Original article

Study of relationship between nitrogen dioxide and chronic obstructive pulmonary disease in Bushehr, Iran

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ABSTRACT

Introduction: Nitrogen dioxide (NO₂) can penetrate deeply into the sensitive parts of the lungs and cause or worsen chronic obstructive pulmonary disease (COPD), respiratory disease, emphysema, bronchitis and increased causes admission in hospital.

Objective: The purpose of this study is the determination of COPD attributed to NO₂ in people's life of Bushehr megacity, Iran.

Methods: This descriptive study was conducted in Bushehr during 2011. The chronic obstructive pulmonary disease data were calculated by utilizing indices of exposure risk to health effects NO₂. In this study, data were analyzed by SPSS.

Results: According to the research findings, 60 and 15 µg/m³ concentrations the yearly average NO₂ in Bushehr were the highest and the lowest. When the NO₂ concentrations were more than 10 µg/m³, 2.9% of admission happened to COPD. Low concentration of NO₂ was one of the reasons of a low percentage of the observed COPD.

Conclusion: According to this study increasing the NO₂ concentration has a direct and a significant effect on chronic obstructive pulmonary diseases. Electrical heating, alternative fuels solar and cooking are important factors in decreasing the concentration of NO₂.

1. Introduction

Nitrogen dioxide produced in those environments which have been harmful effects on human health.¹ It is a potential harm that makes anthropogenic air pollution as a significant concern.^{2–8} Nowadays, in developing countries, chronic diseases are very prevalence in people 65 years and over.⁹ Chronic obstructive pulmonary disease can cause fatigue, shortness of breath, emphysema, chest tightness, coughing and hard to breathe.^{10–14} Smoking is the major cause of COPD and can increase it.¹⁵ Cooking and heating fires are the famous sources of air

pollution that can potential factors of COPD. Chronic bronchitis are still used to define a productive cough that is present for at least three months for two years annually.^{14,16} Disability and death are an important leading cause of COPD in the United States.^{16–18} Most of the time, COPD is diagnosed in middle-aged or older adults.¹⁵ Diabetes mellitus, heart disease, blood pressure, depression, anxiety, osteoporosis and lung cancer are major reasons of COPD.¹⁵ COPD is a long-term (chronic) disease. The disease will get worse more quickly if you do not stop smoking.¹⁹ Not smoking prevents most COPD. Ask your provider about quit-smoking programs. Medicines are also available to

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help you to stop smoking.^{20,21} Based on the results of several studies about the relationship between smoking and COPD, Smokers constitute 80–95% of people who have COPD.^{20,22,23} Indoor air pollution resulting from cooking and air poor ventilation are one of the major common causes of COPD in developing countries.²⁴ Nearly 3 billion people, especially women, because of the method of cooking and heating are greater exposure group.²⁵ Rate of the prevalence of COPD in large cities because of high air pollutant concentration in comparison with rural areas is very higher.²⁶ Areas with poor outdoor air quality, including exhaust gas, generally have higher rates of COPD.²⁵ In the United States, more than 30% of cases of COPD are among those who have never smoked and probably represent a greater risk.²⁷ According to the report, 10–20% of cases happened in workplace exposures.^{28–30} Based on the result of another study, poor air pollution and malnutrition were the most risk factors linked to COPD.³¹ According to different studies, there is a relationship between the increase of NO₂ concentration and COPD.³² Based on the result of a study of Dockery et al. in the six US cities, long-term air pollution exposure, increase the health endpoint in human such as cardiovascular mortality.³³ Also, studied the association between NO₂ and COPD of Ahvaz, Iran, in 2009.³⁴ In a similar work, Goudarzi et al. studied the relationship between NO₂ and COPD of Tehran, Iran.³⁵ Also based on results of Zallaghi et al. in Ahvaz, Bushehr and Kermanshah, there was a relationship between COPD and NO₂.³⁶

The aim of this study was planned and carried out to assess the potential COPD of NO₂ exposure on human health in Bushehr (located in south of Iran) during 2011.

2. Materials & methods

This study is a descriptive and used model study. In this study, we used Air Q model and Excel software to analyze the data.^{37,38} Sampling was performed for 24 h. Data were taken from Bushehr Department of Environment (BDoE) during 2011. Calculating daily mean was done based on codification, condition modification, primary filtering and secondary filtering. For estimation of health impact attributable to the exposure of air pollution on the target population, using an Air Q model that estimates this impact to specific air pollutants on a resident population in a certain area and period.³⁹ In this study the data were calculated, based on the utilizing relative risk and attributable proportion. We have used a default model that attribute the cases of COPD to exposure on nitrogen dioxide and remove another effective factors.⁴⁰

2.1. Geographical features of Bushehr

Bushehr city is the capital of Bushehr province of Iran, with coordinates of 28° 95' 76" N, 50° 83' 71" E and with an area of around 1441 km²^{41–43}(Fig. 1).

3. Results

According to the research findings, the highest and the lowest yearly average Nitrogen dioxide concentrations during 2011 were 70 and 21 µg/m³. National Ambient Air Quality Standard (NAAQS) reported the primary standard for NO₂ is 100 µg/m³¹⁰. According to annual standard and hourly averages of NO₂, which is recommended by the World Health Organization (AQG WHO), it should be 40 and 200 µg/m³, respectively.^{27,34} Based on the result which is reported in Table 1, the annual average of NO₂ in Bushehr was 27.76 µg/m³ in 2011, which is much lower than NAAQS and AQG WHO standards. Table 1 presented the early average, summer average, winter average and 98 percentile of NO₂ concentrations.

Fig. 2 shows the average concentrations of Nitrogen dioxide during seasons of this year, respectively. As can be seen in Fig. 2, NO₂ concentration of the winter was max. The important sources of NO₂ that can affect the increase of Chronic Obstructive Pulmonary Disease are resulting from human intervention particulate road traffic, stationary

combustion and industrial processes. Bushehr has been well known due to the development of petroleum and gas industries.

In the field of relative risks, attributable proportions and the number of people who have suffering from COPD related to NO₂ concentration has shown in Table 2. Evaluated number of cases that are related to NO₂ for COPD at lower, central and higher confidence interval of RR were 1, 6 and 14, respectively.

4. Discussion

Nowadays, air pollution because of the climate change, industrial and urban development is a serious threat to the environment, quality of life and health. In this study, the effects of exposure to NO₂, such as Chronic Obstructive Pulmonary Disease, evaluated by Air-Q model in Bushehr, Iran. Fig. 2 had showed that the average of NO₂ concentrations during seasons. Based on the result, the highest and the lowest NO₂ concentrations of seasons were winter and summer during 2011, respectively. Baseline incidence of Bushehr population study for estimation of health endpoint was considered base on 497 per 100,000 people. 65% of COPD cases occurred in those days which is the pollution is not exceeding 60 µg/m³.

In a similar work, Gudarzi et al. exploited Air-Q model to estimate the Nitrogen dioxide hygienic effects on potential Chronic Obstructive Pulmonary Disease (COPD) in Tehran (capital of Iran). Based on their results, almost 4.4% of all cases of whole Chronic Obstructive Pulmonary Disease are attributed to the Nitrogen dioxide concentrations greater than 30 µg/m³³⁵. Also, Mohamadi et al. summarized, 3% of hospital admission approximately for COPD happened when the Nitrogen dioxide concentration was over 20 µg/m³³⁴.

Globally, from 2010, COPD affected 329 million people (4.8% of the population) approximately and is slightly more common in men than women.⁴⁴ This research emphasizes on the positive and negative effects of nitrogen dioxide concentration of COPD. This is as compared to 64 million being affected in 2004.⁴⁵ In Ahvaz, 2.1% in Kermanshah and 1.1% in Bushehr of Chronic Obstructive Pulmonary Disease attributed to Nitrogen dioxide in people approximately.³⁶ The increase rates of smoking in the developing world, due to less death from other causes such as infectious diseases.¹⁵ The global numbers are expected to continue increasing as risk factors remain common and the population continues to get older.⁴⁶ The number of deaths of COPD has decreased slightly from 3.1 million to 2.9 million between 1990 and 2010.⁴⁷ Overall, it is the fourth-leading cause of death.¹⁵ In some countries, mortality has decreased in men, but increased in women.⁴⁸ This is most likely due to the rates of smoking between women and men which becomes more similar; also in COPD is more common in older people; it affects 34–200 out of 1000 people older than 65 years, depending on the population.^{11,49} In England, an estimation of 0.84 million people (of 50 million) have a diagnosis of COPD; translating into approximately one person in 59 receiving a diagnosis of COPD at some point in their lives. In the most socioeconomically deprived parts of the country, one in 32 people were diagnosed with COPD, compared with one in 98 in the most affluent areas.⁵⁰ In the United States 6.3% of the adult population approximately, 15 million people totally, have been diagnosed with COPD.⁵¹ 25 million people may have COPD if currently undiagnosed cases are included.⁵² There were approximately 730,000 hospitalizations in the United States for COPD, in 2011.⁵³

4.1. Limitations and strengths

The major limitations of this study are the lack of databases and amounts of studied indicators which were used the values of WHO (Middle east) for calculated health effects attribute Nitrogen dioxide. Therefore, to estimate the health effects of air pollutants epidemiologic studies are require actually for accurate calculation of RRs and BIs. Finally, the survey results show that the implementation of basic actions to control Nitrogen dioxide which is entering to the stratosphere

Fig. 1. Location of the study area and sampling station in the Bushehr Province (Bushehr city), in the south of Iran.

Table 1

Average concentrations of Nitrogen dioxide($\mu\text{g}/\text{m}^3$).

Parameter	Average Bushehr
Annual mean	27.76
Summer mean	23.48
Winter mean	32.20
98 percentile	49.74

Table 2

Relative risks, attributable proportions and number of people suffering from chronic obstructive pulmonary disease due to Nitrogen dioxide exposure (Baseline incidence: 101.4 per 100,000).

Indicator Estimate	RR (Medium)	AP (%)	Attributable excess cases (persons)
Down	1.0004	0.0152	1.1
Mediocre	1.0038	0.9038	6.4
Up	1.0094	1.1563	14.3

Fig. 2. Relationship between Nitrogen dioxide concentration and seasons in year 2011.

by decreasing gaseous fuel of industries and development of green space is essential.

5. Conclusion

According to the results of this study, 2.9% cases of COPD were related to inhale NO_2 pollutant in Bushehr citizen. Because of many different geographic characteristics and uncontrolled growth oil and gas industries, there is still much need to further studies to calculate the local epidemiological indices of exposure risk to health effects air pollutants especially NO_2 . Electrical heating, alternative fuels, solar and cooking are effective performance for decrease concentration of NO_2 .

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Declaration of Competing interest

Authors have no conflict of interests.

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