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Study of Carbon Monoxide (CO) Level in Ambient Air of Tabriz Streets

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ABSTRACT

Background: Air pollution with its gaseous and particulate material is important factor in induction and aggravation of different illnesses especially pulmonary and cardiovascular diseases. Carbon monoxide (CO) is one of the gases which is produced mainly from combustion of motor vehicles. It has high affinity for hemoglobin, causing acute and chronic toxicities and deleterious cardio-pulmonary effects.

Material and methods: We measured CO concentration (ppm) with Compur Monitox Plus CO, GmbH in the streets of Tabriz at different times of the day (working/ holiday) and also in different seasons. For each target point, 4 measurements and overall 1536 measurements were taken.

Results: The mean concentration of CO was 15.6 ± 0.87 ppm with 25.34 ppm in the summer and 7.89 ppm in the fall. ($p < 0.001$). In holidays the mean value of CO was 10.8 ppm compared with on 16.66 ppm working days. ($p = 0.002$). The highest concentration at different times during a fortnight was 20.72 ppm in the afternoon and the lowest was 11.12 ppm at midnight. ($p < 0.001$). The highest recorded value was 105 ppm in the Bazaar area next to the central bus station.

Conclusion: Drivers and people walking or working in crowded areas of Tabriz are exposed to high concentration of CO. This may cause acute and chronic CO poisoning with its related health hazards. This may be very important in patients with decreased cardio-pulmonary reserve. (*Tanaffos* 2004; 3(10): 47-52)

Key words: Air pollution, Carbon monoxide, Tabriz city

INTRODUCTION

Carbon monoxide is the most prevalent gas released from motor vehicle combustion. (1-3) This gas is colorless, odorless, and tasteless; and its predilection to bind hemoglobin is 200-220 times more than that of oxygen. Thus, it can prevent

oxygen transfer to tissues and cause tissue hypoxia. It also prevents release of oxygen from hemoglobin and potentiates tissue hypoxia (1-5). This problem is most important in high risk patients such as those with chronic obstructive pulmonary disease (COPD) and coronary artery disease (CAD) who have limitations in oxygen delivery due to heart or pulmonary disease or both. In cities, vehicles

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combusting gasoline have the most important contribution to CO air pollution. On average, every day 165 pounds/ 1000 vehicles/mile, or 2300 pounds/ 1000 gallon of gasoline and or 4.16 pounds /vehicle/ day carbon monoxide is released (1).

In city center streets, CO concentrations of more than 10-15 ppm for 8-hour periods is common and even higher levels have been reported in large cities. Exposure to this level for 8 hours causes carboxyhemoglobin (COHb) to increase up to 2.5% (1). According to WHO (World Health Organization) and NAAQS (National Ambient Air Quality Standards) standards, the acceptable exposure limit for CO is 86, 50, 35, and 9 ppm for 15 min, 30 min, 1 hour and 8 hours respectively (2,3,6,7).

We have studied the concentration of CO in Tabriz in different seasons, different times of the day (on work days and holidays) during a one year period, to assess the situation and help health authorities decrease air pollution and prevent high risk groups from dangerous exposure.

MATERIALS AND METHODS

We measured CO concentration in 12 points of Tabriz streets, four times a day; 6-8AM, 12AM-2PM, 6-8PM, and 12PM-2AM, in (on working days and holidays) and also in 4 different seasons. For each point 4 measurements were taken with portable Compur Monitox Plus CO, GmbH. Overall 1536 measurements were performed. After measuring CO levels at the street levels, the apparatus was moved inside the lanes and alleys for assessing the CO concentration in nearby living places. Mean, standard deviation and confidence intervals were used for expressing the results. P value <0.05 has been considered as significant.

RESULTS

The concentration of CO (ppm) with confidence interval has been shown by different times of day by

different seasons, and by work-days/ holidays in figure 1-3 respectively.

As it is apparent in city map (figure 4), the concentration of CO in Streets of Tabriz is different in various parts of the city and has a direct relation to the traffic load. Although we have recorded concentrations as high as 105, mean concentration in highly polluted areas on working days and during work hours with heavy traffic load is ≈40 ppm. The highest concentrations are detected in crowded places, at mid-day and summer afternoons, and lowest concentrations are noted at midnights of winter and fall.

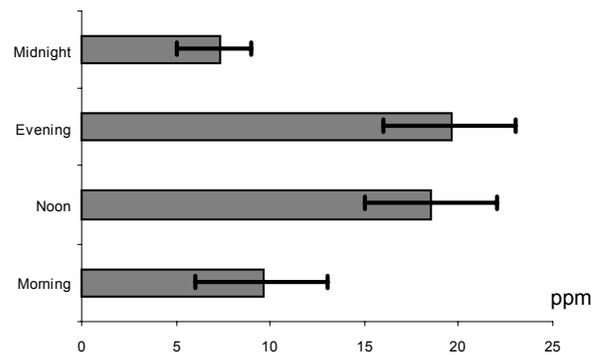


Figure 1. Mean CO concentration at different times of day and night

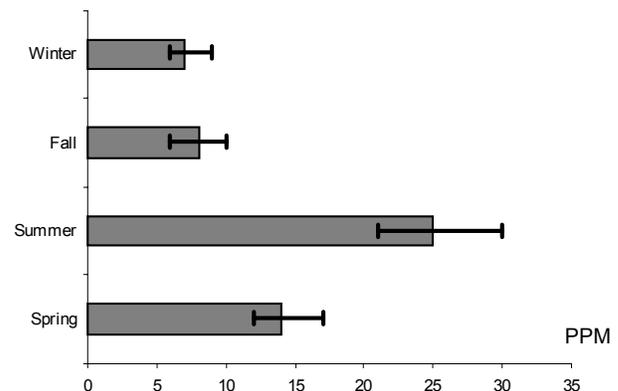


Figure 2. Mean CO concentration in different seasons

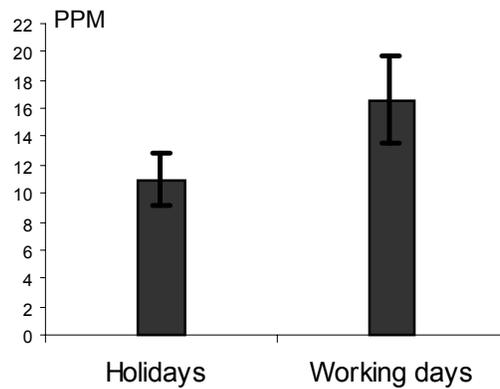


Figure 3. Mean CO concentration in working and holidays.

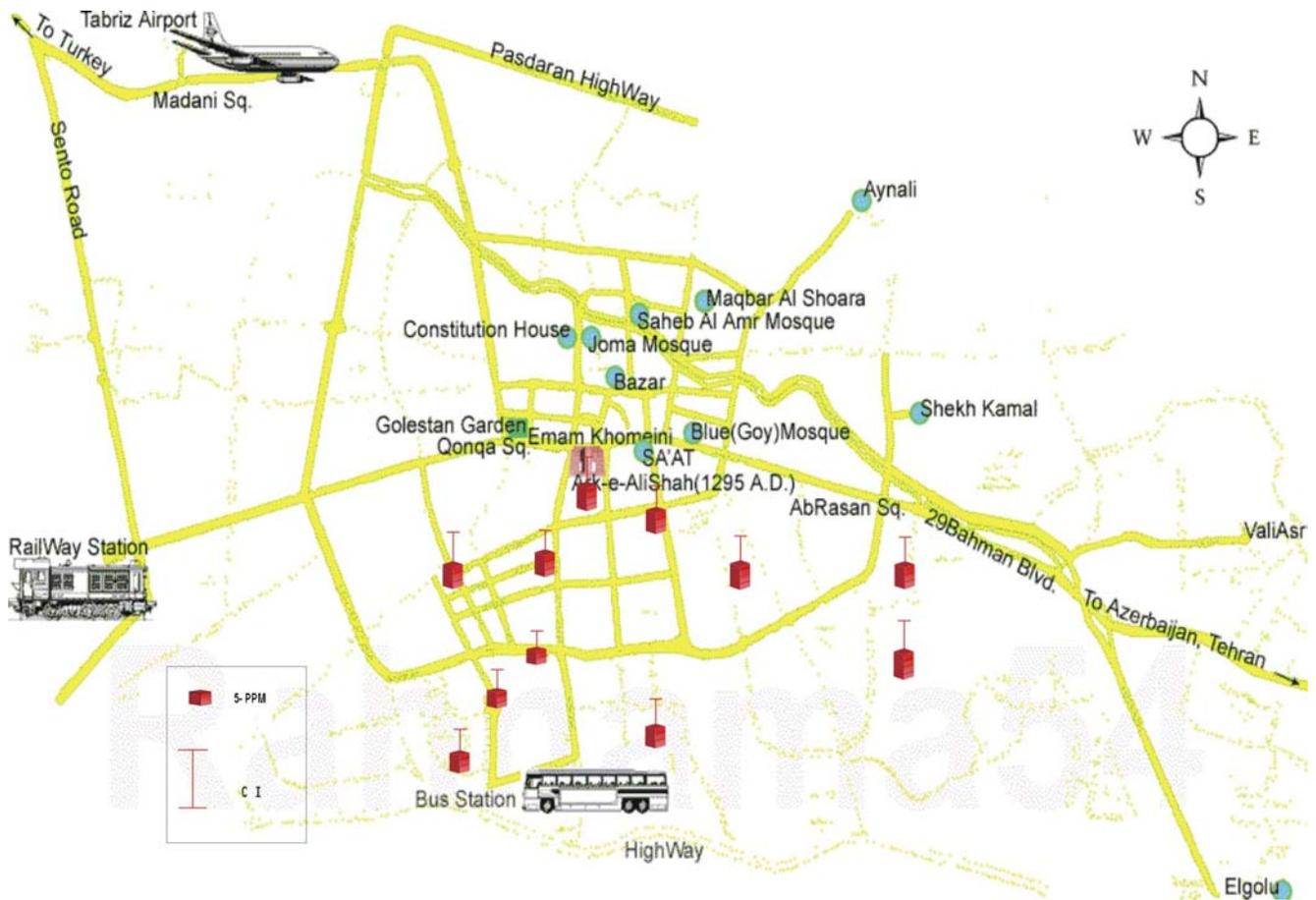


Figure 4. City map

DISCUSSION

Although the health effects of air pollution have been known for years, unfortunately population growth, increasing city traffic, and extra-ordinary use

of out- of- date vehicles in developing countries are major risk factors of traffic related air pollution in city streets. We do not have facilities for assessing other gases like NO₂, SO₂, and particles of ambient

air, but we can roughly estimate the situation of other pollutants from CO concentration. Health effects of CO, the majority of which is produced by motor vehicles has been well studied. In the USA, about 900 deaths are reported due to acute CO poisoning, most frequently from motor vehicles (8). Symptoms and signs of CO poisoning are directly related to its concentration in the blood; and the status of the heart and central nervous system have important impact on the outcome of the victims. Tissue hypoxia due to CO has the highest effect on heart and CNS because of their high oxygen consumption. In CNS, headache, confusion, psychomotor disturbances, behavior changes, visual disturbances, ataxia, convulsion, central hypoventilation, coma, and death may be seen (3, 6, 9).

Measurement of COHb is a good index for monitoring CO concentration in the body. We have not facilities to measure COHb in exposed people of different areas of Tabriz street but we roughly assess COHb by CO levels. The amount of COHb formed depends on the CO concentration and duration of exposure, exercise, ambient pressure, health status, and the specific metabolism of the exposed individual. The formation of COHb is a reversible process, but because of tight binding of CO to hemoglobin, the elimination half-life is quite long, varying from 2- 6.5 hours depending on the initial COHb levels. This may lead to accumulation of COHb, and even relatively low inhaled concentrations of CO could produce relatively high blood levels of COHb. In healthy non-smokers, without CO exposure, the COHb is 0.5%, but it may increase up to 4% in most smokers and may be higher in heavy smokers. In COHb >20% frank symptoms of poisoning appear, and in COHb>60-70% convulsion, coma, and respiratory arrest may occur. (10)

Carbon monoxide is a major cause of sudden death in severe air pollution. In patients with

decreased cardio-respiratory reserve such as coronary artery and chronic obstructive lung diseases, it is very important. Cardiac manifestations of CO poisoning are tachycardia, increase in cardiac output, and decrease O₂ delivery to the heart which has relation to coronary artery diameter. Even a small increase in CO is important because in CAD patients, limitation of exercise and increase in myocardial ischemia has been noticed in COHb< 4%. Also, it has been noticed that, in standard exercise test the onset- time of chest pain is decreased in COHb 2-6% (4). In patients with CAD, the risk of cardiac arrhythmias increases if COHb reaches to ≈6% (11).

Pregnant women are another population at risk regarding exposure to CO gas. Decrease in fetal growth and weight in smokers has been attributed to CO; thus, pregnant women should avoid long-term stay in polluted areas especially in the first months of pregnancy, and also encouraged to quit smoking (3).

Carbon monoxide has other effects on body tissues, and cell damage has been noticed in animal studies (12, 13). In ultra structure studies on rabbit lungs exposed to CO, epithelial cell swelling, interstitial edema, and depletion of lamellar bodies in type 2 epithelial cells have been observed.(12) Standards of 35 ppm for one hour and 9 ppm for 8 hours have been accepted because the resulted COHb ≈1% has no significant effect on myocardial oxygenation in CAD patients. The average concentration for usual driving days is 10-15 ppm, but higher amounts have been noticed in highly polluted cities. In Tabriz 2-3 times more than this is noted in areas with high density of traffic load on working days in the summer. Direct relation of CO concentration with motor vehicles is noticeable in our study .By moving from streets into lanes and alleys the concentration of CO gradually decreases to 0-1 ppm. Although the traffic load is a major determinant of the situation, the type of fuel, use of old vehicles, altitude, cultural impacts on driving and

traffic control may be effective in improving the outcome.

CONCLUSION

Tabriz is the second most polluted city of Iran, and pollution at street level with CO is dangerous in some parts of the city especially on work days and work times in the summer season. This is important because of the increasing number of sudden deaths, cardiac attacks, exacerbations of COPD and probably other health effects. Attention should be paid for decreasing traffic load in crowded areas by promoting people to use public transport systems, improving motor vehicle exhaust filters, encouraging social authorities and people to use new devices especially electrical transport systems and education of driving culture in the society. Parallel to these activities, high risk patients should be advised to prevent long –term stay in highly polluted areas of the city especially on work days and crowded times.

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