RESEARCH ARTICLE

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An estimation of COPD cases and respiratory mortality related to Ground-Level Ozone in the metropolitan Ahvaz during 2011

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Background & Aims of the Study: Ground-Level Ozone (GLO) is the component of one of greatest concern that threatened human health in both developing as well as developed countries. The GLO mainly enters the body through the respiration and can cause decrements in pulmonary complications, eye burning, shortness of breath, coughing, failure of immune defense, decreases forced vital capacity, reduce lung function of the lungs and increase rate of mortality. Ahwaz with high emission air pollutants because of numerous industries is one of the metropolitan Iranian polluted. The aim of this study is evaluate to Chronic Obstructive Pulmonary Disease (COPD) and respiratory mortality related to GLO in the air of metropolitan Ahvaz during 2011.

Materials & Methods: We used the generalized additive Air Q model for estimation of COPD and respiratory mortality attributed to GLO pollutant. Data of GLO were collected in four monitoring stations Ahvaz Department of Environment. Raw data processing by Excel software and at final step they were converted as input file to the Air Q model for estimate number of COPD Cases and respiratory mortality.

Results: According to result this study, The Naderi and Havashenasi had the highest and the lowest GLO concentrations. The results of this study showed that cumulative cases of COPD and respiratory mortality which related to GLO were 34 and 30 persons, respectively. Also, Findings showed that approximately 11% COPD and respiratory mortality happened when the GLO concentrations was more than 20 $\mu g/m^3$.

Conclusions: exposure to GLO pollution has stronger effects on human health in Ahvaz. Findings showed that there were a significant relationship between concentration of GLO and COPD and respiratory mortality. Therefore; the higher ozone pollutant value can depict mismanagement in urban air quality.

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Background

The health effect of air pollution can be classified into short term and long term effect (1-5). In last two decades, Most of studies have shown a relation between short and long term exposure to air pollution on human health (6-10). Carbon Monoxide (CO), Ground-Level Ozone (GLO), Particulate Matter (PM), Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2) and Lead are air pollutants index based on report United States National Ambient Air Quality Standards (NAAQS) (11). Ground-level ozone is a one of the important pollutants that cause major environmental risk to health (8,12-14). The maximum concentration of the GLO is formed in the afternoon and it's in general a summer pollutant (15-17). The GLO is a strong oxidizer which is created as a secondary pollution under the effects of the sun radiation upon the azotes dioxide and the atomic oxygen production of the radical in the air (18-20). United States National Ambient Air Quality Standards (NAAQS) has established 8 hour average concentration for GLO 0.075 ppm (11). Based on report World Health Organization (WHO) standard 100µg/m^3 was accepted as the 8 hour mean concentration of GLO (1).

Ground-level ozone in the troposphere is a pollutant that is a significant threat on human health (21,22). GLO in repertory system penetrate into bronchitis and alveolus of the lung tissues and after dissolution enters the blood (14,23). Short and long term exposure to ground-level ozone has been linked to variety of health endpoint, including increased hospital admissions respiratory, Induction of respiratory symptoms, Chest tightness, wheezing, shortness of breath, coughing, increased emergency ward visits, decreased lung function and increased cases repository death (24-27). In 2012, Glad et al studied the Relationship of the number hospital admission because of asthma attacks in emergency ward and GLO (28). Rich et al studied the effects Increases exposures to high GLO with Increased Risk of Paroxysmal Atrial Fibrillation Episodes (29). Mikulska et al in 2008 studied the Relationship between ozone concentrations and health problem in Ukraine (30). Studied Ruidavets et al in French showed that GLO concentration is associated with risk of heart attacks (31). Also Goudarzi et al in 2009 in Tehran studied the number of COPD and respiratory mortality related to GLO levels (32). In similar work Mohammadi et al studied the association between cases of COPD and respiratory mortality and GLO levels in the Ahvaz in 2009 (33).

In recent year a large number of studies were conducted in the developed countries, but unfortunately in Iran only a small number of studies have been conducted (34-37). Ahvaz is one of seven metropolitan Iranian polluted (38). In the last decade, emission air pollution in this city increasingly becoming an enhanced and intensified. High density of industries (steel, oil and gas), transportation, geographical location and topography, the emerging sources in neighboring countries and dust storm are the most reasons increase natural and artificial air pollutants in Ahvaz (39,40).

Aims of the study: In the present study, we conducted a number of cases for COPD and respiratory mortality related to GLO in the air of metropolitan Ahvaz during 2011.

Materials & Methods

The present study is an epidemiological. In this retrospective study, we used Air Q model for assess the potential COPD and respiratory mortality related to GLO on human health in Ahvaz city (located in south-western Iran) during year 2011. Daily GLO data in 2011 were collected from 4 stations "Naderi", "Behdasht Ghadim", "Havashenasi", and "MohitZist" which belong to Ahvaz Department of Environment (ADoE). In this study, we used the 8-hr average GLO according to the recommended by the WHO. Raw air quality monitoring data is required several steps processing (coding, averaging, filtering,

correction of temperature and pressure) for asses health effects model were taken in the recent work. All processing mechanisms were performed in Microsoft Office Excel.
Finally, by using Relative Risk (RR) and Attributable Proportion (AP) from WHO data, we calculated COPD and respiratory mortality related to GLO by Air Q2.2.3 model (5,7,38). RR and AP are index epidemiology that collected for criteria air pollutants.
AP in percentage was calculated as following formula:

AP= SUM {[RR(c)-1] p(c)} /SUM [RR(c) p(c)]

Where: p(c) is population of city.

RR(c) is a ratio of the probability of the event occurring in the exposed group versus a non-exposed group (3,24,25,39).

$$RR = \frac{\text{Probability of event when exposed}}{\text{probability of event when non - exposed}}$$

Geographical features of Ahwaz:
Ahvaz city, the capital of Khuzestan Province, with an area of 8152 km^2 is located between 48 degree to 49°29′ east of Greenwich meridian and between 31 degrees and 45 minutes to the north of the equator in south western Iran (7,34,36,37). In 2011, its population was 1,000,000 people (4,24). Ahvaz is located in the dry area of Iran and it has a semi-humid and sweltering climate (4,24).

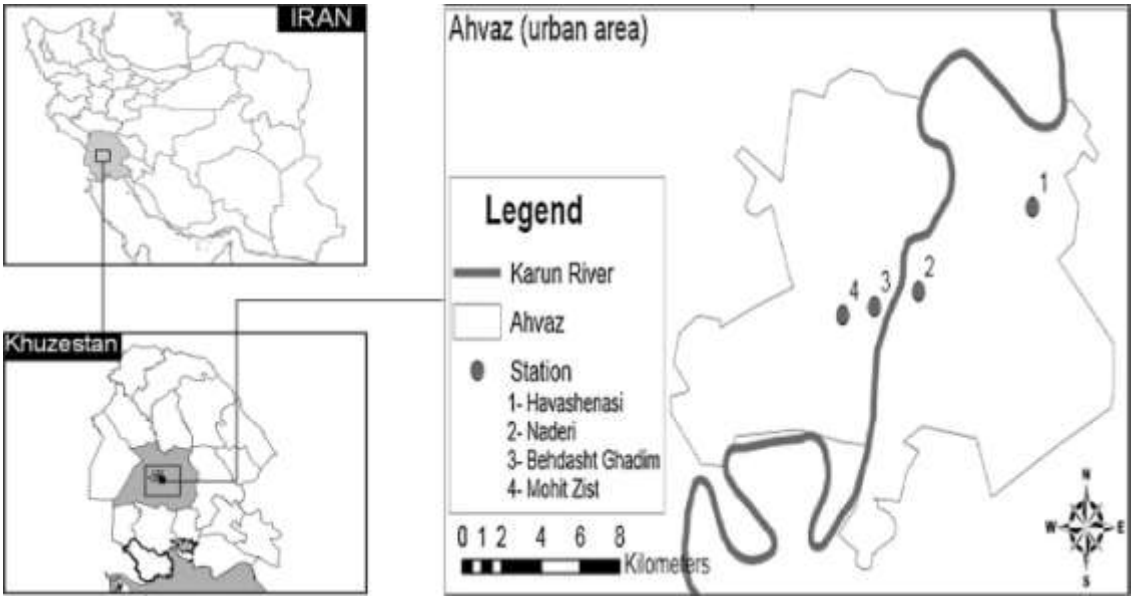

Figure 1) location of the study area and sampling station in Ahvaz city

Results

According to result this study, annual mean of 8 hour averaging time of GLO in Ahvaz was 72.67µg/m^3 that have presented in table 1. The results of this study showed that The Naderi and Havashenasi had the highest and the lowest GLO concentrations during 2011, respectively. Table 1 showed the yearly average, summer mean, winter mean and 98 percentile of GLO concentrations in these stations.

Table1) Summary statistics of GLO concentrations in Ahvaz during 2011

	Average Ahvaz	lowest stations (Havashenasi)	highest stations (Naderi)
Annual mean	72.67	66.98	81.81
Summer mean	84.38	78.87	96.41
Winter mean	60.51	54.62	66.64
98 percentile	121.24	133.98	186.62

Table 2) Estimated RR and AP for COPD and respiratory mortality in case of Ground Level Ozone

Health endpoint	RR,95% CI	AP (%)	Estimated number of excess cases (persons)
COPD	1.0058 (1.0022 -1.0094)	3.5208	34.6
respiratory mortality	1.0040 (1.002-1.006)	4.7922	30.6

RR (with three ranges; down, mean, up) and estimated AP percentage for COPD and respiratory mortality has illustrated in table 2. According result in this table, cumulative case of COPD and respiratory mortality related to GLO were calculated 34 and 30 persons, respectively at the centerline of relative risk.

Figure 2 shows the cumulative COPD and respiratory mortality versus GLO. 81% of COPD number has occurred in the days with concentrations lower than 170 µg/m^3. Also based on result this study 69% of respiratory mortality cases have occurred in days with GLO levels not exceeding 150µg/m^3.

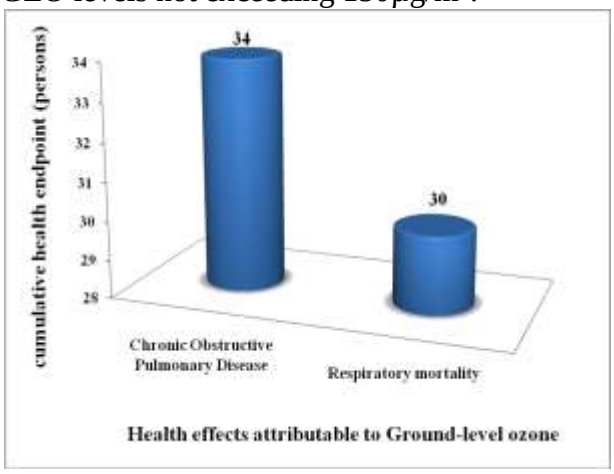

Figure 2) relationship between cumulative of COPD and respiratory mortality versus Ground Level Ozone

Discussion

In this study, we estimate COPD and respiratory mortality associated with short and long term exposure to concentrations of GLO by using AirQ model in Ahvaz, Iran. Breathing GLO can cause different problems on human health including increase rate of respiratory disease, asthma attack, emphysema, coughing, Increase in emergency ward visits, cardiopulmonary disease and death. We found that in Ahvaz all cases COPD and respiratory mortality attributed to GLO in were 34 and 30 persons during 2011, respectively.

According results of this study, 11 percent of all COPD and respiratory mortality were attributed to respiratory concentrations over 20 µg/m^3. Based on the results study Glad et al, 2.5% increase was observed in asthma ED visits for each 20 µg/m3 increase in the 1-hour maximum GLO level on day 2 (28). High percentage of the observed health endpoints in this study was associated with high concentration of measured ozone in Ahvaz. Based on result study of Ruidavets et al, exposure to elevated GLO levels for one to two days increased the risk of heart attacks for middle-aged adults without heart disease (31). Also, Based on the results of my study was significant relationship between GLO levels and increase rate of dieses. Based on the results

study in similar work Grypariset al in 2004, from 23 cities European were collected GLO data (15). Based on result this study, increase in the 1-hour GLO concentration by 10 µg/m^3 was associated with a 0.45% in the number of cardiovascular deaths and 1.13% in the number of respiratory deaths (15). The results this study shows that concentration of ozone in Ahvaz is very high compared to 23 cities European. In similar work in 2009 based on result studied Jerrett et al, for every 10 µg/m^3 increase in exposure to GLO, increase 1.040 percent the risk of death from respiratory causes (16). High percentage of the observed health endpoints in my study in compare to studied Jerrett et al was associated with high concentration of measured GLO and heavy industry such as oil, petrochemical and steel in Ahvaz. In similar work Zallaghi and Associates to evaluate the health effects of ozone by using of Air Q model in south west of Iran (Kermanshah-Bushehr) during 2010. Based on the results of this study, in Kermanshah 8.7 percent of COPD and respiratory mortality was attributed to GLO concentrations over 20 µg/m^3 (41). Based on the results of my study, number of cases health effects was the relatively higher because of concentration greater in Ahvaz city. In another similar work Goudarzi and Associates, evaluate the cardiopulmonary mortalities and COPD Attributed to Ozone Air Pollution by using of Air Q model in Ahvaz city (42). Based on the results of this study, 10.8 percent of all cardiopulmonary mortalities and COPD was attributed to ozone concentrations over 20 µg/m^3 (42). Results of this study are similar to with Goudarzi studied because of the geographic, demographic, and climate characteristics.

Conclusion

This study was conducted to estimate cumulative case of COPD and respiratory mortality attributed to GLO in Ahvaz, Iran. The results presented here show an independent association between COPD and respiratory mortality and GLO exposure between citizens in Ahvaz. High percentage of the number of cases COPD and respiratory mortality was associated with high concentration of measured GLO. Careful monitoring, public education, control and optimization of urban traffic, application of technical methods for decrease GLO in purpose source such as regulations urban development will have an important role in controlling air pollutants including GLO.

Footnotes

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Conflict of Interest:
The authors declared no conflict of interest.

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