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Original Article

Effect of painting products on liver function, hematological markers, heavy metals and GSH levels among painters in Sulaimani city

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ABSTRACT

Occupational toxicity as a result of exposures to hazardous chemicals is common in industries using solvents based materials as well as in indoor environments, including painters, , where they exposed to volatile organic compounds. The present study was designed to evaluate health problems and metals-related toxicities among painters in Sulaimani city. A cross sectional study was performed on 35 male painters and twenty non-exposed healthy subjects were included as a control group. Venous blood samples were obtained and analyzed for hematology markers and the serum were utilized for estimation of liver enzyme activity, total bilirubin, serum levels of lead, chromium, and reduced glutathione. The results showed non-significant change in total serum bilirubin between the groups, while liver enzyme activities were significantly increased in the workers. The hematological markers showed a significant increase in Hb level in painters and no significant changes in hematocrit and platelet count between both groups. The data also showed a significant increase in total WBC in painters, and significant increase in the level of lead and non-significant increase in the level of chromium in painters. The level of GSH decreased significantly in painters. In conclusion, evaluation of occupational toxicity in painters in Sulaimani city did not reveal potential health hazards.

Key words: Painters, Liver toxicity, Hematological toxicity, Heavy metals, Glutathione.

INTRODUCTION

Occupational toxicity as a result of exposures to hazardous chemicals is common in industries using solvents based materials as well as in indoor environments, including painters, where they exposed to volatile organic compounds from various sources [1].Various chemical compounds are being used in paint products as pigments, extenders, binders, solvents and additives. The most common rout of toxicity with paints is by inhalation of solvents and other volatile paint components; while the second more common rout is dermal contact, or through other chemical agents that they are used by their coworkers [2]. Most epidemiological studies to evaluate the hepatotoxicity of industrial solvents in widespread use (white spirit, toluene, and xylene) have shown no effect on serum liver enzymes during chronic exposure [3-5]. Lead, cadmium and chromium are major toxic metals, which are found in paints. They are components of paint pigments, such as lead chromate, lead oxide, cadmium yellow, chrome yellow and chrome orange [6-8]. Chronic inhalation of chromium compounds may cause allergic asthmatic reaction, ulceration in the mucus membrane, damage of the nasal septum and bronchial carcinoma [8]. Lead is widely used in many types of paints because of its anticorrosive properties and ability to hold pigments together [9-11]. Exposure to lead is correlated with a wide range of physiological, biochemical, and behavioral dysfunctions [12]. It potentially induces oxidative stress, and there is a large body of evidence, which support the role of oxidative stress in the pathophysiology of lead toxicity [13, 14]. There are scanty data on the occupational toxicity during chronic exposure of workers to painting products in Iraq/ Kurdistan region, so the present study was designed to evaluate health problems and metals-related toxicities among painters in Sulaimani city.

MATERIALS AND METHODS

This cross sectional study was performed on 35 male workers who employed in paint shops in Sulaimani city during the period from February to June 2015. Their age ranges was (22- 35 years), and have work experience ranged from 5- 10 years. Each worker was interviewed using structured

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questionnaire that includes personal data, metals toxicity symptoms, duration of exposure and the whole time they spend in this profession. All subjects were apparently healthy at enrolment time. Twenty non-exposed healthy subjects, their age matched with that of workers, were included as control group. Each subject signed informed consent before enrollment and the study protocol was approved by the local ethical committee of the School of Pharmacy, University of Sulaimani. Venous blood samples (10 ml) were obtained by vein puncture from the workers and control group subjects; 5 ml was kept in a plain tube. After clot formation, the samples were centrifuged at 3000 rpm for 15 min to obtain the serum, which was utilized for estimation of liver enzymes activity (AST, ALT) [15], serum levels of total bilirubin [16], serum levels of lead (Pb) and chromium (Cr) using ICP atomic absorption spectrophotometer (Perkin Elmer, USA) [17], and for the estimation reduced glutathione (GSH) using the method of Ellman [18]. The other part of the blood was kept in EDTA tube, and analyzed for hematology markers using automated hematometer (Coulter Swelab, Switzerland) [19].

STATISTICAL ANALYSIS

All values were expressed as mean±S.D. Statistical analysis was performed using Graph Pad prism software (Version 6.0). Unpaired Student's *t*-test was utilized to evaluate the difference between means. P values less than 0.05 indicated significant differences.

RESULTS

In table 1, the data showed non-significant change in total serum bilirubin between painters and control group, while serum ALT and AST activity were significantly increased in worker group compared with the control ($P<0.05$). Regarding hematological markers (Table 2), it showed significant increase in Hb level in painters compared to the control group but there were no significant changes in hematocrit and platelet count between both groups. The data also showed a significant increase in total WBC and lymphocytes in painters compared to the control, with no significant changes in granulocyte levels in both groups. The results of lead and chromium revealed significant increase in the level of lead and non-significant increase in the level of chromium in painter group compared with the control group as presented in figures 1. In the current study the level of GSH in painter group decreased significantly compared to the control group (figure 2). Figure 3 reveals weak and non-significant correlation between duration of exposure to painting materials and liver enzymes activity. Moreover, ALT activity demonstrates positive correlation with the serum levels of lead, while AST activity was weakly correlated with lead levels (Figure 4). Figure 5 indicates positive correlation between serum GSH levels and serum levels of Pb. In figure 6, total WBC, lymphocytes and granulocytes count showed weak and non-significant correlation with serum Pb levels.

DISCUSSION

The health of workers might be affected by their type of occupation. People have continued to suffer from hazardous occupational exposures in the work environment due to various chemicals they handle [20]. In the present study liver enzymes activities ALT and AST were significantly elevated in painters compared to control group. Similar findings have been reported in other studies [21], while serum bilirubin remained unchanged in painters, supposing the idea of exposure-induced mild liver toxicity. These findings are consistent with other reports, which showed that exposure to non-permissible levels of a mixture of solvents can only cause mild hepatic dysfunction [22]. Other studies have found an increase in serum bile acids among workers exposed to mixed solvents as well as among workers exposed to styrene [23-25].The controversial data regarding the toxicity of painting products might be explained on the bases of difference in exposure pattern, acute or chronic exposure, or other factors that contribute to changes in liver function tests [24]. Approximately 100,000 chemicals are currently in use worldwide and 500 new ones enter the market annually. Some of these chemicals such as paints and petroleum products handled by painters in their various work places have been reported to contain heavy metals like lead and chromium, which might enter the biological system and produce deleterious effects [20]. In the current study, the level of lead was significantly increased in the studied samples. Lead adversely affects numerous part of body compartments and causes many forms of health problems and illnesses after acute or chronic exposure [26]. Acute lead poisoning from uncontrolled occupational exposures has resulted in fatalities, and chronic exposure to lead may result in a severe damage to the blood forming, nervous, urinary, and reproductive system [27]. Meanwhile, the results showed non-significant increase in the level of chromium in painters group, which might be attributed to lower incidence of exposure to this metal in the work fields. The toxicity of chromium stems from its tendency to be corrosive and to cause allergic reactions. Chromium is a carcinogen, particularly to the lung through inhalation. Cell toxicity caused by heavy metal ions is attributed to oxidative stress [28]. Cells have different antioxidant defense systems against free radical attack. GSH is one of the antioxidants molecules that play an important role in protecting the cell against oxidative damage [29]. Glutathione has a sulfhydryl moiety that binds directly to many toxic metals. Such binding efficiently inactivates glutathione, decreasing its antioxidant activities and increasing the production of free radicals in the body. In the present study, serum levels of GSH were significantly decreased in the painters compared with the control and it showed a positive correlation with serum lead levels; it has been reported that GSH concentration in the blood of lead-exposed animals, children and adults was considerably lower than the controls [30, 31]. Several epidemiological studies among workers with high occupational lead exposure have reported positive association between lead exposure and oxidative stress markers [9-11]. It has been reported that heme synthesis is inhibited by lead; therefore, the activity of heme containing enzymes were decreased in the presence of lead [32]. In the current study, Hb in painters were significantly higher than the control group, although the results were within normal, but these results are not in tune with other studies that found linear reductions in hematological parameters, suggesting anemic conditions in the experimental animals exposed to heavy metals such as lead [33]. This finding can be attributed to high incidence of cigarette smoking habits among the studied sample of painters (72%). The fluctuation in exposure period to paint products may be one of the reasons of non-significant changes observed in some of the parameters including some of the hematological parameters. In conclusion, evaluation of occupational toxicity in painters in Sulaimani city did not reveal potential health hazards. However, because of sample size limitation further study on larger samples are recommended.

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Table 1: Liver function markers in painting workers compared with healthy non-exposed subjects

Markers	Control (*n*=20)	Painters (*n*=35)
Serum ALT (U/L)	24.8±11.4	39.8±11.9*
Serum AST (U/L)	23.9±8.8	40.9±12.8*
Total Bilirubin (mg/dl)	0.91±0.3	0.86±0.5

Values are presented as mean±SD; n=number of subjects; *significantly different with respect to control (*P*<0.05)

Table 2: Hematological indices in painting workers compared with healthy non-exposed subjects

Markers	Control (*n*=20)	Painters (*n*=35)
Hb (g/dl)	15.7±0.7	16.2±1.2*
Hct (%)	47.4±2.1	48.3±3.7
Platelets (x10^9/L)	228.3±38.2	216.2±65.1
Total WBC (x10^9/L)	7.2±1.4	8.7±2.2*
Lymphocytes (x10^9/L)	2.3±0.5	3.0±0.6*
Granulocytes (x10^9/L)	4.5±0.9	5.1±1.5

Values are presented as mean±SD; n=number of subjects; *significantly different with respect to control (*P*<0.05)

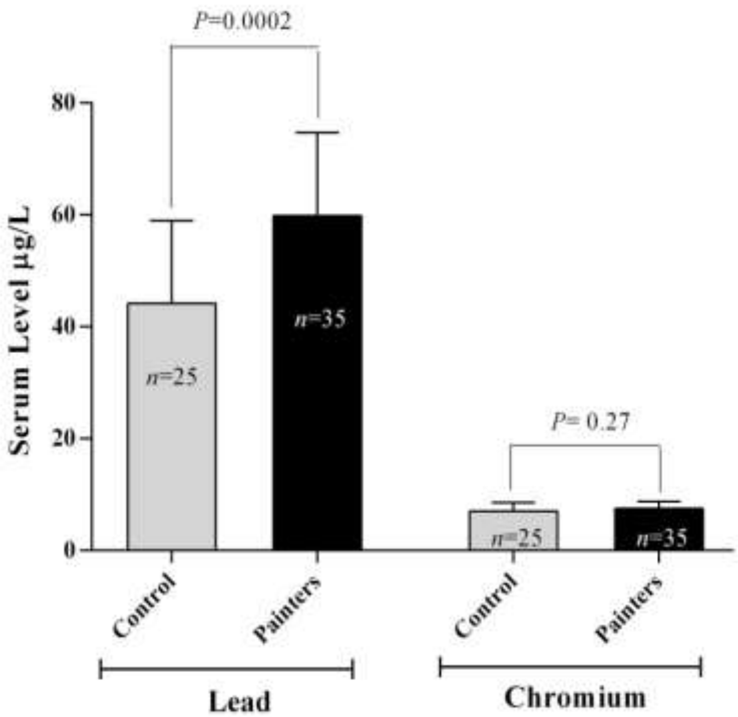

Figure 1: Effect of exposure to painting materials on the levels of lead and chromium of painters in Sulaimani city.

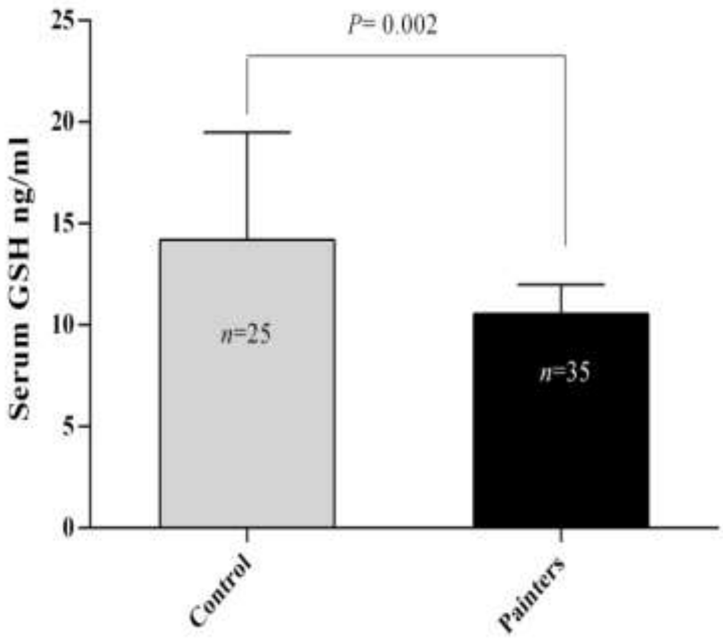

Figure 2: Effect of exposure to painting materials on the levels of GSH of painters in Sulaimani city.

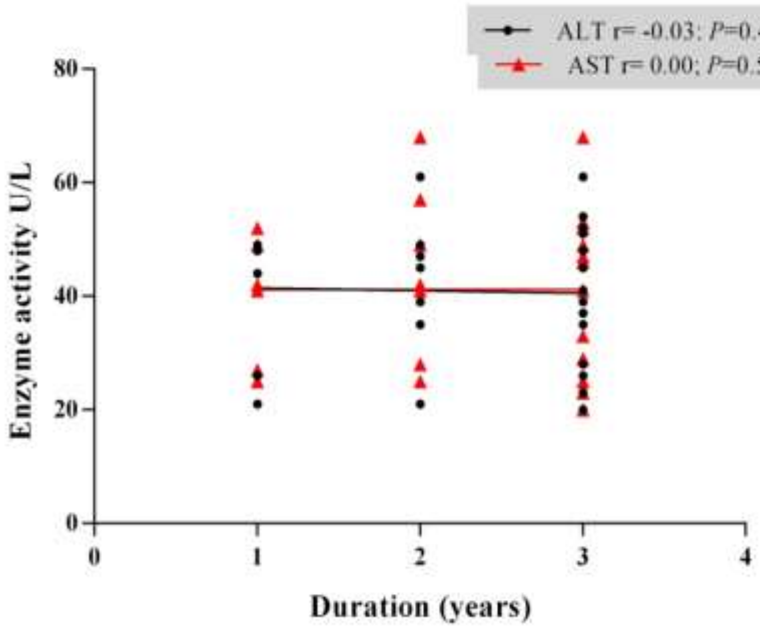

Figure 3: Correlation between the duration of exposure to painting materials and liver enzyme activity of painting workers in Sulaimani city.

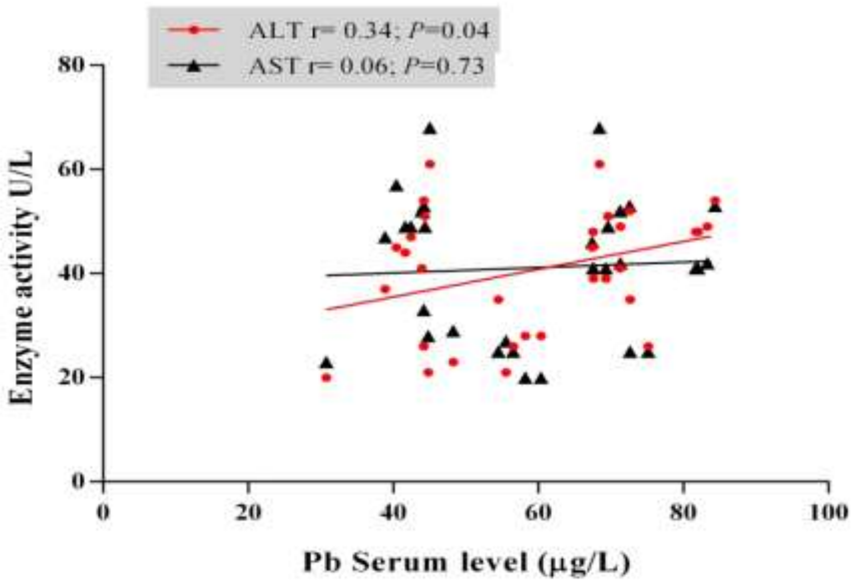

Figure 4: Correlation between serum Pb levels and liver enzymes activity of painting workers in Sulaimani city.

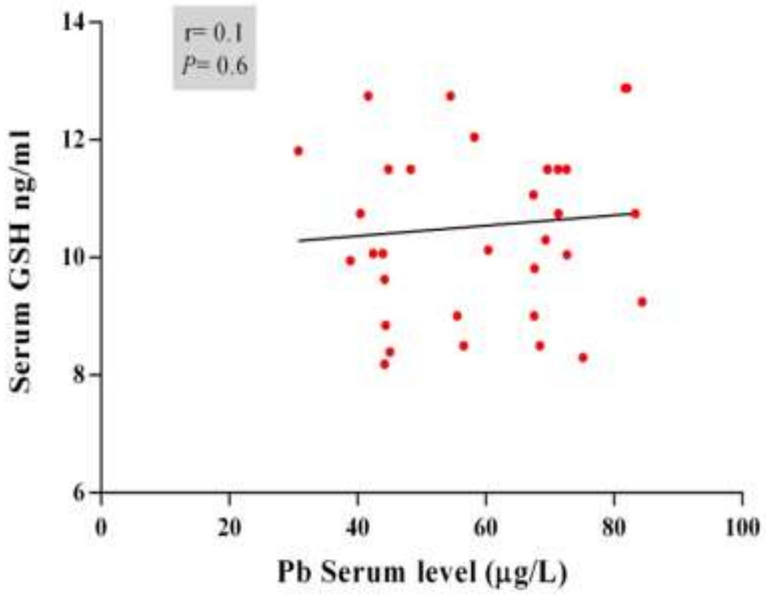

Figure 5: Correlation between serum levels of Pb and GSH in painting workers within Sulaimani city.

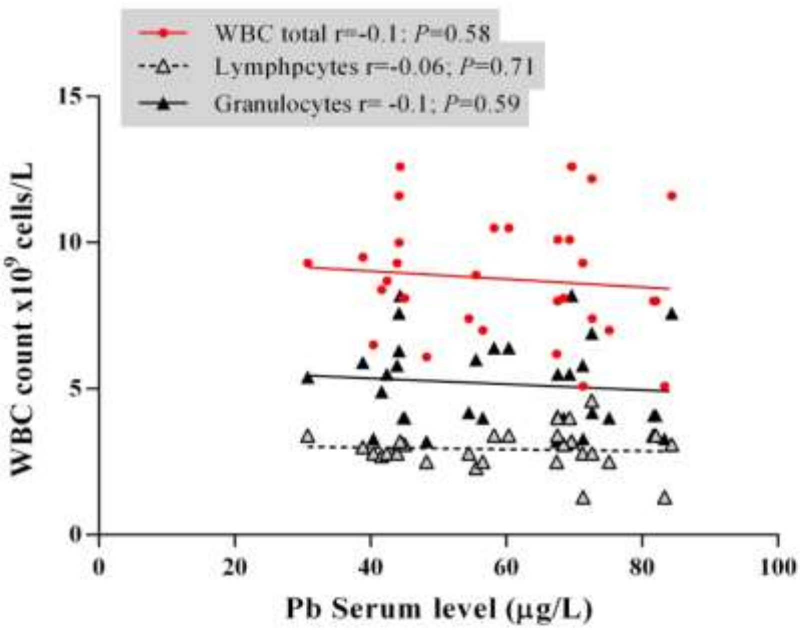

Figure 6: Correlation between serum Pb levels and WBC count of painting workers in Sulaimani city.

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