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RISK FACTORS INVOLVED IN ELEVATION OF ASTHMA INCIDENCE AMONG OIL AND GAS REFINERIES WORKERS IN KIRKUK, IRAQ

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ABSTRACT

Background: There is no universally accepted definition of asthma. Asthma is a syndrome characterized by airflow obstruction. Asthmatics host a special type of inflammation in the airway mucosa that makes them more responsive to a wide range of triggers compared to non asthmatics, leading to excessive narrowing with the consequent reduced airflow, symptomatic dyspnea and wheezing, that is usually reversible. Asthma might be associated with various risk or predisposing factors like genetics and family history, body mass index, smoking, stress, respiratory infections, age, gender, occupation and education level and others might be still unkown. The present study was an attempt to assess the relationships of asthma and selected predisposing factors among the Iraqi asthmatic patients working in gas and oil refinaries in Kirkuk district. **Methods**: Patients previously diagnosed with asthma by physician were chosen. The inclusion criteria for all cases were bronchial asthma, where the diagnosis was established through demonstrating reversible airway obstruction. The participants were requested to fill in a questionnaire for identifying their demographic characteristics such as age, gender, asthma history, medical history and details related to current asthma exacerbation. Body mass index was also considered. **Results**: The results of North Oil and Gas Company asthmatic patients, Other asthmatic patients and control group revealed high levels of incidence of asthma according to males, family with no asthmatic history and nonsmokers and the variations were mostly statisticaly significant($P > 0.01$).The study of education,age,body mass index and occupation showed a variable effect on asthma induction among different three groups estimated. **Conclusions**: There was no association

between asthma and smoking and body mass index. Gender, family history and occupation were highly effective factors causing an induction of asthma in the patients locally studied.

1. INTRODUCTION

Asthma is a heterogeneous disorder that is characterized by variable airflow obstruction, airway inflammation and hyperresponsiveness, and reversibility either spontaneously or as a result of treatment. Multiple etiologies no doubt exist for both its inception and symptom exacerbation once the disease is established. Factors underlying inception can range from viral respiratory tract infections in infancy.[5,6] to occupational exposures in adults.

Variability in the type of airway inflammation may underlie this heterogeneity.[7,8-11] There is good evidence that both inherited and environmental factors influence the risk of developing asthma.[12] Asthma occurs in genetically susceptible individuals as a result of exposure to risk factors including allergens, environmental irritants and infection.[13] *W*orkrelated asthma is defined as asthma that is either attributable to or exacerbated by workplace environmental exposures. It encompasses two separate but related clinical entities: occupational asthma (OA) and work- aggravated asthma (WAA).[62] In both circumstances, the work environment contributes to the symptoms of asthma. However, OA is defined as asthma that is actually caused by the workplace, whereas WAA is classified as pre-existing asthma with symptoms aggravated by the work environment.[62-64] The effects of OA are numerous. In addition to the immediate health consequences, many studies have demonstrated the persistence of asthma symptoms, bronchial hyperresponsiveness, and airway inflammation even after removal from the causal agent.[65-68] The incidence of asthma has increased by four-fold in the last 20 years. Nowadays, the disease affects as much as 15% of the population in industrialized countries.[69] An analysis of general populationbased studies published up to 2007 showed that 17.6% of all adult-onset asthma is due to workplace exposures.[70-73] Asthma is caused by a complex interaction of environmental and genetic factors that researchers do not yet fully understand. These factors can also influence how severe a person's asthma is and how well they respond to medication.[92] A family history of asthma or atopy is an important risk factor for the development of asthma in an individual, and genetic factors are important in the etiology of asthma. Asthma genetic, however, does not show the classical mendelian inheritance pattern. Asthma is a polygenic disease with a variety of genes interacting to increase the risk of developing asthma.

Monozygotic twins show only 50-60% concordance for atopic disease and only 26% concordance for asthma. This may be partly due to mutations in genes that influence the development of asthma. but also indicates that the environment has a major impact on whether an individual develops asthma.[93] Recently, asthma and obesity have evolved into two major health concerns in developed countries.[127] Many publications have shown an association between asthma and obesity in adults and children.[128-131] The relationship between asthma and smoking is unclear, and contradictory results have been found in different studies. Smoking has been considered a risk factor for incident asthma in some studies.[138-140] while others have found no association.[141] Stress is increasingly recognized as a risk factor for incident asthma. High versus low stress was found to be associated with a two- to three-fold higher risk of self-reported asthma incidence in several longitudinal population studies.[146] The occurrence of acute lower respiratory infections is strongly associated with the risk of new adult-onset asthma.[155] The link between respiratory infections and the development of asthma in adulthood has been proposed for many decades[156] although it is still unclear how respiratory infections might induce asthma. Age-related altered antigen presentation and decreased specific antibody responses may lead to subtle immune deficiencies that may allow respiratory infections to provoke injury to the airways. This, in turn, may set up a vicious cycle of an ongoing inflammatory process leading to asthma.[157]

2. MATERIALS AND METHODS

Description of the refinery

This study was carried out at Kirkuk city in the North Oil Company (N.O.C.), which is a state company within the Ministry of Oil of Iraq. The company contains more than fifty installations comprising pump stations, process units , oil tank fields ,degassing stations, gas compressor stations , water treatments plants, electric generation stations , and a large number of oil wells which are connected with a network of flow lines and pipelines dispersed throughout the company's area of operation, This company occupies first position among extracting oil companies in the Middle East and the world at both.

The number of workers at this company is about 12000 workers distributed in six main sections and these sections are divided into major sub-sections. There are roughly three types of gases emitting from oil companies: suffocating gases (H2, CH4, CO2) where they take a space in the air of the working environment which leads to lowering the percentage of

oxygen, irritating gases (Cl2, F) in which they cause irritation and inflammation in both skin and respiratory tissues and the erosion of these tissues leads to the death of the cells, and toxic gases (CO, H2S) poisoning with CO causes stress, mental illusion, losing the ability to concentrate and unconscious while H2s affects the respiratory center in the brain. There are heavy metals and other substances in which the continuous exposure to them causes chronic poisoning among the workers as a result of their exposure to them either in the form of dust or smoke or steam vapours in the working environment and injury is caused either by inhalation or precipitation the major heavy metals are Pb, Cu, Ni, Cr, Cd, S, P and CCl4.

Study design

This cross-sectional study was conducted in kaiwan General hospital in the North Oil Company and Allergy /Immunology Center in Kirkuk city during the period from January 2014 August 2014. Data were collected by personal interview and using questionnaire. Participants were informed about the study, and those who agreed to participate were included.

Patients selection

100 subjects were included in this study from both genders. Their age ranging from 25 to 65 years. 50 of them were attending allergy/immunology center in Kirkuk city. The other 50 adult asthmatic patients were working in North Oil Company.

Asthmatics were defined as having work-related asthma if they answered positively the questions: ―Have you ever had respiratory symptoms in relation to your work? Did the symptoms improve on absence from work?"

A number of studies carried out on asthmatic populations.[246] and community samples.[248] have tried to assess the proportion of asthma of occupational origin. The term occupational asthma is often used in these studies. This term implies a causal relationship between the exposure and the disease.[253] However, in none of the studies cited is it possible to tell whether the asthma had started prior to the exposure or if it had started after.

Exclusion criteria

1. patients with chronic obstructive pulmonary disease (COPD).
2. pregnant women.
3. patients with cardiovascular disease.

4. Children and adolescents.

5. Uncooperative patients

Control group

Fifty individuals were considered as a control group in this study. They were apparently healthy, after taking details of history of asthma and clinical examination the same methods and instruments were used in all stages for the control group as for the asthmatic group.

Diagnosis

Clinical evaluation

Patients previously diagnosed with asthma by physician were chosen. The inclusion criteria for all cases were bronchial asthma, where the diagnosis was established through demonstrating reversible airway obstruction.

Questionnaire

The participants were requested to fill in a questionnaire for identifying their demographic characteristics such as age, gender, asthma history, medical history and details related to current asthma exacerbation.

Body parameter

The following anthropometric measurements were obtained: weight, and height, BMI (body mass index). Weight was measured after calibration the scale before each weight measurement. Height was obtained with an aluminum cursor stadiometer graduated in millimeters. The subject was barefoot, with heels, back, and head in contact with the stadiometer in horizontal plane. Body mass index (BMI) had been estimated from person's weight and height; it was calculated by dividing weight (in kilograms) by height (in square meters).

BMI≤18.5 (Underweight).

BMI=18.5-24.9(Normal weight).

BMI=25-29.9(Over weight).

BMI≥ 30(Obese) [254].

3. RESULTS

Age distribution of asthmatic patients and control group

Table 1 shows that the highest percentage (40%) of asthmatic patients was in the age group 25-35 years old in North Oil and Gas Company worker patients and (32%) in other patients respectively. The present data showed that the lowest percentage (12%) of the disease was in the age group 56-65 years old in oil refinery worker patients. These findings were calculated at a P value less than 0.05 and there was a significant difference in age distribution among asthmatic patients (P < 0.05).

Table 1. Age distribution of asthmatic patients and control group

Age	Oil & Gas company patients		Other patients		Control	
	No.	%	No.	%	No.	%
25-35	20	40	12	24	30	60
36-45	15	30	16	32	10	20
46-55	9	18	10	20	5	10
56-65	6	12	12	24	5	10
Total	50	100	50	100	50	100

□2 = 14.872; p= 0.02127597, 0.01≤ P ≤ 0.05, Significant(S)

Gender distribution among asthmatic patients and control group

Table 2 shows that 20 (40%) of asthmatic patients were females and 30 (60%) were males in North Oil and Gas Company worker patients whereas 35 (70%) of asthmatic patients were females and 15 (30%) were males in other patients 21 (42%) of the control were males and 29 (48%) were females and revealed that there was a statistically high significant difference (P< 0.01).

Table 4.2. Gender distribution of asthmatic patients and control group

Gender	Oil & Gas company patients		Other patients		Control	
	No.	%	No.	%	No.	%
Male	30	60	15	30	21	42
Female	20	40	35	70	29	58
Total	50	100	50	100	50	100

□2 = 9.253; p= 0.0097, P < 0.01, Highly Significant (HS)

Family history distribution of asthmatic patients and control group

Table 3 shows that only 18 (36%), 22 (44%) and 5 (10%) of North Oil and Gas Company worker patients, other asthmatic patients and control group respectively revealed a positive family history of asthma while the rest had negative history. These results were a statistically highly Significant (P < 0.01).

Table 4.3. Distribution of family history of asthmatic patients and control group:

Family history	Oil & Gas company patients		Other patients		Control	
	No.	%	No.	%	No.	%
Positive	18	36	22	44	5	10
Negative	32	64	28	56	45	90
Total	50	100	50	100	50	100

□2 = 15.048; p= 0.00053997, P < 0.01, Highly Significant (HS)

Smoking distribution among asthmatic patients and control group

Table 4 shows that the smokers frequencies were) 18%(,)6%(and)12%(for North Oil and Gas Company worker patients, Other patients and control group respectively. There was a statistically non-significant difference between these groups (P > 0.05).

Table 4.4. Smoking distribution of asthmatic patients and control group:

Smoking	Oil & Gas company patients		Other patients		Control	
	No.	%	No.	%	No.	%
Smoker	9	18	3	6	6	12
Non smoker	41	82	47	94	44	88
Total	50	100	50	100	50	100

□2 = 3.409; p= 0.18, P > 0.05, Not Significant (NS)

Occupation distribution of asthmatic patients and control group

Table 5 shows that the highest percentage was (32%) of technicians, (60%) housewives and (44%) engineers for North Oil and Gas Company worker patients, Other patients and control group respectively. There was a highly significant difference (P < 0.01).

Table 5. Occupation distribution of asthmatic patients and control group:

Occupation	Oil & Gas company patients		Other patients		Control	
	No.	%	No.	%	No.	%
Engineer	12	24	0	0	22	44
Technician	16	32	0	0	14	28
Health care staff	5	10	0	0	3	6
Driver	3	6	3	6	1	2
House wife	1	2	30	60	2	4
Business	13	26	17	34	8	16
Total	50	100%	50	100%	50	100%

□2 = 94.988; p= 0.0002, P < 0.01, Highly Significant (HS)

Learning level distribution of asthmatic patients and control group

Table 6 shows that the highest percentage of asthma was (34%) of graduates from institution, (38%) non-learned and (48%) of graduated from college subjects in the North Oil and Gas Company worker patients, Other patients and control group respectively. There was a statistically highly significant difference between these groups ($P < 0.01$).

Table 6. Distribution of asthmatic patients and control group according to learning level

Education	Oil & Gas company patients		Other patients		Control	
	No.	%	No.	%	No.	%
Non-learned	2	4	19	38	2	4
Primary school	5	10	8	16	7	14
Secondary school	10	20	17	34	3	6
Institution	17	34	5	10	14	28
College	16	32	1	2	24	48
Total	50	100	50	100	50	100

$\chi^2 = 62.082$; p= 0.0002, P < 0.01, Highly Significant (HS)

Body mass index distribution of asthmatic patients and control group

Table 7 shows that the highest percentages were (44%) overweight, (60%) obese and (42%) obese of North Oil and Gas Company worker patients, Other patients and control group. There was no statistically significant difference between these groups ($P > 0.05$).

Table 7. Distribution of body mass index (kg/m2) of asthmatic patients and control Group

Group	Oil & Gas company patients		Other patients		Control	
	No.	%	No.	%	No.	%
Normal weight (18.5-24.9)	8	16	9	18	12	24
Over weight (25-29.9)	22	44	11	22	17	34
Obese (≥ 30)	20	40	30	60	21	42
Total	50	100	50	100	50	100

$\chi^2 = 7.1$; p=0.13, P > 0.05, Not Significant (NS)

4. DISCUSSION

The results of presen study showed that the majority of cases occurred between the ages 25-35 years among oil refinery patients and with the age groups 36-45 years among other patients (control) and the results showed that there was a significant relationship between age

group and asthma (P < 0.05). These results were almost similar to the findings of Cawen et al[256] and AL-Tae[257] who stated that the signs and symptoms of asthma generally appear before the fourth decade of life and decrease with old age. Furthermore,Muhbes found that asthma increased in the age range (29-38) and (39-48).[258] In the case of both oil refinery patients and other patients group increased prevalence of asthma in these age groups might be due to their exposure to various workplace and environmental stimuli as allergen, chemicals, air pollution, drugs, stress, chest infection. These results were almost similar to those of Bakke who suggested that work-related respiratory symptoms were less frequently reported with increasing age, being approximately four-fold more frequent in the youngest age group compared to the oldest individuals.[259]

Regarding the gender distribution of asthmatic patients the present results showed that in the oil refinery patients 20 (40%) of asthmatic patients were females whereas in the city patients 35 (70%) of asthmatic patients were females. These results were highly significant (P < 0.01). In case of oil refinery patients these results might be because the number of male workers in the company was already higher than females also male workers are working daily closer to the emitted gases in the fields whereas females are mostly working in the office, however, males are working in night shifts another source of stress for them. This finding provides supportive evidence to the fact that males seek more employment opportunity than females and taking most of the family bread winners` role in our country and in the third world nations. These results were almost similar to those of Bakke[259] who found that the prevalence of work-related asthma was twice as high in men as in women. In case of city patients these results are explained by the fact that incidence of asthma was higher among females than males in adults. This finding was in agreement with a study carried on males and females randomly selected from the general population and followed for 8–10 years.[260] At baseline, asthma was 20% more frequent in females than in males over the age of 35 years. Several community surveys in Europe[261] have shown that occupational airborne exposure is widely distributed in the general population, varying between 25% and 60% in men and between 8% and 20% in women.

The results of the current study showed that there was higher percentage of positive family history 32 (64%) among oil refinery patients and 28 (56%) among other asthmatic patients group. There was a highly significant relationship between family history of asthma and asthma in nonasthmatic history family(P < 0.01). Because asthma has familial predisposition,

and genetic basis and it is caused by a complex interaction of environmental and genetic factors that is why researchers do not yet fully understand. Numerous studies have shown a strong association of asthma risk with family history of asthma and allergies.

Moreover, reports carried out by Martinez et al[265] and Rusconi et al[266] revealed a strong association between parental history of asthma and asthma found in this study.

Farthermore, the data of this study showed that there were 9 smokers and 41 non smokers among the oil refinery patients while there were 3 smokers and 47 non smokers in the city patients whereas the number of smokers were 6 and non smokers 44 among the control group. The results demonstrated non-significant difference in smoking distribution among asthmatic patients ($P > 0.05$). These results were almost similar to those of Eagan[141] who concluded no association between asthma and smoking. Several previous community studies[267] have found no relationship between smoking and the prevalence of asthma. The present result was different from those of Larsson,[138] Ronmark[139] and Piipari[140] who suggested that cigarette smoking might be a risk factor for exacerbation of asthma. Active cigarette smoking has been associated with the development of asthma in some,[270] but not all studies.[274]

The results of the current study shows that the highest percentage of asthma within the oil refinery study group patients was among technicians, business and engineers while the highest percentage in the other patients group was among housewives. These results were statistically highly significant ($P < 0.01$). In case of oil refinery patients, the technicians revealed the higher percentage of asthmatic patients because they were in the location close to the emitted gases and heavy metals in the work place and they had higher exposure. These findings were almost similar to those of stoleski[276] who suggest that occupational exposure in the petroleum industry is associated with a higher prevalence of respiratory and nasal symptoms, lung function impairment and higher prevalence of non specific airway responsiveness. Also they work during night shifts which represents a stress source for them.

Moreover, a study performed by Eng et al.[277] revealed an association between workrelated stress and asthma. Stress has been shown to modulate and activate a number of biological pathways that may be involved in asthma pathophysiology.[278] Shift work is the work done in periods other than conventional working hours (7 am to 6 pm).[280] Nowadays shift work is an

unavoidable part of the work system of many industries such as refineries. The oil refinery industry is an around-the-clock operation.[281] More than 20 to 30 percent of workers are shift workers.[282] Shift-workers are forced to work and sleep against normal chrono-biological rhythms. They sleep at times that their organism is set to be active, and work when their physical and psychical effectiveness is generally low. These contradictions results in various disorders; most frequently, sleep disturbances.[283] In case of housewives because they usually spend the majority of their time inside the house and they are exposed to indoor air pollutants which include (house dust mites, dust particles, cockroaches, mold, chemical irritants and stove fumes) Poor air quality inside a building might constitute a serious environmental threat.[284] It has been confirmed that air pollution inside buildings is usually 2 - 5 or even 100 times higher than outside.[285] Interestingly, not only pollutants coming from outside are responsible; pollen, house-dust allergens such as mite allergens and cockroach allergens, as well as fungal spores, animals, household cleaning products, building materials, air fresheners, naphthaline and even dry-cleaned clothes also exert an allergenic effect [286]. House owners are also threatened with breathing fumes emitted during the process of burning traditional biofuels, such as gas, coal and wood, as well as highly toxic nicotine smoke, which contains more than 6000 toxins. One such component of cigarette smoke is nitrogen oxide.[287]

The results of the current study showed that the highest percentage of the disease was among institution and college graduates of the oil refinery group whereas in the other patients groups the highest percentage were among noneducated(nonlearned) and secondary school graduates. There was a statistically highly significant difference between these groups ($P < 0.01$). These results logically follow the results of the relationship between asthma and occupation in which the institution graduated students usually are employed as technicians and the college graduated as engineers in the north oil company while in the other group patients the higher percentage are non-learned and secondary school educated which represents the housewife group. Lower socioeconomic status is consistently associated with poorer health, measured both by morbidity and mortality. Several cross-sectional studies have observed an association of a lower socioeconomic status with an increased prevalence of asthma or respiratory symptoms.[290] In a study carried out by Eagan found that lower educational(non-learned) level is a risk factor for the incidence of adult asthma, even after adjustment for sex, age, hay fever, smoking and occupational exposures.[291]

However, The results of this study showed that the highest percentage (44%) of oil refinery patients where over weight while the highest percentage was (60%) among other patients and there was no statistically significant difference. ($P > 0.05$). This may be because of the small size of the population studied in the present attempt. These results were almost similar to those of Barranco[292] who found no association between asthma and obesity. In contrast, Chinn,[128] Chen et al.[129] and Shaheen et al.[130] concluded an association between asthma and obesity. Several studies have been shown that obesity could be a risk factor for adult asthma at least in women.[129]

5. CONCLUSIONS

There was no significant association between smoking and working in oil and gas refineries in relation to asthma illness.The body mass index did not show any effect of overweight with incidence of asthma among oil and gas refineries workers.Housewives and technicians working in oil refineries were under risk of catching asthma more than any other population groups. The mechanisms of toxic products of gas and oil refineries on immunophysiology leading to asthma need further investigations.

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