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Effect of Lead Exposure on Malondialdehyde (MDA) Level and Some Biochemical Parameter in Workers of Gasoline Stations.

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ABSTRACT

Workers of gasoline stations in Basra Government /Iraq are usually exposed to heavy metal especially (lead).The current study was aimed to evaluate the effect of lead(pb) on *lipid peroxidation (MDA)* and some biochemical parameter: *superoxidase dismutase (SOD), catalase (CAT), glutathione-s-transferase (GST) and glutathione (GSH)* in blood of gasoline station workers. The results revealed that Pb and *MDA* levels were significantly higher in the blood of workers than healthy controls, while the levels of *SOD, CAT, GST and GSH* were found a significantly decreased in workers compared to healthy controls. Statistical analysis of the present results showed that the level of pb was positively and highly significantly correlated with *MDA* levels ($r= 0.723$, $p < 0.0001$) in workers of gasoline station. On the other hand, pb level was negatively and highly significantly correlated with *SOD, GST* and *GSH* ($r = - 0.733$, with $p < 0.0001$ and $r = - 0. 395$, $r= - 0.455$ with $P < 0.001$)respectively. Also, found that pb level was significant negative correlated with *CAT* ($r = - 0.295$, $P < 0.05$) in gasoline station workers. In conclusion, exposure to pb in gasoline stations happen continuously as a result of the use of leaded fuel and therefore cause an increase in oxidative stress (increased *MDA*) and accompanied by a reduction in enzymatic and non-enzymatic antioxidant.

Keywords: Gasoline station workers, pb , *MDA, SOD, CAT, GST*

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INTRODUCTION

Occupational exposure to lead (pb) can lead to serious threat to humans health. The various properties of the lead makes him widespread use where it is used in building materials, paints and protective coatings, gasoline additives and lead-soldered water pipes. Lead is a non-essential toxic heavy metal to serve any necessary biological function within the body [1]. Lead can cause hypertension, renal dysfunction, anemia, neurological problems [2], including central and peripheral nervous systems [3], and effect of cardiovascular system [4], gastrointestinal and renal systems [5].

Lead causes oxidative stress by inducing the generation of *ROS*, reducing the antioxidant defense system of cells via depleting glutathione, interfering with some essential metal, inhibiting sulfhydryl dependent enzymes or antioxidant enzymes activities and /or increasing susceptibility of cells to oxidative attack by altering membrane integrity and fatty acid composition [6]. The lead can inhibit activity of antioxidant enzymes likes *SOD, CAT, GPx , GST* and *GRx*.

Overall, these inhibitory effects of lead on various enzymes would probably result in impaired antioxidant defences by cells and render cells more vulnerable to oxidative attacks.

The present study was designed to show the effect of lead on oxidative stress (*MDA*), and study correlation between lead and the level of enzymatic antioxidant (*SOD, CAT, GST*) and non-enzymatic antioxidant (*GSH*) that protect cell from *ROS* that caused by lead.

MATERIAL AND METHODS

The present study included (50) non-lead exposed healthy control subjects aged between (18) –(50) years(Mean ± SD = 30.27 ± 10.37) and (50) lead exposed gasoline stations workers of Basra Government / Iraq aged between (18) and (56) years (Mean ± SD = 30.45± 9.31). (10 ml) of Venous blood samples were collected from workers and healthy control and it was divided into two parts; (5ml) of blood were added into EDTA contained plain tubes and became ready in digestion procedures for determining pb, while the (5ml) of whole blood samples were allowed to clot on ice, and then centrifuged in (402 X g for 10 min.). The obtained serum immediately use for estimate *MDA, SOD, CAT ,GST ,GPx , GRx* and *GSH*, and others of serum were stored in deep freezing at (-20°C)until using. The concentrations of Pb was determined using Graphite Furnace Atomic Absorption Spectrometry (AAS) (GBC 933 Plus) [7]. *MDA, SOD, CAT ,GST* and *GSH* were measured according to the methods of (Burtis & Ashwood) [8], (Winterboun et al.) [9] , (Mueller et al.,) [10], (Habig et al.,) [11] and (Burtis &Ashwood) [8] respectively.

Statistical analysis

The data were statistically analyzed according to the t-Student's test using the variance analysis Version 17, SPSS Inc, Chicago). The obtained results were expressed as (mean values and standard deviations) are presented in tables. The level of $p < 0.05$ was considered as statistically significant, and as a highly significant at $p < 0.01$.

RESULTS

The level of Blood lead , *MDA, GSH* and activity of enzymatic antioxidant in the serum of healthy control and workers of gasoline station are presented in Table 1and Figure 1. The results show that levels of Pb and *MDA* were significantly higher in gasoline station workers than those of healthy controls. Also , data obtained revealed that there was highly significant and decreased activity of *SOD, CAT, GST* and *GSH* of workers compared to healthy controls. From statistical analysis of the results obtained in this study, we found positive and highly significant correlated between blood pb and level of lead and *MDA* ($r = +0.723$, $p < 0.0001$) Figure 2, and found negative correlation between levels of lead and (*SOD, CAT, GST* and *GSH*) ($r = -0.733$, $r = -0.455$, $r = -0.395$ and $r = -0.295$) respectively, in gasoline station workers compared to the control group Figures 3 - 6.

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Table 1: Level of all parameters in blood of gasoline station workers and healthy control

Parameter	Concentration of parameters		Significance
	Exposure group	Control	
Pb (µg/ml)	0.704 ± 0.17	0.267 ± 0.131**	P < 0.0001
	0.35 - 1.04	0.04 - 0.52	
MDA (µmol/L)	5.74 ± 1.32	2.25 ± 0.568**	P < 0.0001
	3.20 - 7.99	1.38 - 1.03	
SOD (U/ml)	1.1258 ± 0.312	1.83 ± 0.1997**	P < 0.001
	1.52 - 0.36	2.05 - 1.42	
CAT (K/ml)	0.258 ± 0.102	0.7157 ± 0.734*	P < 0.01
	0.48 - 0.10	2.91 - 0.14	
GST (µmol/L)	3.616 ± 1.3148	7.576 ± 6.815**	P < 0.001
	6.56 - 1.90	24.09 - 1.25	
GSH (µmol/L)	1.054 ± 0.416	1.85 ± 1.450**	P < 0.001
	1.86 - 0.37	5.29 - 0.30	

N= 50, Mean ± standard deviation, * p<0.05; ** p<0.001 .

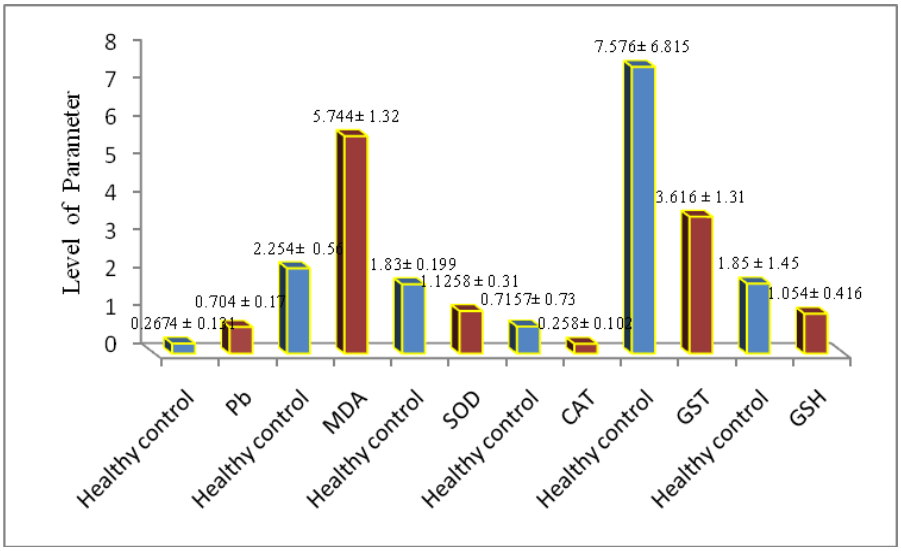

Figure 1: Level of all parameter of healthy control and petrol station workers. The values are the Mean ±SD

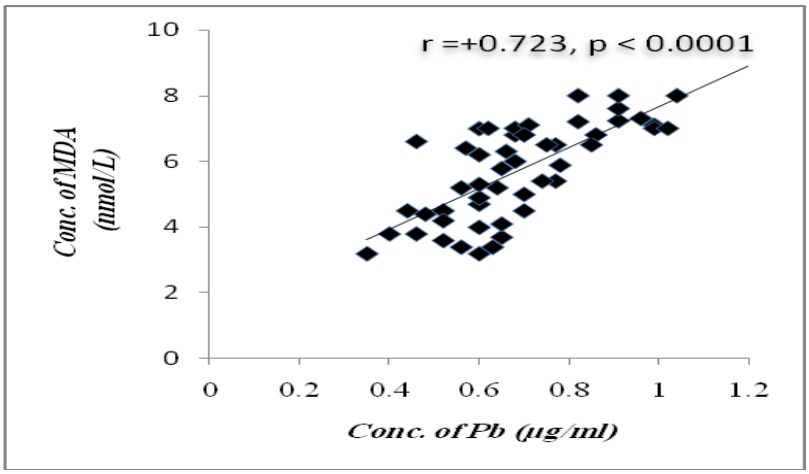

Figure 2: Correlation between level of lead (pb) and level of *Malondialdehyde* (*MDA)* in blood of Gasoline Station Workers

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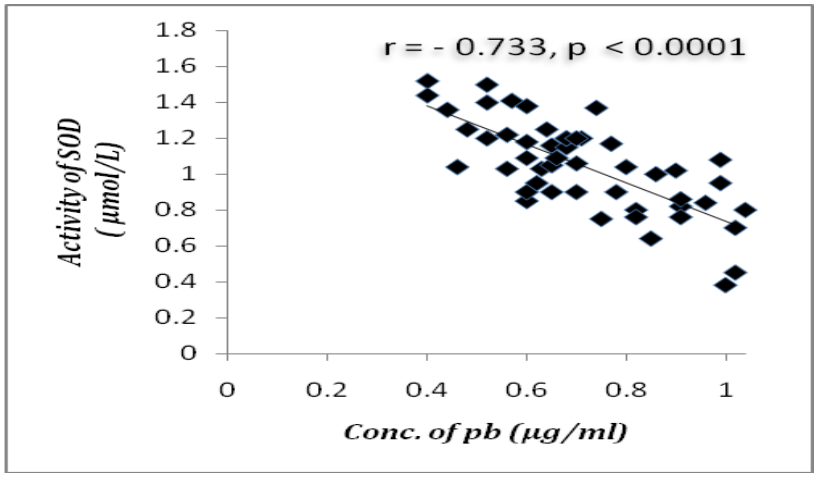

Figure 3: Correlation between level of lead (pb) and activity of *superoxide dismutase* (*SOD*) in blood of Gasoline Station Workers

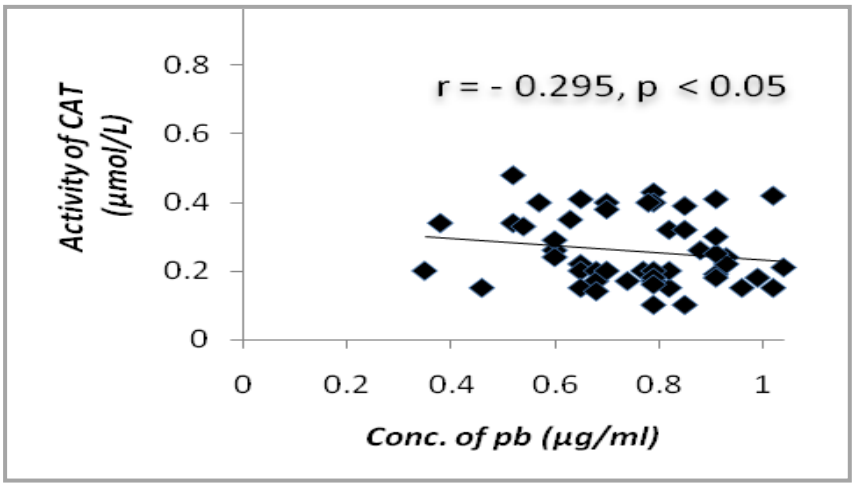

Figure 4: Correlation between level of lead (pb) and activity of *Catalase* (*CAT*) in blood of Gasoline Station Workers

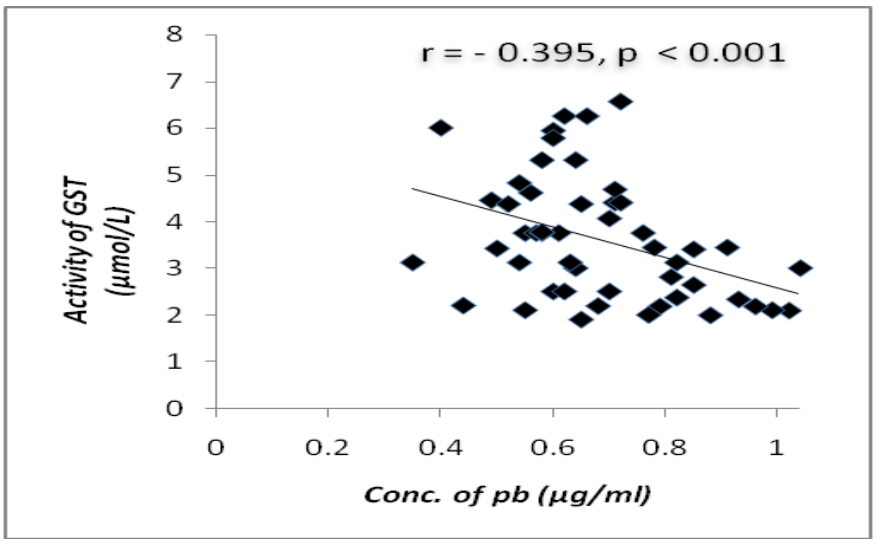

Figure 5: Correlation between level of lead (pb) and activity of *Glutathione -s- transferase* (*GST*) in blood of Gasoline Station Workers

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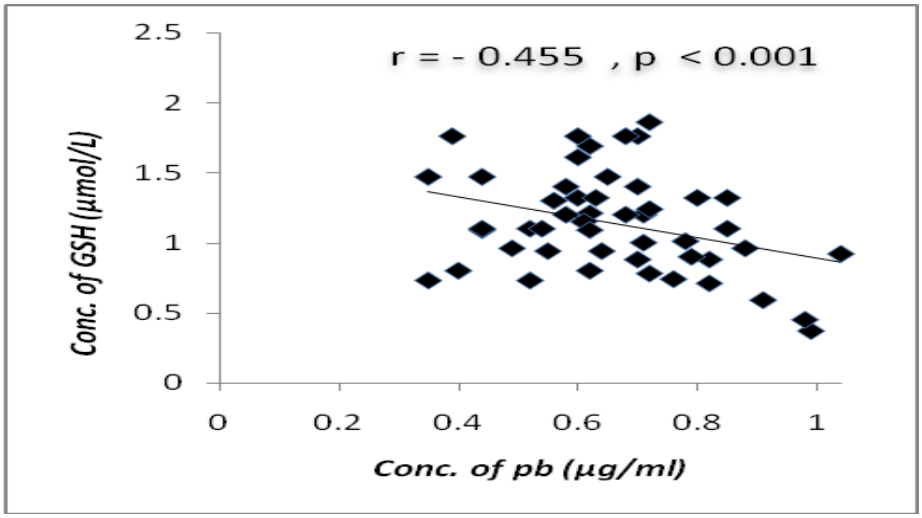

Figure 6: Correlation between level of lead (pb) and activity of *Glutathione* (*GSH*) in blood of Gasoline Station Workers

DISCUSSION

Heavy metals such as lead poisoning is usually caused to humans and produce health effects [12]. The main source of lead from using anti-knock lead additives in petrol for its ability to increase the fuel's octane rating (that is, to prevent knocking in the engine) thus allowing the use of higher compression ratios for greater efficiency and power.

The results in current study table 1 showed significant increase in the level of lead pb in the blood of gasoline station workers (0.704±0.170 µg/ml) compared to healthy control (0.2674±0.132 µg/ml). These resulst may be due to several reasons:First, station workers neglect to use face masks during work and this significantly increases blood lead levels due to the inhalation of airborne lead. Second, they neglect to use the protective clothe and to wash their body after work and this increases blood lead levels due to dermal absorption [13]. This result is similar with other studies [14-16]. Increasing the concentration of lead in the blood when the workers cause health problems caused by the tendency of the accumulation of lead in the body and thus affecting the enzymatic protection systems within cells.

The increased level of lead causes oxidative damage by the increase production of free radicals ROS, reducing the antioxidant defense system of cells via depleting glutathionel, inhibiting sulfhydryl dependent enzymes or antioxidant enzyme activities and /or increasing lipid peroxidation (increased *MDA*) [6]. This agreement with the results obtained in this study in table 1, figure 1 that showed high level of pb in workers leads to increased level of lipid peroxidation (*MDA* as the final products) (5.74 ± 1.32) and reducing of antoxidant enzyme (*SOD, CAT, GST* and *GSH*) in gasoline stations workers (1.1258 ± 0.312, 0.258 ± 0.102, 3.616 ± 1.3148 and 1.054 ± 0.416) respectively compared to healthy controls.

Through the correlation Analysis of the results, we find that the blood pb was positively and highly significantly correlated with serum *MDA* ($r = 0.723$, $P < 0.0001$). This result can explain through the ability of pb to generation ROS by ability pb to depletion of glutathione and protein-bound sulfydryl groups, resulting in the production of reactive oxygen species. As a consequence, increased lipid peroxidation (increased *MDA*). Also, the present results showed that pb level was negatively and highly significantly correlated with *SOD, GST* and *GSH* ($r = - 0.733$ with $p < 0.0001$, $r = - 0.395$ and $r = - 0.455$ with $P < 0.001$) respectively. Also, found that *MDA* level was significant negative correlated with catalase ($r = - 0.295$, $P < 0.05$).

The lead (pb), have electron-sharing affinities that can result in the formation of covalent attachments mainly between pb and -SH groups of proteins. pb is known to deplete *GSH* level which result in the excess formation of *GSH* from cysteine via the γ-glutamyl cycle but *GSH* is usually not effectively supplied, if depletion continues because of chronic metal exposure. Several enzymes in antioxidant defense systems may protect the imbalance between pro-oxidant and antioxidant but unfortunately, most of the enzymes

contain sulfhydryl groups at their active site hence become inactive due to direct binding of lead to sulfhydryl group [17].

SOD requires copper and zinc for its activity. Both the metal ions are replaced by lead, which decreases the activity of *SOD* [18]. *Catalase* contains heme as the prosthetic group, the biosynthesis of which is inhibited by lead and resulted in decrease erythrocyte *catalase* activation [19]. Depressed levels of *glutathione-S-transferase GST* was found to correlate with depressed glutathione *GSH* levels in occupationally-exposed workers.

CONCLUSION

In conclusion, occupational exposure to leaded gasoline in filling gasoline stations represents a risk factor for wrokers health by increased level of lipid peroxidation and decreased activity of enzymatic antioxidant like *SOD, CAT, GST* and non-enzymatic antioxidant *GSH* that protect cell from oxidative stress damage that produced by lead.

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