n	(%)				
Mother smoking during pregnancy								
Yes	53	(60.2)	35	(39.8)				
No	591	(27.2)	1583	(72.8)	45.343	0.000	4.056	2.62 - 6.28
Mother smoking now								
Yes	19	(45.2)	23	(54.8)	5.91	0.015	2.108	1.14 - 3.898
No	625	28.2)	1595	(71.8)				
Father smoking during pregnancy								
Yes	199	(39.1)	310	(60.9)	36.415	0.000	1.887	1.53 - 2.32
No	445	(25.4)	1308	(74.6)				
Father smoking now								
Yes	199	(40.3)	295	(59.7)	43.31	0.000	2.006	1.63 - 2.47
No	445	(25.2)	1323	(74.8)				

association,[8-11] while others were on the negative side.[12-14] In our study, a male predominance was found in asthmatic children with marginal significancy as a risk factor for asthma occurrence. The explanation of gender variation in relation to the childhood asthma is not yet clear, cultural habits of our society to keep females more indoor and being less exposed to the outdoor environment may play a role in this respect. In addition, infection among females during infancy and childhood may protect against asthma.[8] A study from Turkey demonstrated that crowding index acts as a risk for asthma occurrence.[15] This finding was confirmed by our results. Overcrowding and large number of siblings combined with unhygienic environmental conditions and increase infections would have a protective effect against asthma (hygiene hypothesis),[5,16] therefore negative association between crowding and asthma was reported by several studies.[13,16] The positive association found in our study between crowding index and asthma can be related to genetic etiology and sharing the same environment. Similar to results of 2 studies from United Kingdom and Sri Lanka,[7,17] our students whom residing in urban areas have higher rate of asthma, which could be attributed to exposure to ambient air pollution.[6,16,19] In addition to changes in life style, and building, with increasing indoor allergens exposure such as house dust mite, pets, plants and chemical agents in the indoor environment.[5,20] Moreover in recent studies, it had been documented that children living within a farming environment has less atopy and asthma.[5,6] This was explained that through specific microbial exposures either via ingestion or inhalation, which modify the immune development into a non-atopic

direction.[5] Our results provided an evidence that the lower the education of either mother or father, the higher the risk of asthma occurrence among their children. This finding was supporting that of Brazil, Turkey, Sri Lanka and Canada studies.[10,13,17,21] This could be attributed that, with less educated families, there are adverse environmental factors such as tobacco smoking, crowding, bad nutrition and housing conditions, also LBW and prematurity. These factors will make children of less educated mothers and fathers more susceptible to aeroallergen in addition to less medical care.[7,22] In agreement with our results, several studies confirmed the role of premature birth as a risk factor for asthma occurrence.[10,12,23] Moreover, 2 large prospective studies following subjects from birth up to 13 and 31 years old conducted at Denmark and Finland,[4,5] confirmed an inverse association between gestational age and asthma.

Regarding to birth weight, several studies were consistent to our study. They pointed out that LBW acts as a risk factor for asthma development in early childhood.[4,5,23-25] Interestingly, a wide study in 2470 school children aged 5-14 years from Germany, investigating the effect of LBW and prematurity on asthma occurrence and they found that there was a higher prevalence of asthma in full-term LBW children. Therefore, they concluded that birth weight is more important factor than prematurely for asthma development.[26] These findings could be explained that only major changes in airways from birth to adulthood are their size, therefore the immature bronchial tree of premature infants seems to be recovered by school age by catch up improvement in their growth.[26] While in children with history of LBW and associated intrauterine growth retardation, the smaller lungs seems to be an indicator of a damaging factor for parenchymal lung growth, whether direct effect on pulmonary development or indirect by altering the immune system.[26]

Interestingly, Yuan et al[4] in his recent study on 2002, found an increased risk of asthma in children large at birth, with a ponderal index of >2.5 gm/cm^3 . This is related to enhanced fetal growth in the late stage of gestation. This association could be secondary to lower fertility and better socioeconomic status, improved maternal diet leading to higher birth weight and reduced exposure to infectious agents in early childhood.[4,5]

Our study found no significant association between type of delivery and asthma occurrence during childhood, this finding was in agreement to a study carried out in Jordan,[27] while a new study from Sweden stated that there is a significant increase in the risk of developing asthma in children delivered by cesarean section.[28]

The importance of BF issue to childhood asthma is controversial. Several studies conducted in different regions demonstrated insignificant association between BF and asthma.[12,14,27,29] These findings are in accordance to ours. On the contrary, several studies from Japan and United States of America demonstrated the higher prevalence of asthma among children who had been breast fed particularly with asthmatic mothers.[30,31] In contrast to a study from Australia,[32] which detected that BF acts as a reducing factor for asthma development. Moreover, exclusive BF during the first 4-6 months of life was highlighted by several authors and confirmed as a significant protective factor against asthma occurrence.[9,17,33-35] Unfortunately, we could not confirm this association. Those authors explained their findings that feeding the baby by other than BF are potentially allergenic component, while human milk provides an immunomodulatory, anti-inflammatory and nutritional component to the baby.[33,34] In spite of higher rate of children (29.2%) whom were breast fed, insignificant association between BF as well as its duration and asthma occurrence was found in our study. This finding may be attributed that protective effect of BF may be hampered by the presence of other risk factors for asthma, particularly the high prevalence of asthmatic parents among our study population . The existing of family history of asthma as a risk factor for asthma development among their offspring which had been reported by several authors[8-13,16,17,23,24,27,32] was confirmed by the current study. Atopy could be used to explain this finding, in addition asthma is a known familial problem with multifactorial mode of inheritance.[8] Genetics play an important role as indicated by familial aggregation and identification of candidate genes and chromosomal regions linked to asthma risk,[1] in addition to high prevalence of consanguinity in a community such as ours could strength this association. In agreement with several investigators,[9,12,23,27,36,37] our study confirmed that passive smoking exposure during prenatal or childhood through one or both parents be act as a risk factor for asthma development. Prenatal exposure to mainstream smoke from the mother and to environmental tobacco smoke (ETS) from the father in utero has been shown to change fetal lung development and cause airflow obstruction and airway hyperresponsiveness.[22,32,38] Also, results from a recent study from USA suggests that premature exposure to cigarette smoke affects lung airway reactivity by modulating the lung cyclic adenosine monophosphate (cAMP), which acts as an anti-asthmatic by relaxing smooth muscles.[37] Beside it is postulated that current ETS exposure operates as a co-factor with other insults such as intercurrent infections as a trigger of wheezing attacks.[36]

Finally we conclude from our study, that cigarette smoking, prematurely, LBW, family history of

asthma and low educational level of parents be act as risk factors for asthma during early childhood. Therefore, a good antenatal care and quitting smoking are highly recommended to overcome this problem. Further studies regarding the role of BF may be needed.

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