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Biochemical Correlation between Some Heavy Metals, Malondialdehyde and Total Antioxidant Capacity in blood of Gasoline Station Workers

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Abstract

The present study was aimed to evaluate the effects of some heavy metals (Hg, pb& Cd) and MDA on total antioxidant capacity (TAC) in blood of gasoline station workers in Basra Governorate/Iraq. The results revealed that Hg, Pb, Cd and MDA levels significantly higher in the blood of workers than healthy controls (p <0.0001) respectively. This study also found a significant increase in the level of TAC (p <0.05) in serum of workers compared to the control. The results confirmed that the level of serum TAC was negatived and significantly correlated with Hg, Pb, Cd and MDA levels (p< 0.0001, r= -0.39, r= -0. 3, r= -0.551, r= -0.671) respectively, in gasoline station workers. The present study suggests the chronic exposure to gasoline in the work place (gasoline stations) led to increase in the oxidative stress in workers which decreased the antioxidant enzyme levels.This behavior might give an indicator for the oxidants that take place in exposed persons.

Keywords: Total antioxidant capacity, Malondialdehyde, heavy metals, workers, pollutants.

Introduction

Many workers are exposed to heavy metals in the industry, especially for gasoline station. Heavy metals such as lead, mercury and cadmium have hazardous effects on human health as a result of their deployment in the environment and their ability to accumulate in the human body inside.

When not digest heavy metals accumulate in the human body becomes toxic and cause many problems for human health, including damage to the nerves and the central, blood composition and many organs[1,2]. And these metals become toxic when an increase from the normal level allowed. As a rule, acute poisoning is more likely to result from inhalation or skin contact of dust, fumes or vapors, or materials in the workplace.

Oxidative stress is defined as an impaired balance between free radical production and antioxidant capacity resulting in excess oxidative products '[3]. Malondialdehyde (MDA), which is an end product of the oxidation of polyunsaturated fatty acids has been used as index to estimate oxidative stress[4].

'TAC is a dynamic equilibrium that is influenced by the interactions between each serum antioxidative constituent. It is thought that the cooperation of antioxidants in human serum provides greater protection against attacks by free radicals than any antioxidant alone[5].

In the current study the effects of Pb, Hg, Cd and MDA on (TAC) were investigated of petrol station workers and in healthy control.

Material and methods

The study samples included (50) persons who had worked in gasoline stations aged between (18) and (56) years (Mean ± SD = 30.45± 9.31), and controlled with (50) healthy individuals (non-workers) aged between (18) and (50) years (Mean ± SD = 30.27 ± 10.37) to assess the health of gasoline station workers. All the subjects gave their informed consent and a semi-structured questionnaire was used to obtain information age, smoking habit, job duration /exposure time and history of disease or aergy of the subjects. About 10ml of the blood was drawn from a forearm vein of each fasting worker in gasoline station and control subjects. Five milliliters were added into EDTA containing polypropylene tubes and shacked gently to be used for measurement the concentration Pb, Hg, Cd. The rest 5ml of whole blood samples were allowed to clot on ice, and then centrifuged in (402 X_g for 10 min.) to be used serum samples immediately for measuring Total Antioxidant capacity (TAC) and Malondialdehyde (MDA). The concentrations of Pb and Cd were determined using Graphite Furnace Atomic Absorption Spectrometry (AAS) (GBC 933 Plus)[6]. Hg was measured by Atomic Absorption Spectrometry using cold vapor apparatus AAS (Shimadzu AA-630-12)[7]. TAC and MDA were measured according to the methods of Koracevic et al.[5] and Burtis and Ashwood[8], respectively.

Statistical analysis: Comparison between exposed and unexposed groups was carried out using Student's t-test in SPSS computer statistical package (Version 17, SPSS Inc, Chicago). All parameters were expressed as mean ± standard deviation and the comparison was made with respective control groups of non gasoline station workers. P < 0.05 were considered significant, and as a highly significant at p < 0.01.

Results and Discussion

Table-1 shows the comparison of various biochemical components blood parameters in gasoline station workers with unexposed control group. A significant decreasein the level of TAC was observed in workers (P< 0.05), whereas Pb, Hg, Cd and MDA were found to be elevated. The effect of duration of exposure to gasoline on Total antioxidant capacity in gasoline station workers was shown in table 2. It was found that long time exposure to gasoline (increase the period of working) causes adverse effects on the health of station workers. The results revealed that oxidative stress was Increasing and total antioxidant capacity (TAC) level decreasing as the periods of works increases. Figure 1- 4 shows that level of serum TAC was negatively and significantly correlated with Pb, Hg, Cd and MDA levels (p <0.000 1, r = -0.39, r = -0. 3, r = -0.551, r= -0.67) respectively, in gasoline station workers compared to the control group.

The present study showed that heavy metals (Pb, Hg, Cd) affected total antioxidant capacity (TAC) in the gasoline station workers.

The heavy metals, lead, mercury and cadmium, all have electron–sharing affinities that can result information of covalent attachments[9]. These attachments are mainly formed between heavy metals and sulfhydryl groupsof proteins[10]. 'Interaction of toxic metals with GSH metabolism is an essential part of the toxic response of many metals'[11].

Blood lead, cadmium and mercury levels were higher with high statistical significance in in gasoline station workers whose exposed to heavy compared with reference groups table-1. The results showed in table 2 predicted that an increase of the period of pollution, Increase the accumulation of these elements within the body and led increase information of ROS.

The toxicity of heavy metals and benzene on workers was clearly seen in the increase of ROS that means an increase of MDA with decrease TAC were shown in table-1. The increase in the production of ROScauses an increase in lipid peroxidation and production MDA which is considered a good indicator to evaluate oxidative stress[12]. The ability heavy metal to produce ROS was shown in the present study by significant increase in the level of MDA in workers than in control. And noticed that MDA and ROS were increased dramatically in the study group with increasing years of exposure confirming the increase concentration blood lead, mercury, cadmium to increase oxidative stress table 2.

Table-1
Concentrations of determining parameters in blood of gasoline station workers and control

	Concentrations of parameters		
Parameters	**Exposure group**	**Control**	**Significance**
pb(µg/ml)	0.704 ± 0.17	0.267 ± 0.131**	p < 0.0001
	0.35-1.04	0.04-0.52	
Cd (µg/ml)	0.053 ± 0.022	0.017± 0.011**	p < 0.0001
	0.03-0.1	0.01-0.07	
Hg (ng/ml)	29.63 ± 4.28	14.7± 2.63**	p < 0.0001
	21-37	11.0-19	
MDA (nmol/L)	5.74 ± 1.32	2.25 ± 0.568**	p < 0.0001
	3.20-7.99	1.38-1.03	
TAC (mmol/L)	1.15 ± 0.355	2.54 ± 0.342*	p < 0.05
	0.18-1.79	2-3.47	

N= 50, Mean ± standard deviation, * p<0.05; ** p<0.0001.

Table-2
Effect of different periods of working on determining parameters in blood of gasoline station workers

Parameter	Periods of Working (Year)	Petrol station workers (n=50)	
		Mean	**SD**
Pb (µg/ml)	(0 - 5)	0.6986	0.1921
	(6 -12)	0.7093	0.1454
Cd (µg/ml)	(0 - 5)	0.0356	0.0133
	(6 -12)	0.0698	0.0309
Hg (ng/ml)	(0 - 5)	26.683	3.825
	(6 -12)	32.59	3.311
MDA (nmol/L)	(0 - 5)	5.46	1.8506
	(6 -12)	6.0283	1.237
TAC (mmol/L)	(0 - 5)	1.2194	0.448
	(6 -12)	1.0867	0.305

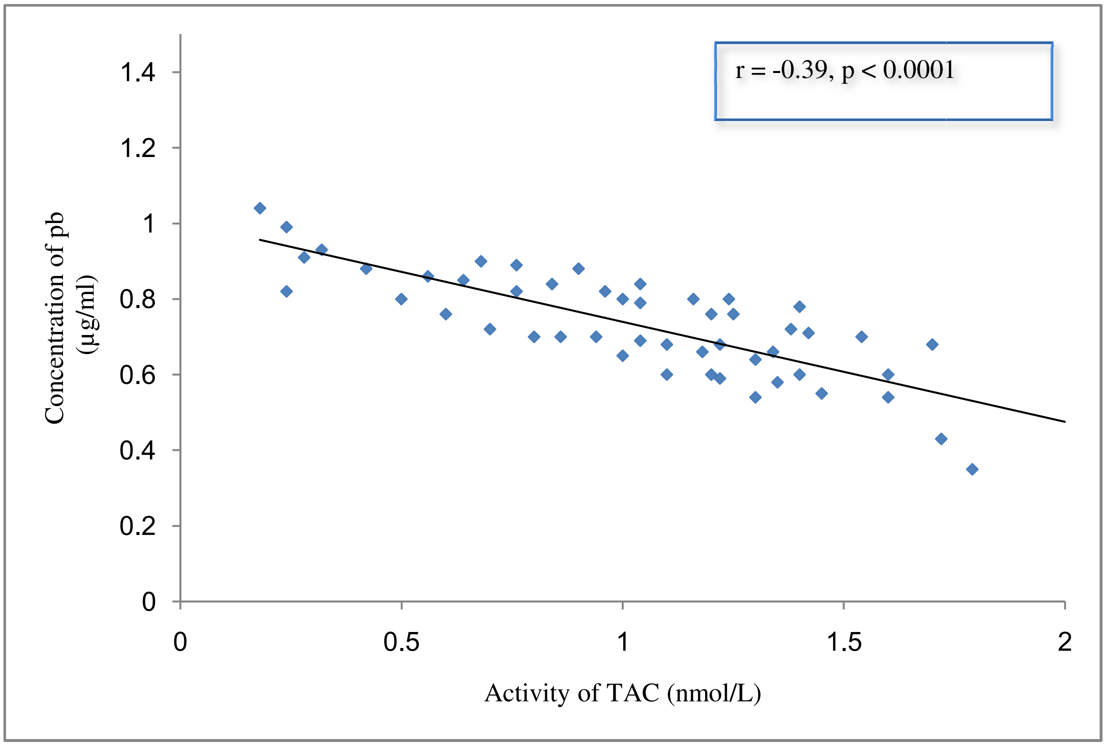

Figure-1
Correlation between lead (pb)and total antioxidant capacity (TAC) in blood of Gasoline Station Workers

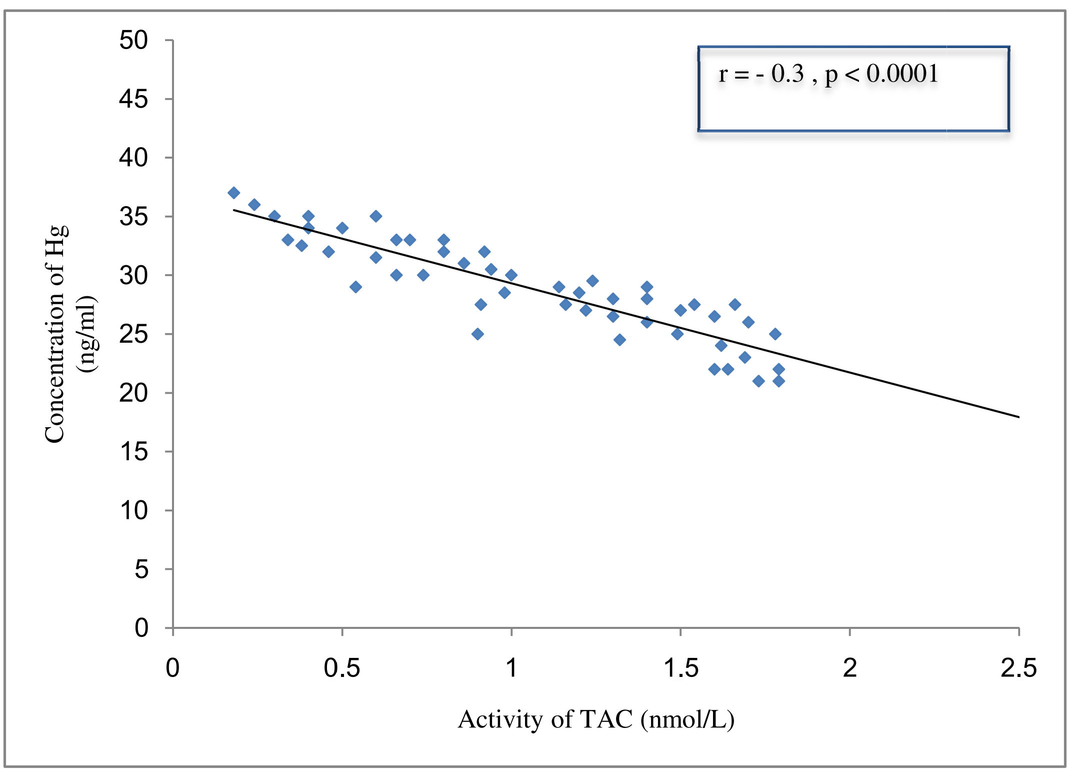

Figure-2
Correlation between mercury (Hg)and total antioxidant capacity (TAC) in blood of Gasoline Station Workers

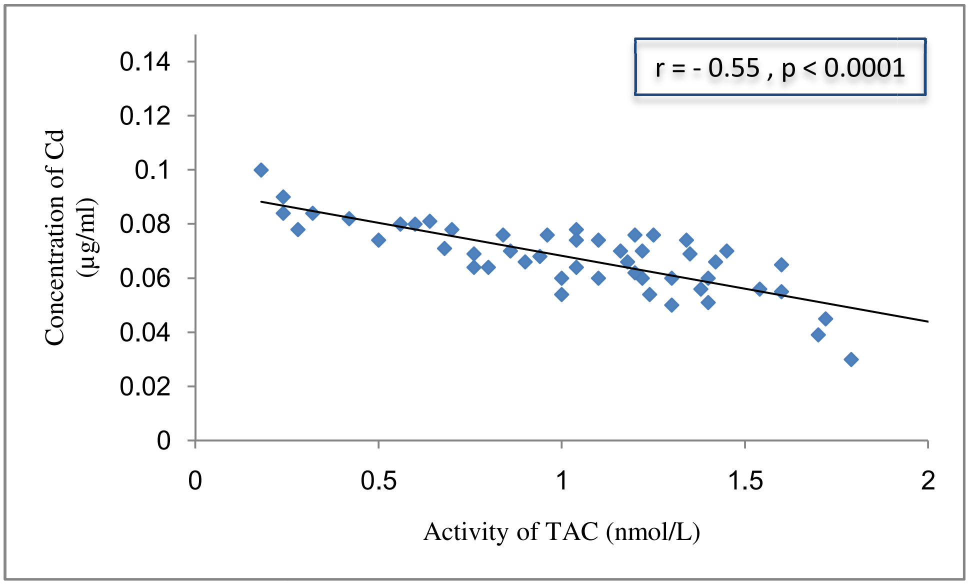

Figure-3
Correlation between cadmium (Cd)and total antioxidant capacity (TAC) in blood of Gasoline Station Workers

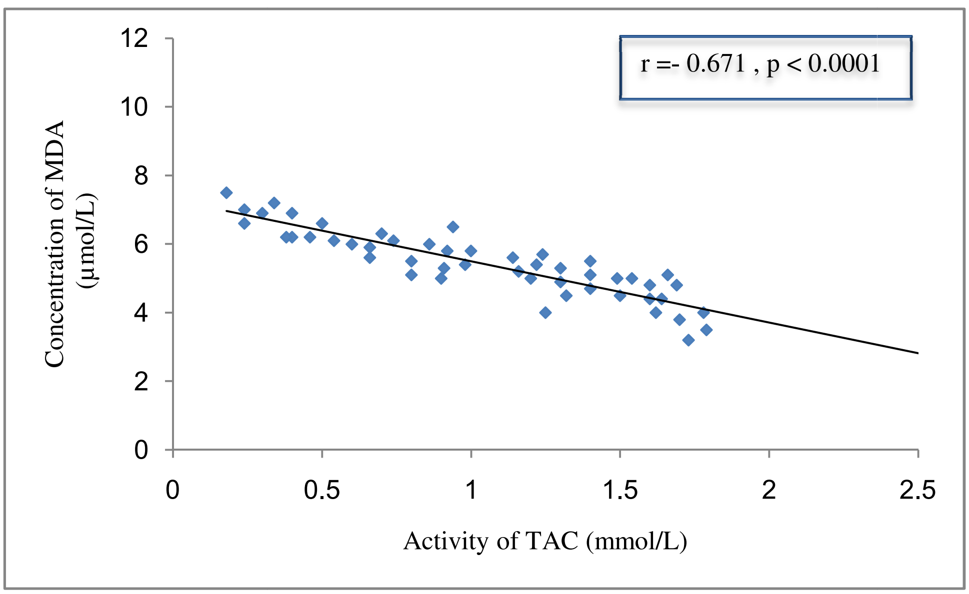

Figure-4
Correlation between malondialdehyde (MDA and total antioxidant capacity (TAC) in blood of Gasoline Station Workers

As we mentioned earlier, heavy metals cause an increase in the formation of ROS, oxidative Stress and decrease antioxidant defenses (total antioxidant capacity) or cause to an increase in the processes that produce oxidants[13,14]. So in this work, serum TAC of gasoline station worker level was significantly lower than controls activity, $P < 0.05$, as shown in table-1, and therefore found strong inverse correlation between TAC levels and (Pb, Cd, Hg and MDA concentration) ($p<0.0001$, r= -0.39, r= -0. 3, r= -0.551, r= -0.671) respectively in gasoline station. This result agrees with above discuss about effect heavy metals on TAC.

Conclusion

In conclusion, the Current study presents gasoline induced health hazards in occupationally exposed workers. Heavy metals (Pb, Hg and Cd) in gasoline induce oxidative stress through excessive produced of ROS and MDA and it also decreased levels of TAC. These observations support the need for preventive action that will improve conditions in the job environment and in micronutrient status since several studies have indicated that an increase in health toxicity effects is associated with an increased oxidative stress. Thus the study provides further evidence to dysregulation of antioxidant/ oxidant balance in gasoline workers.

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