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Original Article

Impact of occupational lead exposure on industrial workers health condition in Tehran-Iran

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Abstract. The continual occurrence of occupational lead exposure remains a serious problem worldwide despite awareness of its adverse health effect. Blood lead Level (BLL) in a group of 31 male non smoking industrial workers was determined. Then possible relationships between BLL and health condition of workers , employment years, and fatigue and chronic bone pain symptom were investigated. Workers Blood lead level (BLL) were determined by GTA_AA-220 and hematology parameters were determined by Sysmex-K1000. The workers age mean and employment years mean were 38± 8 years and 12±7.0 years respectively and BLL ranged from 15.50 µg/dL to 59.99 ug/dL with mean=34.80±12.90 µg/dL. The pearson product moment test indicated no correlations between BLL and Hgb (r =-0.09 & p=0.62) and BLL & Hct (r = -0.14 & p=0.46). However, BLL & employment years correlated (r = 0.37 & p= 0.04). To investigate the effect of BLL on fatigue and bone pain, we used independent t-sample test and results indicated 23/31 workers with fatigue and bone pain had higher BLL than those (8/31) without the symptoms (mean= 38.41µg/dL vs mean= 20.44µg/dL, t= 6.06,p=0.00). Furthermore, they had many years of employment (mean=13.4 years vs mean=8.8 years , t= 2.07, p=0.04). In our study 74% of the exposed workers complained of fatigue and chronic bone pain with BLL (mean=38.41 µg/dL) and employment (mean=13.4 years). We conclude that occurrence of fatigue and chronic bone pain symptom may associate with high blood lead level and thus complementary to routine BLL measurement and screening, bone lead measurement can be an important tool in the study of chronic lead exposure among non-smoker and industrially lead exposed workers as well .

Keywords: Electrothermal atomic absorption spectroscopy, occupational lead exposure.

1. Introduction

Lead serves no useful biologic function in the human body, however, it is absorbed primarily through the respiratory and gastrointestinal system, with the former being the more important route of entry in occupational exposures. Most of the absorbed lead is carried and bound to erythrocytes (>90%). The remaining serves as an intermediate in transporting lead from the erythrocytes to other body compartments (1).

Virtually every part of the body is affected by lead. It competes with metals that are essential to the body, such as zinc, iron, and calcium. For example, lead interferes with bone formation by blocking absorption of calcium and affects memory storage and differentiation of cells in the nervous system (2). Lead is stored in the bones, which serve as a cumulative source of lead exposure over many years (1,2).

Occupational lead exposure has been a recognized health hazard for many years among industrial workers and for prevention recommendation on the biologic monitoring of children and occupationally lead exposed workers (3,4) measuring Blood lead level (BLL) has been widely performed in laboratories throughout the world. Characteristic features of occupationally exposed workers, in addition to common signs and symptoms (5,6), is fatigue and

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Table 1

The Workers Information

Workers	n= 31(exposed)
Age mean	38±8
Smoking	NO
Employment (years)	12±7
Bone pain	23
*Hgb mean (g/L)	159.0±2.1
*Hct mean (%)	46.17±4.3

Gender=male *Descriptive Statistics

Table 2

Pearson Product Moment Correlation Results

	R	P value
Pb&Hgb	-0.09	0.62
Pb& Hct	-0.14	0.46
Pb & Employment	0.37	0.04

Table 3

Independent t-Sample Test Results

	mean	T	p value
Pb (ug/dl)	38.41	6.06	0.00
Employment (years)	13.4	2.07	0.04

and chronic pain in the bones (7). The aims of the present work were to measure BLL and study its effect on the health condition of 31 male non-smoking industrial workers at the Reference laboratory of Iran.

2. Method and materials

2.1. Study design

In a group of 31 male non-smoking workers we determined BLL. For the purpose of the effects of lead exposure on workers health at the time of sampling a questionnaire for each participant was completed (Table 1). It is of importance that among workers "symptom" referred to self-reported chronic bone pain symptom and there has been no medical examination.

2.2. Analysis of blood leads level and hematology parameters

One milliliter of venous blood from each worker was drawn into a 5 ml polypropylene acid washed tube with 50 µl 3% EDTA as anticoagulant. The whole blood samples were

thoroughly mixed and freezed at -70 ^{0} C until the time of analysis. The method for the BLL determination was based on the procedures described by Parsons and Flajnik (8,9). A Varian spectra AA-220 with deuterium background correction system equipped with Varian GTA-110 partition graphite tube atomizer and a programmable dispenser (PDS) was used for analysis. Varian hollow-cathode lead lamp was the light source. Hematological parameters (Hb, Hct, RBC count) were measured using Sysmex-K1000 on the same day of sampling.

All chemicals and reagents had a grade suitable for trace metal analysis and were purchased from Merck Co. De-ionized water (D.I-H2O) was used for reagents preparation. The control materials used for the precision and accuracy of the method were Seronorm-whole blood level I & II (Sero AS Asker-Norway).

3. Results

Workers BLLs were determined by GTA-AAS and acceptable between day percentage coefficient of variations (%CV) of 7.2%, and 6.5% for Seromorm- whole blood level I & II (control materials) were obtained respectively. Workers BLL ranged from 15.50 µg/dL to 59.99 µg/dL (mean=34.80± 12.90 µg/dL). The Pearson product moment correlation indicated no relationship between BLL & Hgb (r =-0.09 & p=0.62) and BLL & Hct (r = -0.14 & p=0.46). However, BLL & employment years correlated (r = 0.37 & p= 0.04) (Table 2). To investigate the effect of BLL on fatigue and chronic bone pain symptom among workers we used independent t-sample test. The obtained results indicated (23/31) workers who reported fatigue and chronic bone pain had higher BLL and had been employed for more years than those without bone pain (8/31); (mean BLL= 38.41ug/dL VS 20.44ug/dL, t= 6.06, ,p=0.00) and (mean employment =13.4 VS 8.8 years, t= 2.07, p=0.04).

4. Conclusion

The assessment of chronic lead exposure by BLL measurement is difficult and it may not be an adequate reflection of workers long term health condition for lead associated risks (10,11). In the present work BLLs in 31 lead exposed non-smoking workers in industrial occupations were determined. Then the effect of BLL on their health condition and employment years was investigated.

Our preliminary results indicated (Pearson product moment test) no correlation between BLL, hemoglobin, and hematocrit (hematology parameters). This finding is in agreement with other studies (12,13) and confirms our previous work (14). Furthermore, fatigue and chronic bone pain was reported among 23/31(74%) workers who had higher BLL and more employment years (Tables 2 & 3). Although the mechanisms by which lead interferes with calcium functions have not yet understood completely (15,16), studies have shown that lead substitutes for calcium in the bones resulting in the loss of physiological regulations and causes continues dissolving of the central bone. The calcium loss in bones increases their susceptibility to fractures and is often felt as aching pain in bones. Furthermore, the lead accumulation in bone can be mobilized into circulation providing a delayed toxicity and the accumulation of lead in bone cells may have toxic consequences for bone status (2,15,17,18).

It is a difficult task to determine a precise BLL below which symptoms among non-smoker and occupationally lead exposed workers may occur. However, our preliminary data indicated that occurrence of fatigue and chronic bone pain symptom may associate with high lead exposure, and thus conclude complementary to routine BLL measurement and screening , bone lead measurement can play an important role in the study of chronic lead exposure among non-smoker and industrially lead exposed workers.

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