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A Study of the Relationship between Ambient Lead and Blood Bead among Gasoline-Station Workers

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Abstract

Consumption of leaded gasoline in Iran cause to emit lead compounds in ambient air of gasoline stations and is known to effect on workers health in these locations. The objectives of this study were assessment of ambient lead levels and blood lead levels of gasoline station workers in Hamadan city, Iran. For this purpose, 82 samples were obtained in ambient air of gasoline station locations. Serum samples from 44 workers and 44 unexposed people were collected to determine blood lead levels. Samples were analyzed with atomic absorption spectrometry.

Blood lead levels in workers and control group were 30.05 and 17.31 µg/dl, respectively. The correlation coefficient between blood lead level and ambient lead level, age as well as duration of employment were 0.44, 0.66 and 0.81, correspondingly.

The highest concentration of lead was recorded at the gasoline station in the city center. A high correlation between vehicle numbers in gasoline station locations and lead concentration was determined in the city center, but with a poor correlation in the suburb of the city. 48% of exposed workers had blood lead levels more than the biological exposure limit recommended by American Conference of Governmental Industrial Hygiene (ACGIH). Using unleaded gasoline and liquefied gas together with a health program education are importance factors to reduce blood lead level in workers of gasoline stations.

Key words: Ambient, Lead, Level, Blood, Gasoline station

Introduction

Growing consumption of leaded gasoline results in significant emission of lead compounds into the atmosphere. Lead compounds are being emitted from car exhaust into the ambient air in urban sites which cause a variety of clinical signs and hematopoietic changes. This issue has always been a source of major concern in occupational health (3, 9, 15). Most of the gasoline-stations in Iran are next to streets and pollutants transfer from street to those sites.

This research was carried out in the Hamadan city, west of Iran in. Hamadan is the center of Hamadan province with high vehicular density including 500-2000 per hour in the center of city and 5-200 per hour in the gasoline-stations. 90% of fuel consumption in Hamadan is leaded gasoline and 10% is diesel oil (2). The number of automobiles that use leaded gasoline is a good indicator of health problems in workers of these locations. Gasoline station workers in Iran have poor personal hygiene habit (unutilization of personal protective, standing near the gasoline pumps, lack of shower etc.) which increases the level of lead exposure and absorption into the human body.

Although there are a number of articles on the lead toxicology in different occupations (battery, pottery, plumber industries etc.) and the permissible exposure based on blood lead concentration on these occupations (5, 8, 11, 16), there are a few studies regarding blood lead levels in gasoline-station workers (10).

As lead compounds in ambient air effect health of gasoline station workers, the objective of this study was assess lead in ambient air and measure blood lead levels in gasoline station workers.

Materials and Methods

Eighty two samples were obtained to measure lead compounds in ambient air at gasoline stations. The samples were collected during morning, afternoon and night shifts.

The subject population comprised 44 gasoline station workers, all of them worked in center and suburbs of the city of Hamadan; in addition 44 age-matched controls which did not have previous exposure to any lead compounds were studied in this regard. The latter group worked in milk industry and was matched with the former group regarding age, area of living and duration of employment.

A questionnaire was used to collect information about past and present medical histories for each subject, including age, during of employment, cigarette smoking, drinking habits, disease history and overall duration of lead exposure.

A blood specimen was drawn from each case into a 10-ml polypropylene tube with sodium heparin as anticoagulant (12). Then, it was stored at 4 °C in a refrigerator until further assessment.

A sampling pump model SKC-224 connected to a filter holder with a teflon tube was used to obtain samples of lead particulates. Ester membrane filter with 3.7 cm diameter and 0.5 µm pore size were used to trap samples of lead particulates. Calibration and adjustment of the sampling flow rate was achieved using a flow meter connected between the sampler and the pump. A special form was used to record the

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number of vehicles per hour, location of sampling, date of sampling, relative humidity, temperature etc.

Blood lead levels and ambient lead concentrations were measured by furnace atomic absorption spectrophtometry model SH22 Thermo Jarrell Ash (12).

The statistical package of SPSS was used to perform statistical data analysis. The variety of statistical analysis included frequency distribution, t-test, correlation coefficient and analysis of variance.

Results

Analysis of blood lead parameters in gasoline station workers and the control group is shown in Table 1. There was a statistical difference of blood lead level between control and the exposed group ($P<0.0001$).

Mean concentration of blood lead levels in workers increases with age and duration of employment. A positive correlation was observed in this regard. The correlation coefficient between ambient lead level and blood lead level in center and suburb of city were 0.44 and 0.36 respectively. The regression equation was PbB= 20.42 + 432.48 PbA.

The average blood lead value was almost 1.73 μg/dl higher in the exposed group than control group. 48% of worker had blood lead levels greater than 30 μg/dl, with a mean blood lead level of 30.05 μg/dl (threshold limit value recommended by ACGIH).

The mean concentrations of lead in ambient air at gasoline stations during sampling period of three shifts (morning, evening and night) are shown in Table 2.

The average of blood lead level in workers occupied in gasoline station at center and suburb of Hamadan city and also concentration of ambient lead in those areas are shown in Table 3.

Discussion

Simple linear regression analyses showed a poor correlation between ambient lead level and blood lead level. This correlation shows that absorption of lead is not only depends on ambient lead levels but also to several variables including contamination of food and water by lead, entrance of lead by poor personal habits (unutilization of personal protective, hand-to-mouth movement, eating at work etc.) and smoking (1, 4).

. The mean concentration of lead in the morning and evening whenever the number of vehicles were more than 40 vehicles per hour was significantly higher than night shift. The

To decrease blood lead levels in gasoline station employers, it is necessary to make a program for health education, reduction of ambient lead concentration and water lead. It is well known that poor personal hygiene at work sites increases the level of lead exposure and absorption by the human body (1). It is reported that a health program education led to decrease blood lead level among lead workers in a prospective study (13). Other factors that effect to increase absorption of lead by body include; age, education of employees and smoking (6, 7, 13, 14, 17). The increase of blood lead concentrations with age is a well-known and documented association in adult populations (7, 14).

ambient lead concentration in gasoline station with more traffic density was higher than that of the suburb. The correlation coefficient between lead concentrations and number of vehicles per hour for center of city and suburb were 0.65 and 0.54 respectively. The highest blood lead levels were employees working in gasoline stations with more than 40 vehicles per hour in the city center. There was a statistical difference between blood lead levels in gasoline station workers when the number of vehicles per hour is less than 40 vehicles per hour and more than 40 vehicle per hour ($P<0.05$).

The mean concentration of lead in ambient of different gasoline stations indicates that pollution is related to traffic flow. The low-level concentrations detected at the gasoline stations in suburb were primarily related to low incidence of vehicles in this site. The concentration of lead in ambient air was as follows: night < evening < morning, which related to traffic density and accumulation of lead pollution along the day.

There was not any significant difference between working in night shifts with other shifts because nobody was permanently assigned to the night shift, i.e. all workers were rotated through day and night shifts.

The significant difference between blood lead levels of gasoline station workers in center (more than 40 vehicles per hour) and suburbs (less than 40 vehicles per hour) demonstrates clearly the influence of vehicle activity on blood lead.

There was a significant difference between concentration of lead in ambient air of gasoline station in center and suburb as well as blood lead level of workers in these areas ($P<0.05$). The gasoline stations in center of Hamadan city were more polluted than those in suburb of the city due to transfer of pollution from street to gasoline stations and also more traffic of vehicles for pumping of gasoline in center of city compare to the suburb.

The number of gasoline stations (4 gasoline stations) compared to number of vehicles (100,000 to 120,000) in Hamadan city was low; that causes to increase traffic of vehicles per hour in each stations. The rate of vehicles for pumping of gasoline in stations was low due to staying vehicles in long line, producing more polluted transfer from car exhaust to ambient air of gasoline stations.

The correlation of blood lead levels with traffic density may be an indication of the increased leaded gasoline combustion as a source of lead exposure in Iran.

The results of this study show that lead compounds emits in the ambient air of gasoline station area. Concentration of lead depends on traffic vehicle per hour and location of gasoline station.

It is recommended the government increases number of gasoline pump stations to prevent more traffic of vehicle in gasoline stations, use unleaded gasoline to care workers and civilian people and take the workers of gasoline stations under constant care and medical examination.

Table 1. Analysis of studied factors in exposed and control groups

Factor	Exposed group n=44			Control group n=44			P.Value
	Mean	SD	R*	Mean	SD	R**	
Age (years)	39.38	8.03	0.66	39.45	8.26	0.68	0.97
Duration of employment (years)	13.52	6.82	0.71	13.63	6.56	0.48	0.94
Blood lead concentration (μg/dl)	30.05	7.01	-	17.31	3.46	-	<0.0001
Systolic Blood pressure	12.10	1.97	-	12.00	1.98	-	0.82
Diastolic Blood pressure	7.77	0.91	-	7.86	0.97	-	0.66

*Correlation coefficient between parameters studied and blood lead levels in exposed group
**Correlation coefficient between parameters studied and blood lead levels in control group

Table 2. The mean Concentration of lead in ambient air of gasoline station in different Shifts and blood lead levels of workers based on number of vehicles per hour

Parameter	Shift	Number of vehicle per hour	Mean	SD	P.Value
Ambient Lead Concentration (mg/m^3)	Morning	>40	0.0370	0.008	<0.001
		<40	0.0183	0.006	
	Afternoon	>40	0.0296	0.012	<0.002
		<40	0.0149	0.006	
	Night	>40	0.0246	0.004	<0.001
		<40	0.0156	0.005	
Blood Lead Levels (μg/dl)	All of workers	>40	32.03	7.43	<0.05
		<40	26.24	4.13	

Table 3. Blood lead levels and concentration of lead in ambient air of gasoline stations at center and suburb of Hamadan city

Parameter	Location	Mean	SD	P.Value
Blood Lead Levels (μg/dl)	Center of city	36.45	8.15	<0.05
	Suburb of city	21.18	6.15	
Ambient Lead of pumping stations (mg/m^3)	Center of city	0.0350	0.007	<0.05
	Suburb of city	0.0135	0.01	

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