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ASSESSMENT OF CONCENTRATION CHANGES AND TRAFFIC EFFECTS ON CARBON MONOXIDE LEVEL IN THE CITY OF YASUJ, IRAN

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ABSTRACT

Background and objectives: Identification and measurement of air pollutants are the first steps to manage air pollution. Because many of these pollutants can have adverse effects on ecosystem and human health, no knowledge of the quality and quantity of pollutants can cause problems in identifying, determining concentration and, if necessary, controlling. The purpose of this study was to evaluate the changes in carbon monoxide (CO) concentration and the effect of traffic on the level of this pollutant in the city of Yasuj in Iran.

Materials and methods: In this study, the first action was the selection of study sampling stations, where were considered to be ten major squares of the city. The samples were collected in cold and hot seasons at traffic hours (between 7am and 22pm). In the next step, the direct-reading instrument (First Check) was used to measure the concentration of air CO. Traffic intensity measurements were also performed visually. Finally, the data were analyzed using SPSS 16 software.

Results: The mean CO concentration in the city of Yasuj was estimated at 1.01 ppm. The maximum concentration of this pollutant was measured in the hot season and in night hours on the first days of the week

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In addition, the results of this study showed that increased traffic intensity enhanced linearly the CO concentrations.

Conclusion: Although the results of the present study indicated the CO concentrations less than the allowable environmental standard limits, but since even small amounts of air pollutants can cause damage to the health of exposed people and environment, the necessary interventions should be taken into account in order to control the air pollutants for maintain and improving the existing conditions.

Keywords: Carbon Monoxide; Air Pollution; Free Air; Yasuj

INTRODUCTION

The air pollution causes different adverse health and environmental impacts, imposing heavy burden on nations and governments. The carbon monoxide is one of the most important air pollutants evaluated in this study.

The CO gas is a common airborne pollutant in the indoor and outdoor environments resulting from incomplete carbonated fuels. It is an odorless, colorless and tasteless gas with affinity to hemoglobin about 240 times higher than that of oxygen. This gas combines with blood hemoglobin to produce Carboxyhemoglobin (COHb), resulting in a reduced oxygen-carrying capacity by cells. The gas is released from various sources such as vehicle exhaust, fire, defective heaters and industrial event (1, 2). The half-life of carbon monoxide in the atmosphere is about 1-3 months and its background levels in districts away from urban centers and human activities are around 0.05 -0.12 ppm. The CO gas in distant areas of the city plays an important role in the production of photochemical ozone (3, 4).

The brain, heart, lung and other organs that are more susceptible to oxygen deficiency may be damaged strongly by CO gas. For example, Lee et al. showed that the risk of cardiovascular disease increases after CO poisoning (5, 6).

According to studies, increased CO concentration is associated with the risk of asthma exacerbation among urban children, and exposure to this gas during pregnancy can also result in early childbirth, decreased intrauterine growth and birth weight loss (7- 9).

Therefore, due to the importance of CO and its negative impacts on human and environment health, this study was conducted to evaluate the changes in CO concentration and the effect of traffic intensity on the concentration of this pollutant in the city of Yasuj.

MATERIALS AND METHODS

In the present descriptive-analytical cross-sectional study, the sampling stations ten major squares of the city of Yasuj in Kohgiluyeh and Boyer-Ahmad Province located at southwest of Iran. The samples were collected in cold and hot seasons at traffic hours (between 7am and 22pm) using Full Factorial sampling design. The total number of samples taken during the study was 1500.

To facilitate statistical analysis, sampling times were divided into three intervals of before noon, afternoon and evening, on the first days of the week, the middle days of the week and the weekends.

In this study, the direct-reading instrument (First Check, UK) was used to measure the CO concentration. This device is equipped with a 45.0-micron filter that sucks air at 250 ml/min, and indicates the CO concentration by UV detector. The traffic intensity measurements were also performed visually.

Finally, the data were analyzed using SPSS 16 software. Some of the data were reported as descriptive statistics (mean, standard deviation).

RESULTS

Based on the results obtained in this study, the mean CO concentration is 0.91 ppm in the cold seasons and 1.11 ppm in the hot seasons. The information is presented in more detail in Table 1.

Table 1. Statistical summary of samples taken during the study

	CO samples in cold seasons (ppm)	CO samples in hot seasons (ppm)	Total CO samples (ppm)
Number of samples	750	750	1500
Mean	0.91	1.11	1.01
Standard deviation	0.946	1.275	1.126
Minimum values	0	0	0
Maximum values	10	7	10

As shown in Figure 1, the CO concentration was the maximum in the hot seasons in the evening hours of the first days of the week, and the lowest concentration was observed during the weekends and afternoon. However, the highest CO concentration in the cold seasons was observed in the first days of the week and before noon and the lowest concentration of the pollutant was obtained in the weekends and before noon.

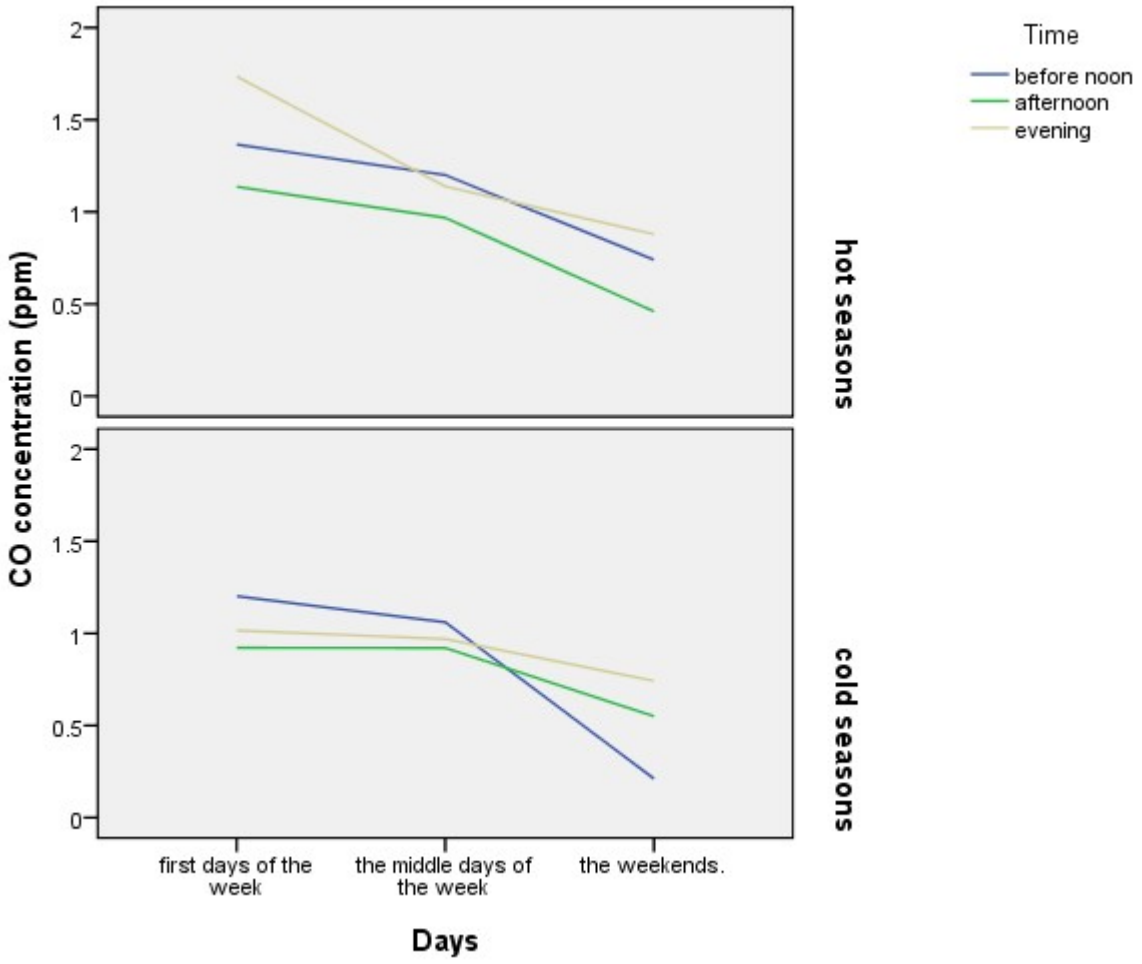

Fig.1. The temporal changes in the CO concentration

As shown in Figure 2, there is a linear relationship between the traffic intensity and the CO concentration, as the CO concentration increases by enhancing the traffic intensity.

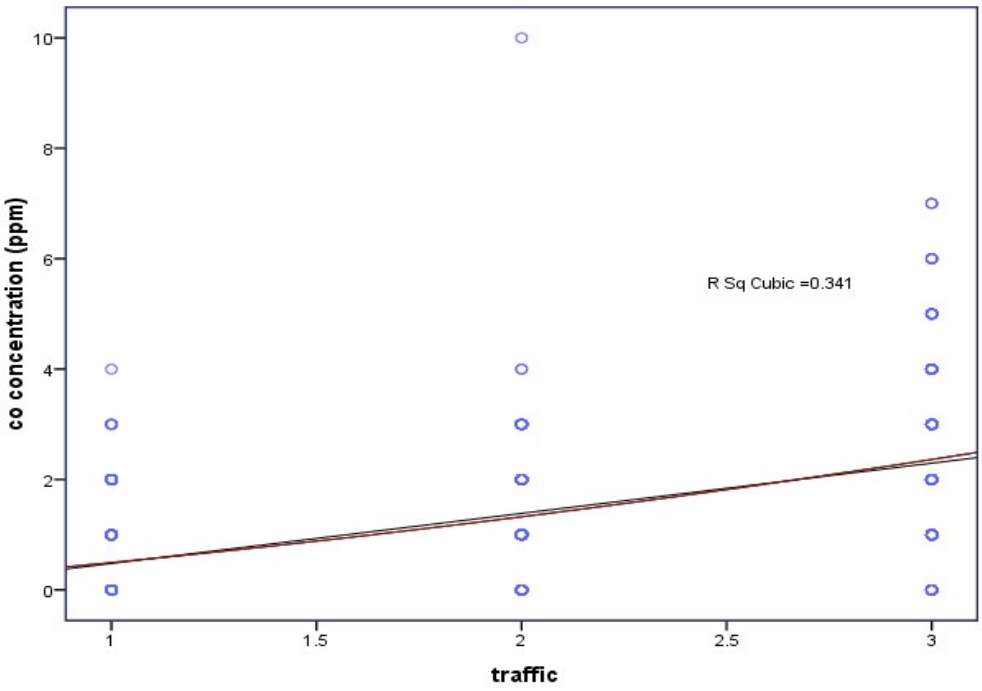

Fig.2. The effect of traffic intensity on the CO concentration

DISCUSSION

According to the results of this study, it was found that the highest CO concentration was observed in the hot seasons and in the evening hours on the first days of the week. The Lawrence et al. (2014) in Lucknow, India, also showed that the highest CO concentration was recorded in June in densely populated areas along the road (10). The findings of this study also are in line with the study of Hsu et al. (2009) on the high concentration of this compound in the hot seasons (11).

A study by Wen et al. (2013), along 1.5 km from Keelung Road, Taipei, showed four peaks in the CO concentration. A peak (4.5ppm) was at 2 pm, which may be due to being sympathetic coincidence with the return of employees from the workplace. Another peak (2.26ppm) was seen at 9 am and a peak (3.5ppm) at 2 am, probably due to the alteration of work shift of the workers. The main peak (5.3ppm) was occurred at 7 am -17 pm, due to the maximum traffic congestion (12). The study of Chan et al. (2003) also demonstrated that the most fluctuations in the CO concentration occurred during the traffic hours (13).

A remarkable point in all of the above studies, including the current study, is that the most important factor in increasing the CO concentration in urban air is the traffic congestion of motor

vehicles at all times. The main reason for the higher concentrations of this pollutant in traffic time can be attributed to an increase in the number of vehicles and a reduction in the speed of vehicles during traffic periods and thus an increase in the concentration of emissions from vehicles. Other factors, such as air stability, reduced rainfall and surface pollutant wash-off in the hot seasons, and in some cases wind direction and amount also contribute to the high release of this pollutant in the hot seasons.

CONCLUSION

Results of the present study indicated that CO concentrations are less than the permissible environmental standard limits, It is worth noting that a study to evaluate the concentration of volatile organic compounds in the air of this city, which showed that this compounds are present in the air in this city (14). So due to the increasing number of vehicles, fuel stations and industries, an appropriate management program should be adopted to maintain clean air in the city.

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