Respiratory Symptoms Reported by Adults Living in an Air Polluted Area in Jordan

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Abstract

Al-Hashemeya area is declared officially as one of the most air polluted areas in Jordan. Some of the hazardous air pollutants in Al-Hashemeya are SO2, CO, CO_2, NOx and PM_{10}. This descriptive study aims to describe prevalence of self-reported respiratory symptoms in Al-Hashemeya area, and examine the factors associated with respiratory symptoms.

The sample was 400 male and female residents of Al-Hashemya 18 years or older. Data on respiratory symptoms were collected using Respiratory Risk Profile (RRP). The most frequent respiratory symptoms self-reported were difficulty in breathing when inhale dust or fumes (53%), flu lasting more than one week (51%), difficulty in breathing when exercising (42%), difficulty in breathing because of nasal congestion (39%), mucus without having cough (39%), difficulty in breathing when exposed to cold air (37%). Use of asthma medication was the only factor associated with respiratory symptoms ($r = 0.27$, $p = .01$). Conclusion: the rates of self-reported respiratory symptoms were high.

Keywords: Air pollution, adult, prevalence, Jordan, respiratory symptoms.

(J Med J 2006; Vol. 40 (1): 21- 28)

Received	Accepted
June 2, 2005	January 14, 2006

Introduction

Air pollution in Jordan is rising. According to the Royal Scientific Committee (2001), Al-Hashemeyia area is one of the most air-polluted areas in Jordan. [1] Sources for air pollution in Al-Hashemeyia area are: 1) Stationary sources including the oil refinery, King Hussein Thermal Power Plant (an oil power plant), and Kherbat Assamra landfills. Some of the hazardous chemicals produced by these sources are sulfur dioxide (SO_2), carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NOx) and particulate matter (PM_{10}); 2) mobile sources related to combustion-engine vehicles such as diesel and gas-powered vehicles which are considered significant air pollution sources in this area since the area is crossed by two highways with heavy traffic. [2]

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In fact, the levels of CO, H_2S, and NO in Al-Hashemeyia, measured monthly, over 1 year period and taking into consideration the weather parameters exceeded the permitted levels. [1]

People exposed to toxic air pollutants at sufficient concentrations and durations may have an increased chance of experiencing serious health problems. Indeed, animal experiments demonstrated that rats exposed to air pollutants developed a marked airspace inflammatory response because of retaining pollutants in the interstitial tissue of the lung. [3] Furthermore, air pollutants change chemical reactions within individual cells; these changes impair cell function and eventually organ damage. [4]

Significance: Environmental problems, in particular air pollution, in Jordan are rising. [5] Al-Hashemeyia is one of the most air polluted areas. However, no data are available on the health status of residents of Al-Hashemeyia. Therefore, this is the first epidemiological study to describe prevalence of self-reported respiratory symptoms by adults 18 years and older living in Al-Hashemeyia area, and examine the relationships between characteristics of the sample and self-reported respiratory symptoms.

Methodology

Research Design: This study utilized a descriptive design. Participants were recruited from Al-Hashemyia area. The Hashemite University where the primary investigator of this research is employed is located 8 kilometers from Al-Hashemyia area. This suburban town is part of the Zarqa district in Jordan. The total population of the area is 13,000. [6]

Sample: The target population for this study is composed of all adults living in Al-Hashemeyia for at least 1 year.

Eligibility criteria include that: (1) participants must be 18 years and older and (2) participants must be resident of Al-Hashemeyia for at least one year.

The study sample was computed using PASS 2002 power analysis and sample size software. In a cohort study with no background incidence of a particular adverse reaction, the probability that one or more adverse reaction will not occur in a sample of 400 individuals is 20%; the power of the study is 80%.

Procedures: The human subjects' approval was obtained from the Hashemite's University Scientific Board. Residents of Al-Hashemeyia who meet the eligibility criteria of the study were asked to participate in this study through project advertisements in the Ministry of Health (MOH) Primary Health Centers and the Municipality offices, and through word-of-mouth using door-to-door approach. Al-Hashemeyia area is divided into 13 blocks.

Random cluster sampling was used to obtain 6 blocks that are representative of the township in terms of population parameters and distribution from the pollution sources. Residents of these blocks who have been residents of Al-Hashemyia for at least one year, who are 18 years or older, and who meet the eligibility criteria of the study were asked to participate in this study using door-to-door approach. All household members, both male and female, within the selected blocks were asked to participate in the study. A research assistant explained the study and its significance, procedures, the kind of requirements needed of each participant with all foreseeable benefits/risks. Individuals who agreed to participate responded to a set of questions including a demographic tool and the Respiratory Risk Profile (RRP). Research assistants were nurses with master degree in clinical nursing. They all received one day training by the primary investigator to ensure standardization of data collecting procedure.

Training included handling possible requests from subjects regarding explanations of certain items or words. Research explained the study and its significance and all foreseeable benefits/risks. Because of cultural sensitivity to gender issues, male and female research assistants formed a data collection team, where the male research assistant collected data from male subjects while the female research assistant approached and intervened with the female subjects. Most of the subjects preferred to complete the requested information at the same time they received the package. Less than 5% of the subjects completed the instrument within one week; those subjects called the primary researcher at workplace asking to send a research assistant to pick up the instrument.

The Instruments

Demographic: Demographic data were collected as part of the Respiratory Risk Profile (RRP) on age, gender, employment, level of education, income, address (neighborhood), smoking behavior, length of residence in Al-Hashemeyia, history of asthma and related medications, and daily length of time spent outdoors in Al-Hashemeyia area. Additional data were collected on personal and family history of cancers and any other health problems, and people's concerns regarding the quality of air in Al-Hashemeyia. Subjects were asked about the presence of eye symptoms (watery, itchy, red eyes) and skin symptoms (eruptions, eczema).

Respiratory Risk Profile (RRP): The Respiratory Risk Profile was developed to evaluate the prevalence and severity of respiratory symptoms. [7] The development of this instrument came as a response to the unavailability of such instrument in the Arabic language. The instrument is self-report and consists of 16 items measuring symptoms directly related to respiratory symptoms during the past three months. The instrument is grouped into upper and lower respiratory symptoms. All items are worded positively to allow one direction for all items. That is, every item was scored so that higher scores mean higher potential for respiratory symptoms. Responses are based on a 5-point Likert scale ranging from 1 = never, rarely = 2, sometimes = 3, most of the time = 4, and always = 5. The instrument in its totality was pilot-tested among 100 respondents from the target population and the preliminary testing has shown an acceptable level of internal consistency (Cronbach's Alpha = 0.93).

Results

Statistical analysis procedures were performed using SPSS for windows (version 11.5) at a significance level of .05. Descriptive statistics were used to generate means, standard deviations, and frequencies for self- reported respiratory symptoms. Correlations were used to examine the relationships between demographics and self-reported respiratory symptoms.

***Sample Characteristics*:** Descriptive statistics were used to summarize characteristics of the sample (Table 1). Respondents were men (76%) and women (24%) with a mean age of 34 (SD = 13). Approximately half of the sample completed up to high school. Participation was slightly higher among nonsmokers (59%) than smokers (41%). The majority of the subjects lived in Al-Hashemyia all their life, and spent outdoors a daily average of 6 hours (SD = 5).

Table 1: Sample characteristics (n= 400).

Characteristic	*N (%)*
Gender	
Male	303 (76)
Female	95 (24)
Marital status	
Single	112 (28)
Married	240 (60)
Other	48 (12)
Education	
Illiterate	26 (7)
High school	180 (48)
College	157 (41)
Graduate	16 (4)
Income	
Low (less than $ 300)	92 (24)
Medium ($300-600)	268 (71)
High (more than ($600)	19 (5)
Employment	
Unemployed	50 (11)
House wife	33 (9)
Skilled worker	22 (5)
Retired	43 (10)
Other	242 (65)
Smoking status	
Yes	160 (41)
No	235 (59)
Number of cigarettes	
Smoke daily	9 (6)
Less than 10	88 (58)
10-20	55 (36)
more than 20	
Age	
Less than 25	124 (31)
25-34	111 (28)
35-44	74 (19)
45-54	48 (12)
More than 55	43 (10)

Subjects reported symptoms related to eyes and skin. These symptoms were watery eyes (39%, n= 149), itchy eyes (38%, n= 146), red eyes (31%, n= 117), skin eruptions (13%, n= 13), and eczema (11%, n= 41).

The subjects reported that symptoms were relieved when they are away from Al-Hashemeyia. They expressed their concern regarding the quality of air in Al-Hashemeya, and they were confident that air plays a major role in their health. Furthermore, Al-Hashemeya residents were dissatisfied with the current quality and quantity of health services available in their area.

Prevalence of Self-reported Respiratory Symptoms

Table (2) summarizes the means, standard deviations, frequencies, and percentages of self-reported respiratory symptoms during the previous three months. On a 5-point Likert scale, the total mean of self-reported respiratory symptoms was 3.20, which indicates that respiratory symptoms occurred sometimes for the past three months. In descending order, the highest means were for deep bronchial cough ($\chi = 3.7$), and dry cough ($\chi = 3.5$).

The symptoms were categorized, according to severity, into five groups (never =1, rarely =2, sometimes =3, most of the time =4, and always =5). Symptoms were considered severe when reported always or most of the time. The most frequent respiratory symptoms reported, most of the time and always, were difficulty in breathing when inhaling dust or fumes (53%), flu lasting more than one week (51%), difficulty in breathing when exercising (42%), difficulty in breathing because of nasal congestion (39%), mucus without having cough (39%), difficulty in breathing when exposed to cold air (37%).

Table 2: Means, standard deviations, and frequencies of the self-reported respiratory symptoms (N=400).

Respiratory symptoms	χ	*S.D.*	*N (%) 1*	*N (%) 2*	*N (%) 3*	*N (%) 4*	*N (%) 5*
Difficulty in breathing when inhaling dust or fumes	2.5	1.4	61 (15)	43 (11)	84 (21)	65 (17)	140 (36)
Flu lasting more than one week	2.7	1.4	70 (18)	43 (11)	77 (20)	77 (20)	117(31)
Difficulty in breathing when exercising	2.7	1.4	60 (15)	54 (14)	86 (22)	75 (19)	116 (23)
Difficulty in breathing because of nasal congestion	3.0	1.4	85 (22)	46 (12)	108 (27)	74 (19)	79 (20)
Mucus without having cough	3.4	1.4	88 (22)	57 (14)	90 (25)	76 (20)	71 (19)
Difficulty in breathing when exposed to cold air	3.1	1.4	92 (24)	63 (16)	89 (23)	71 (18)	73 (19)
Itchy nose	3.1	1.3	85 (22)	69 (18)	100 (27)	57 (15)	68 (18)
Difficulty in breathing	3.2	1.3	97 (25)	73 (19)	93 (24)	63 (17)	56 (15)
Pain in sinuses	3.4	1.4	113 (30)	74 (20)	83 (21)	51 (14)	55 (15)
Itchy throat	3.2	1.3	90 (24)	57 (15)	120 (32)	54 (15)	52 (14)
Runny nose	3.3	1.3	104 (27)	69 (18)	108 (28)	57 (15)	47 (12)
Chest wheezing	3.4	1.3	112 (29)	79 (21)	90 (23)	51 (13)	52 (14)
Mucusy cough	3.3	1.3	100 (27)	69 (18)	108 (27)	54 (15)	46 (13)
Dry cough	3.5	1.3	109 (28)	89 (23)	90 (24)	52 (14)	40 (11)
Hoarseness	3.4	1.2	90 (24)	81 (22)	120 (31)	44 (12)	41 (11)
Deep bronchial cough	3.7	1.3	153 (40)	73 (19)	76 (20)	43 (14)	34 (9)

Table 3: Correlations between demographics and self-reported respiratory symptoms.

	Gender	*Asthma medication*	*Smoking*	*Age*	*Hours spent outdoors*	*Income*	*Respiratory symptoms*
Gender	1						
Asthma medication	-.06	1					
Smoking	.33	-.01	1				
Age	-.02	.04	.07	1			
Hours spent outdoors	-.20	.02	.08	-.20	1		
Income	.01	.00	-.1	-.01	-.06	1	
Respiratory symptoms	-.01	.27**	.03	-.01	-.05	.05	1.0

***** p = .01***

Relationships between Demographics and Self-reported Respiratory Symptoms

Using correlations, demographics (gender, use of asthma medication, smoking, age, hours spent daily outdoors) were examined in relation to self-reported respiratory symptoms. Correlations were done based on the total score of reported respiratory symptoms.

According to table (3), only one factor was found to be significantly related to respiratory symptoms. This factor was the use of asthma medication ($r = 0.27$, $p = .01$).

Discussion

This study examined the prevalence of respiratory symptoms in adults living in one of the most air polluted areas in Jordan and characteristics associated with respiratory symptoms. This is the first research done to assess health status of residents of Al-Hashemyia area. In the current study, lower respiratory tract symptoms were prevalent more than the upper respiratory tract symptoms. No study was found to distinguish the prevalence rates of respiratory symptoms in this manner. A thorough investigation was done to find statistics on the prevalence rates of respiratory health problems in unexposed areas in Jordan in order to make comparisons with the current study findings. However, no relevant information was found within the Ministry of Health and Department of Statistics data bases.

Therefore, the frequencies of self-reported respiratory symptoms in this study were compared with those self-reported in international studies that examined health problems of people living in polluted areas. There is a difference between people living in polluted and non-polluted areas. Montnemery and colleagues demonstrated that 36% of people living in a polluted area reported upper respiratory symptoms compared to 31% living in a non-polluted area ($p < .05$). Living in a polluted area was a risk factor for clinical diagnosis of chronic bronchitis or emphysema (OR = 2.6, CI = 1.9-3.6). [8]

The prevalence rates of respiratory symptoms in the current study were similar to the rates reported by Al-Neaimi et al; [9] Marttila et al; [10] Montnemery et al; [8] Stephen et al [11] and were slightly higher than the prevalence rates reported by Zulkarnain et al. [12] Symptoms of cough, phlegm and wheezing without having cold reported in this study were also similar to those reported by Zulkarnain and colleagues. [12]

Demographics (gender, smoking, etc.) were not significantly related to respiratory symptoms. Similar results were reported in the literature. Stephen and colleagues [11] and Montnemery et al. [8] demonstrated that gender was not linked to self-reported respiratory symptoms. Using objective measure Kuo et al.[13] concluded that poor lung function tests were similar in male and female subjects living in an air polluted area.

Smoking in this study was not associated with respiratory symptoms. Montnemery et al. [8] examined the relationship between smoking and respiratory symptoms and reported that smoking did not have any impact on prevalence of nasal symptoms. Al-Neaimi and colleagues [9] demonstrated that the mean differences in the pulmonary function values among the exposed smokers and non-smokers and among the unexposed smokers and non-smokers was not statistically significant at 95% confidence.

Only the use of asthma medication was significantly related to respiratory symptoms in the current study. Prevalence of respiratory symptoms is common among people exposed to air pollutants. Exposure to air pollution aggravates respiratory diseases. Kuoet al. [13] found a positive relationship between prevalence of asthma diagnosed by lung function test and air pollution ($r = .63$). In a case-control study, based on lung function test, there was an increased risk of asthma (OR = 1.72, CI = 0.71-4.17) among workers exposed to sulfur compounds at the workplace [14] Furthermore, Kuo et al. [13] and Jaakkola et al. [14] reported a positive relationship between prevalence of asthma diagnosed by lung function test and air pollution. On the other hand, Al-Neaimi and colleagues [9] did not find differences in reported asthma between exposed and unexposed workers to cement dust. Montnemery et al. [8] demonstrated that respiratory symptoms were not linked to asthma (OR = 1.0, CI = 0.6-1.5).

Limitations of the Study: This study has limitation. The study sample was adults living in one of the most air polluted areas in Jordan. Using comparison group from a non-air polluted area would have been helpful to know whether the prevalence of respiratory symptoms in Al-Hashemyia is high.

In addition, there is a possibility of underestimating self-report respiratory symptoms. There was consensual agreement among the individuals who participated in the current study about two issues. First, the subjects expressed that there is no need to do a study to examine the prevalence of respiratory health problems because they are all suffering from the quality of air in Al-Hashemyia. The second issue is that air pollution has been the case for more than four decades and it is getting worse because of the lack of officials' interest in the area, therefore, no one would care about what Al-Hashemyia residents report regarding their health problems.

Future studies need to measure the lung function test using spirometer to evaluate respiratory impairment and measure outdoor air pollutants in Al-Hashemyia area to examine air pollution in connection with its health consequences.

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