RISK FACTORS OF BRONCHIAL ASTHMA IN BAHRAH, SAUDI ARABIA

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Background: Asthma is a common health problem whose prevalence in Saudi Arabia has risen over the last few decades. Brick factories in the city of Bahrah have exacerbated the problem, and increasing numbers of asthma cases are attending local primary health care centers.

Objective: Determine the risk factors of asthma in Bahrah.

Materials and Methods: The study was comprised of 110 cases of bronchial asthma resident in Bahrah who were diagnosed by the treating physicians and 110 healthy controls matched in age and sex. A questionnaire was completed from cases and controls, consisting of data regarding personal, familial, indoor and outdoor environmental factors that may be potential risk factors to asthma. Bivariate and multivariate logistic regression analyses were done to assess risk factors.

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Results: The mean ages of cases and controls were 22.4 (± 16.7) and 22.8 (± 16.1) years, respectively. Each group consisted of 64 males (58%) and 46 (42%) females. There was a significant association between distance from houses to brick factories and bronchial asthma (Chi square for linear trend = 26.6, p<0.001). Multivariate logistic regression analysis showed that living within one kilometer of a brick factory (OR=5.1, CI=2.33-11.16), family history (OR=4.6, CI=2.16-9.78), allergic rhinitis (OR=3.39, CI=1.49-7.69), skin atopy (OR=4.6, CI=1.53-13.87) and recurrent respiratory tract infections (OR=4.1, CI=1.79-9.22) were independent risk factors for asthma in Bahrah.

Conclusions and recommendations: Brick factories, family history and history of rhinitis, skin atopy, or recurrent respiratory tract infections are risk factors of bronchial asthma. An in-depth study to assess air pollution in Bahrah is recommended. People are advised not to live near brick factories.

Key Words: Bronchial asthma, brick factories, air pollution, allergic diseases.

INTRODUCTION
Asthma is a common condition that affects 5-10% of the population worldwide. Although known since antiquity, asthma has only recently been defined as being only partially reversible. It places a substantial burden on family, health care services and on society as a whole. In children, it impairs ability to enjoy or take part in sporting events, it affects sleep patterns and school attendance. In adults, it affects the quality of life and days of work.

It is widely accepted that there is an increase in morbidity and mortality due to bronchial asthma. This may be attributed to environmental and social changes such as rapid urbanization, increased exposure to indoor allergens and occupational exposure.

In the Kingdom of Saudi Arabia, the prevalence of asthma was 12%, with vast regional variations ranging from less than 10% in Dammam to 23% in Hail. Bahrah is a semiurban area in the middle of the desert along the highway between Makkah and Jeddah. Two brick factories are located near houses in the city. In the last few years the number of asthma cases attending local primary health care centers (PHCCs) has risen. This study aims to examine the risk factors of asthma in Bahrah.

MATERIALS AND METHODS
A case control design was used to execute the study. Assuming that the prevalence of exposure among the controls was 20%, study power of 80% at 95% confidence level with 1:1 case control ratio, a sample size of 110 cases and 110 controls was determined.

All cases of bronchial asthma residing in Bahrah diagnosed by treating physicians and consistent with diagnostic criteria of asthma in the national protocol and attending the outpatient clinics of the two PHCCs in Bahrah were included until the predetermined sample size was recruited. For each case, a control of corresponding age and sex was chosen from visitors to PHCCs in Bahrah with no history of asthma, nor complaint of respiratory symptoms.

Data were collected by means of a structured questionnaire completed by personal interviews with cases and controls. Parents of children aged less than 10 years were interviewed to complete the questionnaire. Data consisted of personal characteristics,
e.g. age, sex, medical history and environmental exposures, e.g. to indoor plants, animals and smoking.

To determine the distance from houses to brick factories a map of the city drawn to the scale of 1.5: 1000000 was used. The houses were located on the map and the distance to the nearest factory was measured and converted into actual distances. Cases were considered severe if they reported history of admission to hospital as a result of asthma.

Data were checked for completeness and consistency. SPSS software was used for data analysis. Chi-square for linear trend was used to assess association between bronchial asthma and distance from houses to factories. The odds ratio and its 95% confidence interval were used as a measure of risk. Factors found to be significantly associated with asthma in bivariate analysis were submitted to multivariate logistic regression analysis for control of confounders.

RESULTS
A sample of 110 cases and 110 controls were included in the study. Each group consisted of 64 males (58%) and 46 (42%) females. The mean ages for cases and controls were 22.4 (± 16.7) and 22.8 (± 16.1 years), respectively.

Table 1 shows that there is no association between education and bronchial asthma (P>0.05). The risk of asthma is significantly higher among housewives and students than other groups (OR=3.29, CI=1.21- 9.02 and OR= 2.92, CI=1.42-7.03, respectively). Persons with family history of asthma face more than

| Factor                  | Cases No. (%) | Controls No. (%) | OR  | Confidence interval |
|-------------------------|---------------|------------------|-----|---------------------|
| **Education:**          |               |                  |     |                     |
| Illiterate              | 46 (41.8)     | 43 (39.9)        | 1.0 |                     |
| R & R                   | 4 (3.6)       | 11 (10.0)        | 0.34| 0.07-1.27           |
| Primary                 | 31 (28.2)     | 27 (24.5)        | 1.07| 0.53-2.20           |
| Intermediate            | 16 (14.5)     | 17 (15.5)        | 0.88| 0.37-2.11           |
| Secondary and above     | 13 (11.8)     | 12 (10.9)        | 1.01| 0.38-2.72           |
| **Occupation:**         |               |                  |     |                     |
| Manual worker           | 15 (13.6)     | 30 (27.3)        | 1.0 |                     |
| House wife              | 23 (20.9)     | 14 (12.7)        | 3.29| 1.21-9.02           |
| Clerk                   | 6 (5.5)       | 7 (6.4)          | 0.86| 0.22-3.01           |
| Student and preschool   | 38 (34.5)     | 26 (23.6)        | 2.92| 1.23-7.03           |
| Retired and jobless     | 28 (25.5)     | 33 (30.0)        | 1.70| 0.71-4.10           |
| **Family history:**     |               |                  |     |                     |
| Yes                     | 78 (70.9)     | 34 (30.9)        | 5.45| 2.93-10.2           |
| No                      | 32 (29.1)     | 76 (69.1)        |     |                     |
| **Allergic rhinitis:**  |               |                  |     |                     |
| Yes                     | 69 (62.7)     | 16 (14.5)        | 9.89| 4.87-20.31          |
| No                      | 41 (37.3)     | 94 (85.5)        |     |                     |
| **Skin allergy:**       |               |                  |     |                     |
| Yes                     | 33 (30.0)     | 7 (6.4)          | 6.31| 2.55-17.67          |
| No                      | 77 (70.0)     | 103 (93.6)       |     |                     |
| **Recurrent resp. infections:** | | | | |
| Yes                     | 68 (61.8)     | 15 (13.6)        | 10.5| 5.11-21.89          |
| No                      | 42 (38.2)     | 95 (86.4)        |     |                     |
Table 2: Environmental factors among cases and controls of bronchial asthma in Bahrah, Saudi Arabia

| Factor                  | Cases No. (%) | Controls No. (%) | OR     | Confidence interval |
|-------------------------|---------------|------------------|--------|---------------------|
| **Home smoking:**       |               |                  |        |                     |
| Yes                     | 39 (35.5)     | 40 (36.4)        | 0.96   | 0.53-1.74           |
| No                      | 71 (64.5)     | 70 (63.6)        |        |                     |
| **Indoor plants:**      |               |                  |        |                     |
| Yes                     | 43 (39.9)     | 34 (30.9)        | 1.43   | 0.79-2.62           |
| No                      | 67 (69.1)     | 76 (69.1)        |        |                     |
| **Indoor animals:**     |               |                  |        |                     |
| Yes                     | 34 (30.9)     | 17 (15.5)        | 2.45   | 1.26-5.01           |
| No                      | 76 (69.1)     | 93 (84.5)        |        |                     |
| **Building materials:** |               |                  |        |                     |
| Red brick               | 15 (13.6)     | 17 (15.5)        | 1.00   |                     |
| Cement and Wood         | 86 (78.2)     | 90 (81.1)        | 1.08   | 0.48-2.49           |
| Cement                  | 9 (8.2)       | 3 (7.2)          | 3.4    | 0.66-22.5           |
| **Ground materials:**   |               |                  |        |                     |
| Soil                    | 17 (15.5)     | 24 (21.8)        | 1.0    |                     |
| Tiles                   | 33 (30.0)     | 49 (44.5)        | 0.95   | 0.42-2.20           |
| Cement                  | 60 (54.5)     | 37 (33.6)        | 2.29   | 1.02-5.17           |
| **Use of insecticides** |               |                  |        |                     |
| Yes                     | 80 (72.7)     | 78 (70.9)        | 1.09   | 0.58-2.07           |
| No                      | 30 (27.3)     | 32 (29.1)        |        |                     |
| **Cleansing materials** |               |                  |        |                     |
| Water                   | 3 (2.7)       | 5 (4.5)          | 1.0    |                     |
| Soap                    | 14 (12.7)     | 27 (24.5)        | 0.86   | 0.14-6.4            |
| Chemicals               | 93 (84.5)     | 78 (70.9)        | 1.99   | 0.37-13.2           |

Table 3: Distance between houses of cases and controls of bronchial asthma and brick factories and roads in Bahrah, Saudi Arabia

| Distance in kilometers | Cases No. (%) | Controls No. (%) | Chi square for linear trend | OR     | Confidence interval |
|------------------------|---------------|------------------|-----------------------------|--------|---------------------|
| **Occurrence of asthma:** |               |                  |                             |        |                     |
| < 1                    | 66 (60)       | 22 (20)          | 26.6*                       | 10.2   | 3.07-38.63          |
| 1-                     | 23 (20.9)     | 47 (42.7)        | 1.66                        | 0.50-6.47 |
| 3-                     | 16 (14.5)     | 24 (21.8)        | 2.27                        | 0.62-9.36 |
| 5+                     | 5 (4.5)       | 17 (15.5)        | 1.0                         |      |
| **Distance to the road:** |               |                  |                             |        |                     |
| < 1                    | 18 (16.4)     | 23 (20.9)        | 0.66                        | 1.96   | 0.28-22.52          |
| 1-                     | 80 (78.2)     | 72 (65.5)        | 2.78                        | 0.44-29.84 |
| 3-                     | 4 (3.6)       | 10 (9.1)         | 1.0                         | 0.1-14.69 |
| 5+                     | 2 (1.8)       | 5 (4.5)          | 1.0                         | 0.2    |
| **Severity of asthma:** |               |                  |                             |        |                     |
| < 1                    | 60 (63.8)     | 22 (20.0)        | 27.7*                       | 9.27   | 2.79-35.23          |
| 1-                     | 18 (19.1)     | 47 (42.7)        | 1.3                         | 0.38-5.18 |
| 3-                     | 11 (11.7)     | 24 (21.8)        | 1.56                        | 0.40-6.77 |
| 5+                     | 5 (5.3)       | 17 (15.5)        | 1                           |      |

* = p<0.001
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five-fold the risk of its occurrence compared to those without such history (OR=5.45, CI=2.93-10.2). Persons suffering from allergic rhinitis, skin atopy or recurrent respiratory infections face an increased risk of asthma (OR=9.89, CI=4.87-20.31; OR=6.31, CI=2.55-17.67 and OR=10.5, CI=5.11-21.89 respectively).

Table 2 reveals the risk of asthma to be significantly high among persons living in houses with concrete courtyards, or with pets (OR=2.45, CI=1.26-5.01 and OR=2.29, CI=1.02-5.17, respectively). The risk of asthma is also high, but not statistically significant, among persons who have indoor plants or those who use chemical cleansing agents (OR=1.43, CI=0.79-2.62 and OR=1.99, CI=0.37-13.15 respectively).

Table 3 shows that there is significant linear association between both the occurrence and severity of bronchial asthma with the distance from houses and brick factories (P<0.001). The highest risk was among those living within one kilometer of the factories (OR=10.2, CI=3.07-38.63 and OR=9.27, CI=2.79 - 35.23, respectively). There was no linear trend between distance from the main road in Bahrah and occurrence of asthma (P>0.05).

Table 4 shows the result of multivariate logistic regression analysis of factors found to be significantly associated with asthma in bivariate analysis. Persons living within more than five-fold the risk of asthma compared to those living further away (OR=5.1, CI=2.33-11.16). Also, persons with positive family history of asthma, skin atopy, allergic rhinitis and recurrent respiratory infections are at high independent risk of asthma (OR=4.6, CI=2.16 - 9.7; OR=4.6, CI=1.53-13.87; OR=3.4, CI=1.49-7.69 and OR=4.1, CI=1.79-9.22, respectively).

DISCUSSION

Asthma is the most common chronic disease in children and an important disease among adults.3,8 Risk factors of asthma vary from place to place according to several factors, including urbanization.9

This study revealed that allergic rhinitis and atopic dermatitis increased the risk of asthma. Many other studies support this finding and have shown the co-existence of allergic rhinitis and asthma.10-13 Zhao et al used multivariate logistic regression analysis and found a high significant risk of asthma among persons with allergic rhinitis or itchy rash.14 El-Gamal et al reported independent association between personal history of allergy and bronchial asthma.15 Immunological studies have shown that children with atopic dermatitis present non-specific bronchial hyperactivity (58-82%) which is a risk factor for later development of asthma.16,17

Recurrent respiratory tract infections were found to be an independent risk factor for bronchial asthma in the present study (OR=4.1, CI=1.79-9.22). Paul et al considered viral respiratory diseases as a defined risk factor for developing asthma.18 Martinez et al found also that recurrent lower respiratory tract infection in early life triggers the development of asthma later in life.19

The present study revealed that persons with family history of bronchial asthma were at high risk of developing asthma (OR=4.6, CI=2.16-9.78). The same finding...
was reported by Infante-Rivard who found increased significant risk of asthma among those with familial history of asthma.20 Al-Frayh et al supported this finding and reported that 35.9% of children who wheeze have mothers with asthma and 40.7% have fathers with asthma.21 Studies of twins have shown a significant increase in concordance among monozygotic twins compared to dizygotic twins, providing evidence for genetic predisposition.22 However, no gene or genes involved in the inheritance of atopy and asthma have been identified.23

Environmental tobacco smoke was suggested as a risk factor for bronchial asthma.24,25 The present study did not support this suggestion. In children, this inconsistency may be explained by the observation that more parents whose children had been diagnosed as asthmatic had quit smoking than parents of healthy controls.26 In agreement with the present finding, Pewits found that smoking does not appear to be related to asthma per se in adults when chronic conditions are removed and those at risk do not smoke, quit smoking or smoke very little.27

Distance from home to brick factory as a measure of exposure to air pollution was found to be a significant risk factor for both the occurrence and severity of asthma. Living near these factories (≤ 1 Km.) carried the highest risk (OR=5.1, CI=2.33 – 11.16). These factories burn fuel and tar to heat bricks. This pollutes air with SO₂, NO₂, CO₂ and CO particles.28 Several mechanisms have been proposed to explain the pollution-induced asthma. These include damage to airway epithelium, induced changes in lung function and enhanced release of inflammatory mediators.29

This study shows the presence of animals at home to be a risk factor for asthma (OR=2.27). However, the risk was not statistically significant (CI= 0.93–5.55). Many investigators have studied the etiological significance of animal handlers and suggested that they had high risk of asthma.30,31

Regarding the role of exposure to indoor plants, the present study reveals an insignificant association between indoor plants and asthma (OR= 1.43, CI=0.79 – 2.62). This finding is inconsistent with reports of high sensitization of allergic patients to regional pollens.32 The inconsistency may be due to differences in exposure to specific regional pollens. Precise measurement of pollen allergens can also give more accurate results about the role of plants and pollens. The lack of precise measurement for detailed environmental factors and the small sample size were the main limitations of the present work.

RECOMMENDATIONS
An in-depth environmental study to assess the levels of air pollutants in Bahrah is highly recommended. People should not live near brick factories. Atopic diseases, e.g. allergic rhinitis and atopic dermatitis, should be prevented through the avoidance of inhalant and cutaneous allergens, particularly by those with positive family history of asthma.

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